Application of GIS & RS on Catchment and Command Area Management of Hattikuni Dam,Yadgir District

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***Abstract*— The catchment and command area management of a dam includes various parameters to be studied. Primarily the catchment area management includes ground water recharge, knowing terrain characteristics i.e. slope of the ground, finding water logging areas etc. coming to command area management, it requires to find on-farm development works such as, construction of field channels, land leveling/ shaping, realignment of field boundaries where necessary and set of action plans for rejuvenation of irrigation system. Management of water below the canal outlets offers the greatest scope for increased production and productivity in the irrigation commands. These parameters are estimated using GIS (geographical information system) and RS (Remote sensing) techniques. The software models used in this study are ArcGIS 9.2 and ERDAS 8.7. These models has been used to analyze terrain characteristics, water logging areas, computing the geographical references data etc, for a part of Hattikuni catchment and command area in Yadgir district, Karnataka. The Hattikuni River is a major tributary of river Krishna and is located between the longitudes and latitudes of 16°52'50"North and 77°10'21"East respectively. The catchment and command area of Hattikuni dam covers around 13789 ha and 3100 ha respectively. The thematic maps of command area and catchment area have been created with all required parameters showing in it. The check dams are proposed at catchment area and Land leveling/shaping, realignment of field boundaries are proposed at command area.**

Keywords*— *Command area, Catchment area, Toposheets, Topography, GIS (geographical information system) and RS (Remote sensing)

I. INTRODUCTION

In the past hundred years, the global population has tripled while demand for water has increased seven-fold. Ideal and effective utilization of alarms crisp water assets is turning into a prime concern nowadays as the uniqueness between the requests by constantly expanding populace to these valuable assets is augmenting at a disturbing rate. In arid and semi-arid ranges intermittent dry season and water lack are basic sensation. Therefore, the opposition over these assets is claimed and a few times lead to clash among diverse users. In view of these an in-depth understanding of the hydrological behaviors of the catchment is necessary in the sense that it is an important step towards management of the water resources. One approach to secure a superior comprehension is to utilize GIS and RS technologies. In recent years the advancement in satellite and computer technology along with different models and soft wares has opened the opportunity to process and drive different hydrologic parameters and terrain characters. These parameters lead to overcome the obstacles for ground water recharge in catchment and command areas. Hence, it is necessary to analyze terrain characters, geo hydrological process which leads to proper management of catchment and command area. This study makes us to come up with set of water resource action plans for improvements in irrigation system.

II. LITERATURE REVIEW

A. Dwitikrishna Panigrahi (Orissa)

He reported that the Management of water beneath the channel outlets offers the best degree for expanded creation and benefit in the watering system charges. This paper exhibits a portion of the issues and alternatives accessible for on-farm water resources assets administration in channel commands of one of the eastern most state of the nation (Orissa) with an expect to adjust the exercises that are, at present, embraced for resource optimization. The conventional administration frameworks of the territory, on-farm improvement measures taken through the halfway supported Command Area Development and Water Management (CADWM) Program and farmers association currently dissemination and usage of watering system water are introduced in the paper.

He concluded that, huge investments have been made for development of water resources through construction of irrigation projects. But a major chunk of the resources remain unutilized because of lack of management of water resources below the outlet level. On-Farm-Development activities through the CADWM programme have been proved to be the most effective method for reducing inequality in distribution of irrigation water below the outlets and increasing irrigation efficiency. The activities should therefore be extended to all the irrigation projects of the state. As the climatologically and geomorphologic situation of the state of Orissa accelerates surface and subsurface flows, the option of having a series of drainage-cum-recycling projects to take the lost water back to the canals or the crop fields at higher elevations is the best option to increase irrigation efficiency and should also be extensively practiced in all canal systems of the state. [1]

B. TENDAI SAWUNYAMA (A Case Study of Mzingwane Catchment, ZIMBABWE)

He reported the current interest in small reservoirs stems mainly from their utilization for domestic use, livestock watering, and irrigation and fisheries enhancement on a sustainable basis. Rarely were small reservoirs considered as part of a water resource system, even though they have a significant effect in planning and management of water resource. The principle restriction is absence of information on little dam's limits, for the philosophies used to evaluate the parameters are exorbitant, time intensive and difficult. The present study is an endeavor to gauge little supply stockpiling limits utilizing remotely sensed surface regions. A field considers on 12 little supplies was completed in Mzingwane Catchment in Limpopo River Basin, where depth of water and directions of every depth was measured. Both area and volume were calculated for each reservoir using geographical information system. The surface areas that were obtained from fieldwork and that from remote sensing were compared. [2]

C. T. Unsal (TURKEY)

He reported that Istanbul one of the fastest growing cities in the world in terms of population, Istanbul experiences essentially unlawful development which is extremely troublesome even to screen with field review strategies. There are seven fundamental common catchment territories supplying water to Istanbul. Each area is divided into different protection zones and construction is prohibited in most of these areas. Istanbul Water and Sewerage Administration, which has the power to decimate the structures in the initial two zones, screens the illicit development in the catchment regions with orthorectified IKONOS symbolism gathered in the times of three months. The imagery of seven catchment areas are collected every three months and following the collection in each period, change detection analysis is performed to determine the newly constructed structures in the five different protection zones of each catchment area. Illegal construction is one of the very important problems for most of the growing cities in the world. It is not only difficult to prevent, but also difficult to detect and monitor. Istanbul, being one of the fastest growing metropolises in the world, significantly suffers from illegal construction. Today Istanbul has a population of 12 Million and this population is spread to two continents where there are a few very important catchment areas that supply water to the city. Considering the fact that this population will increase up to 18 million in the following decades current sources must be protected very carefully while searching for additional sources.
To focus the damage capability of the structures, field work takes after the change identification investigation. Properties of the structures, for example, development sort (private, business, mechanical and so on.), building number, floors and so on acquired from the field work are recorded into geo-databases. The application of such an effective method improves the capability of Istanbul Water and Sewerage Administration in terms of preventing illegal construction with saving considerable time and giving consistent results. Finally he has concluded that, the effectiveness of the method comes from the reliability of the data obtained from the satellite imagery. Before using this technology ISKI (Istanbul Water and Sewerage Administration (ISKI in Turkish)) had to trust all its field workers who are responsible to report the illegal structures in the catchment areas. But the early results of this study showed that ISKI was unaware of the numbers which are clearly determined from the satellite imagery. Implementation of such an effective method to protect catchments should be a model for all the cities that suffer from illegal construction. [3]

III.MATERIALS AND METHODOLOGY

The materials used for this study will be GIS and RS related software models. These soft wares help us to create maps and also help in the management of data. By using these software models, editing and analyzation of the data can be done in shorter period of time.

A. Geographic Information System (GIS)

The Geographic Information System (GIS) is a machine helped framework for securing, stockpiling, dissection and showcase of geographic information. Geographic Information System (GIS) is an incorporated situated of equipment and programming apparatuses utilized for the control and administration of spatial (geographic) and related credit information to digitally speak to and investigate the geographic peculiarities introduce on the world's surface and the occasions occurring on it.
GIS considers making, keeping up and questioning electronic databases of data ordinarily showed on maps. These databases are spatially turned, the urgent joining segment being their position on the world's surface.This framework comprises of a set of mechanized instruments and methods that could be utilized to adequately encode, store, recover, overlay, correspond, control, dissect, question, and showcase area related data. They likewise encourage the determination and exchange of information to application particular logical models fit for evaluating the effect of choices on the nature's turf. The underlying stronghold of sound GIS is an effective automated aide database, altering to an exact even control survey framework.

B. Remote Sensing (RS)

Remote sensing is the science of acquiring information about earth's surface without actually being in contact with it. This is done by sensing & recording reflected or emitted energy & processing, analyzing & applying that information. A further step of image analysis and interpretation is required in order to extract useful information from the image. A further venture of picture examination and elucidation is needed to concentrate helpful data from the picture. The human visual framework is a case of a remote sensing framework in this general sense. In a more limited sense, remote sensing normally alludes to the innovation of securing data about the world's surface (land and ocean) and climate utilizing sensors installed airborne(aircraft, balloons) or space borne (satellites, space shuttles) stages. In Optical Remote Sensing, optical sensors catch sun oriented radiation reflected or scattered from the earth, framing pictures looking like photos taken by a Polaroid high up in space. The wavelength district typically stretches out from the Visible and Near Infrared (VNIR) to the Short-Wave Infrared (SWIR). Distinctive materials, for example, water, soil, vegetation, structures and streets reflect obvious and infrared light in diverse ways. They have diverse colors and splendor when seen under the sun. The translations of optical pictures require the information of the unearthly reflectance marks of the different materials (common or man-made) coating the surface of the earth. There are likewise infrared sensors measuring the warm infrared radiation emitted from the earth, from which the area or ocean surface temperature could be determined as demonstrated in figure 1. [4]

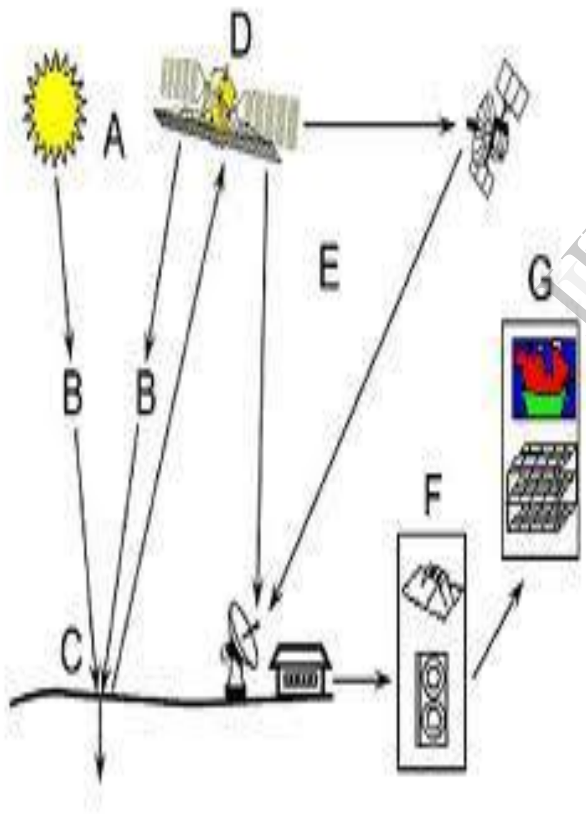


Figure.1: The principle of remote sensing.

- Energy Source or Illumination (A)
- Radiation and the Atmosphere (B)
- Interaction with the Target (C)
- Recording of Energy by the Sensor (D)
- Transmission, Reception, and Processing (E)
- Interpretation and Analysis (F)
- Application (G)

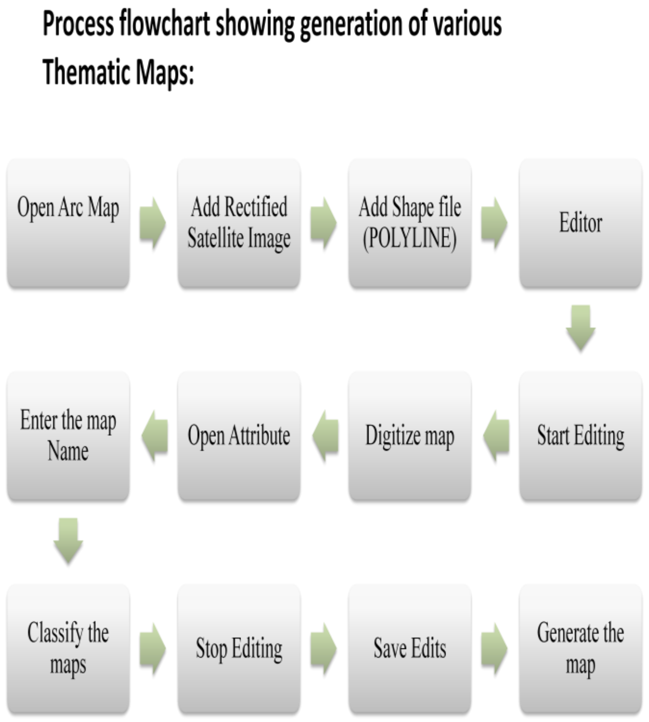
C. Software Model Used For The Study

i. ArcGIS 9.2
ii. ERDAS IMAGINE 8.7

ArcGIS 9.2 is a product model which incorporates a gathering of geological information system (GIS). This product model is delivered by ESRI. ArcGIS is assembled around the geodatabase, which utilizes an item social database approach for putting away spatial information. A geodatabase is a "compartment" for holding datasets, entwining the spatial gimmicks with qualities. The geodatabase can likewise contain topology data, and can demonstrate conduct of gimmicks, for example, street convergences, with guidelines on how peculiarities identify with each other. At the point when working with geodatabases, it is imperative to see about gimmick classes which are a situated of peculiarities, spoke to with focuses, lines, or polygons. With shape records, each one record can just handle one sort of gimmick. A geodatabase can store various gimmick classes or sort of gimmicks inside one record. ArcGIS for Desktop involves a couple of joined applications, including Arc Map, Arc Catalog, Arc Toolbox, and Arc Globe. Circular segment Catalog is the information administration application, used to skim datasets and documents on one's machine, database, or different sources. Notwithstanding demonstrating what information is accessible, Arc Catalog likewise permits clients to see the information on a guide. Bend Catalog additionally gives the capability to view and oversee metadata for spatial datasets. Circular segment Map is the application used to view, alter and inquiry geospatial information, and make maps. The Arc Map interface has two principle segments, including a chapter by chapter guide on the left and the information frame(s) which show the guide. Things in the chapter by chapter list relate with layers on the guide. Curve Toolbox contains geo transforming, information change, and investigation instruments, alongside a significant part of the usefulness in Arcinfo. It is likewise conceivable to utilize group preparing with Arc Toolbox, for every now and again rehashed errands.

ERDAS IMAGINE 8.7 is primarily used for processing of geo-spatial raster data and allowing the user to display the digital images for mapping in GIS software. This software model allows the user to perform different operations on an image. ERDAS IMAGINE Suite which has developed to backing most optical and radar mapping satellites, airborne mapping Polaroid’s, and computerized sensors utilized for mapping. It was discharged on a Sun Workstation utilizing SunOS giving a Graphical User Interface to aid in envisioning symbolism utilized as a part of mapping, vector GIS information, making maps, and so forth.

D. Generation of Thematic Maps



IV. RESULTS AND DISCUSSIONS

The Hattikuni dam is an earthen type of dam. It is constructed for irrigation purpose. The Hattikuni River is major tributary of river Krishna. It is constructed across river Hattikuni near Hattikuni village in the Yadgir taluka of Yadgir district. It provides irrigation facilities over an area of 3100ha (7659.99 acres) of land in Yadgir district. The maximum water level in the dam is of about 415.44m.

The Generated thematic maps are as follows.

A. Location Map

The study area is shown in below. The site is located at 16°52'50"North and latitude 77°10'21"South.The extend of submersion was also reasonable and sufficient command area being available for irrigation and hence this site was finally selected for location of storage dam figure 4.1

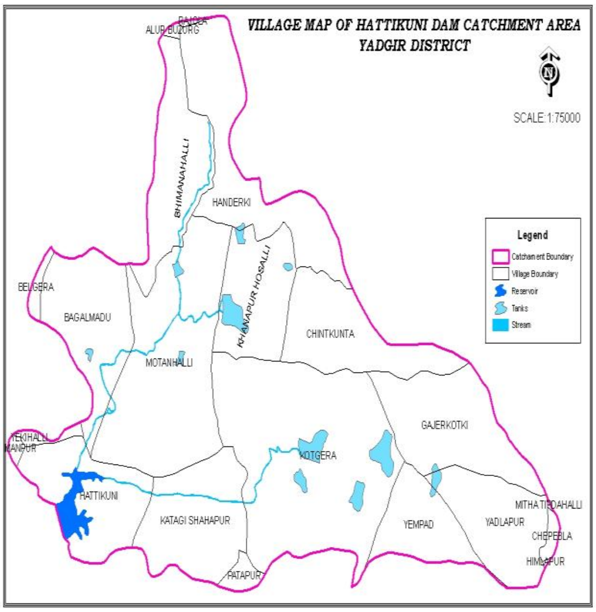


Figure 4.1: Location map

B. Transport Network Map

The transportation network mainly the distribution of metalloid and unmetalled roads have been demarcated using 1:75,000 scale SOI topo map and updated with satellite imagery in order to understand the connectivity of various habitations. The locations of villages, towns, are also mapped, incorporating the village boundaries as shown in figure 4.2. Accessibility is an indicator of the level of socio-economic development and depends on the transport network that exists.

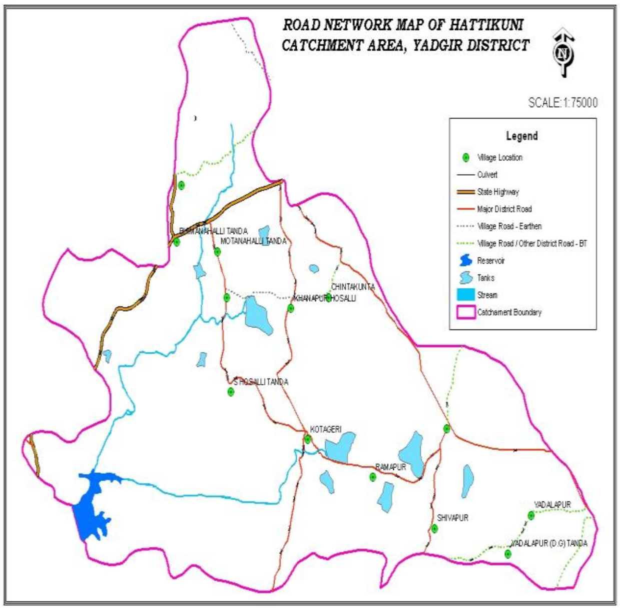


Figure 4.2: Road Network Map

C. Catchment Area Toposheet Map

The catchment area Toposheet of Hattikuni is digitalized to scale 1:75000 as shown in below figure 4.3.

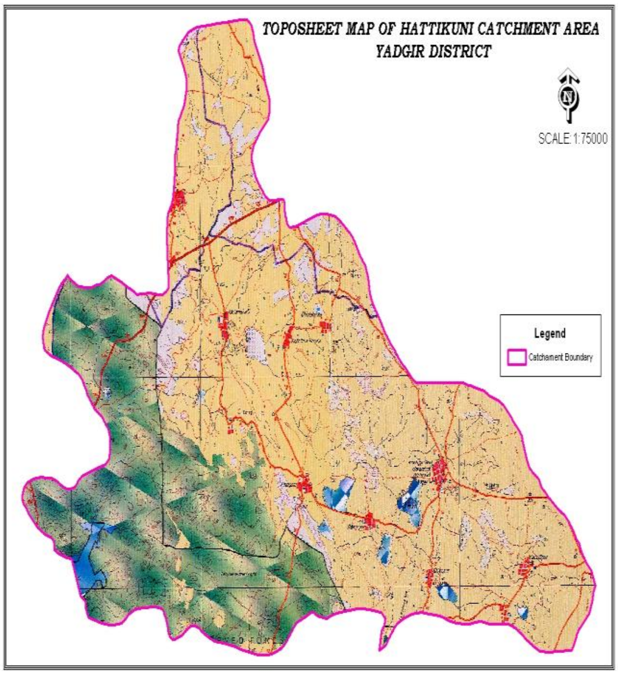


Figure4.3: Catchment Area Toposheet Map

D. Command Area Map

The command area map is digitalized to scale 1:75,000 as shown in below figure 4.4

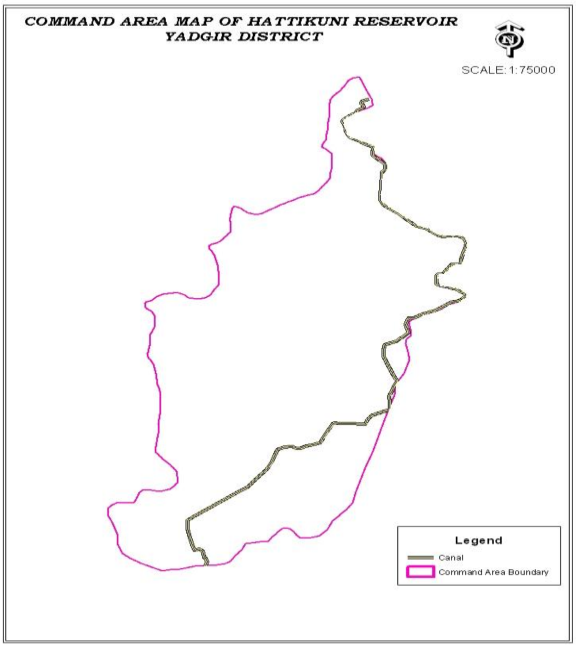


Figure 4.4: Command area map

E. Slope Map of Catchment Area

The slope map of Hattikuni catchment area is digitalized to scale 1:75000 as shown in below figure 4.5. Slope is an angle of inclination of the surface from the horizontal. The majority of the study area occupies moderately steep slope of 20-35%.

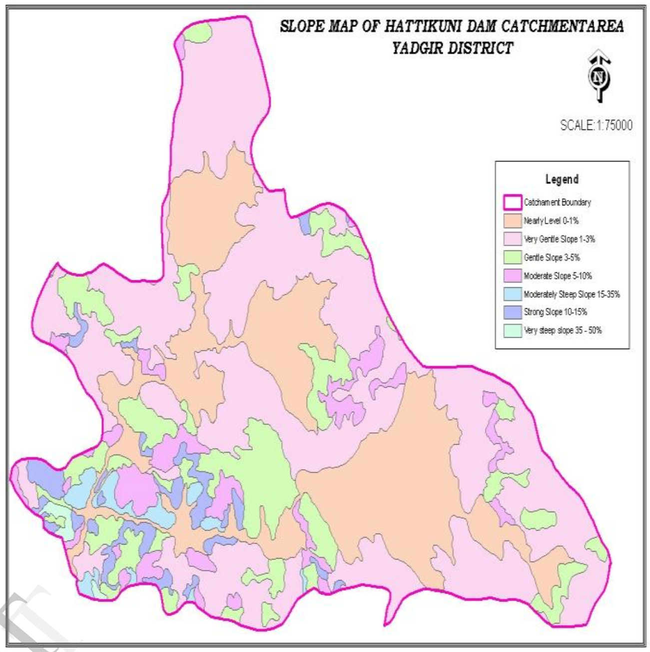


Figure 4.5: Slope map of Catchment Area

F. Drainage Pattern Map

The Drainage map of Hattikuni catchment area is digitalized to scale 1:75000 as shown in below figure 4.6

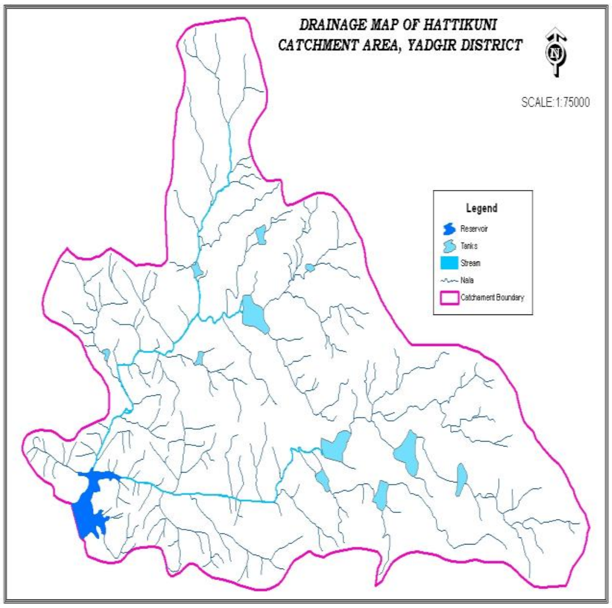


Figure 4.6: Drainage Pattern map

G. Check Dams Map

The Check Dams map of Hattikuni catchment area is digitalized to scale 1:75000 as shown in below figure 4.7

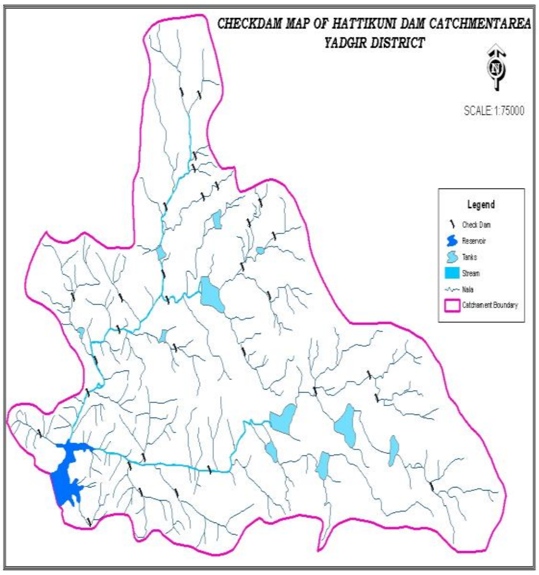


Figure 4.7: Check dams map

V. CONCLUSION

The focus of the project is to analyze the catchment and command area of Hattikuni dam and utilization of this analysis in the development of existing catchment and command areas with highest degree of sensitivities. Different thematic maps are generated with reference to the base map and Toposheets of catchment and command area of Hattikuni reservoir using GIS and RS techniques.

The present study analyzed terrain and hydrological characteristics of Hattikuni region. This analysis is useful in determination of surface water resources for potential use in the irrigation system. The terrain and hydrological model analysis in GIS are useful tools for calculation of slope of the area and drainage pattern. After this analysis the check dams are suggested for ground water recharge.

The obtained information is very much useful to check the incidence of water logging in the catchment area and to enhance utilization of irrigation potential created in the command area. It also helps in making planning activities for construction of field channels, land leveling/shaping and realignment of field boundaries where necessary. Set of action plans can be made with the help of derived information for rejuvenation of irrigation system. The Command Area Development with a view to bridge the gap between the potential created and its utilization and optimizing agricultural productivity through better management of land and water use in the command areas

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REFERENCES

[1]. DR. DWITIKRISHNA, Department of Water Resources (CAD), 5th Floor, Rajiv Bhawan, Bhubaneswar. http://orissa.gov.in/emagazine/Orissareview/2009/October/engpdf/Pages51-57.pdf

[2]. TENDAI SAWUNYAMA.Estimation of small reservoir storage capacities in Limpopo river basin using geographical information systems (GIS) and remotely sensed,Zimbabwe. http://www.waternetonline.ihe.nl/challengeprogram/D29%20Sawunyama%20Thesis%20Small%20dam.pdf

[3]. T. UNSAL, protection of natural catchment areas supplying water to Istanbul and monitoring illegal construction with periodically collected ikonos imagery, Turkey. http://www.isprs.org/proceedings/XXXVI/1-W41/makaleler/Unsal_Protection_catchment.pdf

[4] .http://www.crisp.nus.edu.sg/~research/tutorial/intro.htm.