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Study on Decadal Changes of Gambhirm Reservoir Using Geospatial Technologies

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ABSTRACT:

Water is life. Without water, life on this planet earth itself would be impossible. Mankind is living in the era of water crises. Impacts of population growth, urbanization and climate change on water bodies are daunting. The present study titled “Study on Decadal Changes of Gambhirm reservoir, using Geospatial Technologies with reference to decadal change detection is shown in terms of LULC. The impacts of urbanization and urban sprawl on water body in Visakhapatnam city are visibly shown in the study.

Key words: Water crises, Population growth, LULC, Decadal changes, Geospatial Technologies, Urbanization,.

INTRODUCTION:

Fresh water is a critical, finite, vulnerable, renewable resource on the earth, and plays an important role in our living environment, without it, life is impossible. Since the beginning of the industrial revolution, increasing human population, economic activities as well as shortcomings in their management have resulted in more pollutants being introduced into watercourses. (Mohd. Muzamil et al, 2009).

Water exists in different forms such as rainfall, river water, ground water, ponds and lakes etc. About 71 percent of the Earth's surface is water covered, and the oceans hold about 96.5

percent of all Earth's water. Two third of water is locked up in glaciers and permanent snow cover, remaining one third is distributed regionally with wide disparities. (Bindu and Abdul Razak Mohamed, 2015). India's water bodies are extraordinarily diverse – ranging from lakes and ponds to marshes, mangroves, backwaters and lagoons.

Surface water bodies are dynamic in nature as they shrink, expand, or change their appearance or course of flow with time, owing to different natural and human-induced factors (Karpatne et al, 2016). Water bodies are an integral part of fresh water resources.

Traditionally, these water bodies have played an important role in supply of drinking water, water for domestic needs and agriculture purposes etc. besides rivers and ground water.

Urbanization is a process in which increasing number of people migrate from rural to urban areas. Ultimately it leads to horizontal or vertical growth of urban areas. A country is considered to urbanize when over 50 per cent of its population live in the urban areas. The criteria used to define urban can include population size, space, density and economic organization (Grannis, 1998).

India faces daunting water security challenges. The demands of a rapidly industrializing economy and urbanizing society come at a time when the potential for augmenting supply is limited and water issues have increasingly come to the fore. While India hosts approximately 17 percent of the world's population, it holds only about four percent of its required annual water resources. In urban areas, 50 million people in 15 cities have no access to safe, affordable water. In India, more than 600 million people are facing an acute water shortage. About three-quarter households do not have a drinking water facility.

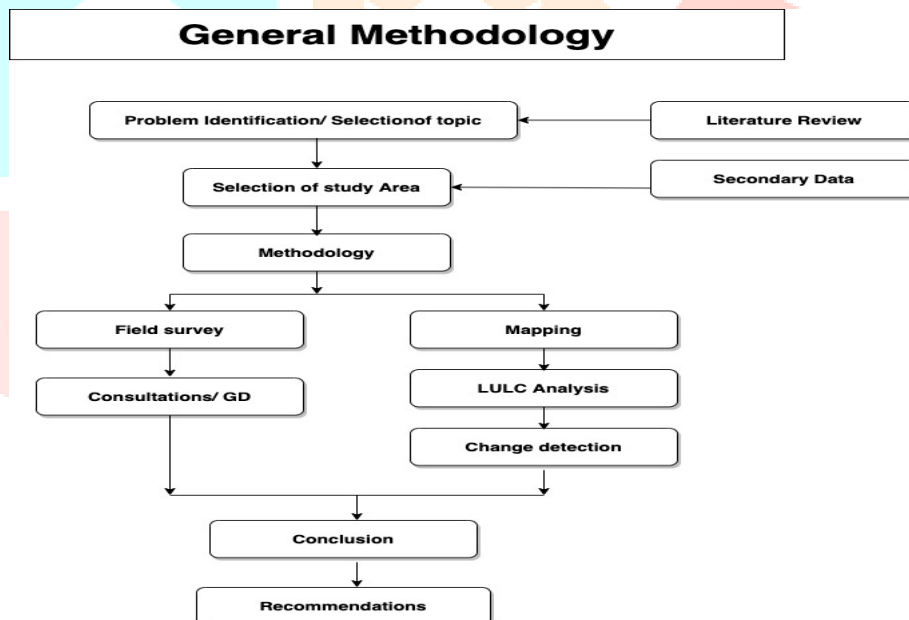
In Andhra Pradesh, the number of water bodies is not increasing. The reason is due to not taking up the formation of new water bodies. Due to continuous drought and deficit rain fall prevailing in last few years, the inflows to the water bodies decreased considerably, as such some of the water bodies located very adjacent to the habitations were being encroached which leads to decrease in water bodies.

Role of GIS in surface water:

It is possible to access historical and real time stream flow data via the Internet. Embedded within a GIS are layers with stream locations and gage or measuring/monitoring sites. It's also possible to link radio transmitted and remotely sensed (Remote Sensing) data in GIS. Historical and real time data are available from the United States Geological Survey (USGS) in the form of gage height and stream flow or discharge in cubic feet per second. Within a GIS, it's possible to direct link via the Internet to real time data. All these data are available for analysis within GIS, providing a spatial representation of what would otherwise be data in a table type format. GIS is much more capable of displaying data spatially than temporally. Within one GIS, ESRI's ArcGIS for example, is it possible to delineate a watershed. The land use/cover pattern of a region is an outcome of natural and socio-economic factors and their utilization by man in time and space. Landuse/cover resulting the demands of increasing urbanization and results to increasing of population in presents years. (Rjasekharetal., 2017). Change detection is a process that observes a phenomenon or feature at different times to categorize the differences in its state. Change detection has various useful applications associated with land cover/use changes such as coastal change and urban sprawl (Shalaby and Tateishi, 2007).

METHODOLOGY

- Data used for location maps of the tank is from Water resource Department (WRD), Andhra Pradesh Integrated irrigation and Agricultural Transformation Project (APITATP).
- Survey of India - Topo sheets, latest satellite data of Low Imaging Sensing satellite — IV (LISS - IV).
- Thematic maps like soils, land use/land cover, drainage, catchment boundaries are drawn on LISS — III.
- The non-spatial data like command area, beneficiaries, meteorological data are taken Department of Earth Sciences and Indian Meteorological Department (DES/IMD).
- The Resolution that used for mappings are 2.5 for Toposheet and 23.5 for LULC Changes and soil types.
- Vegetation indices allow us to delineate distribution of vegetation and soil, based on characteristic reflectance patterns. Numerous vegetation indices have been developed to monitor the state of vegetation from space born sensors (Bannari et al., 1995)



Study Area:

Gambhiramgedda Reservoir

Gambhiramgedda Reservoir Project was constructed across Gambhiramgedda at Boyapalem (V) in Anandapuram (M) Visakhapatnam District is having 640 Acres of Ayacut. Water is being supplied to G.V.M.C at the rate of 2M.G.D from 1st March to 30th June of every year. Even though Major portion of the ayacut is urbanized, still about 250 Acres of Ayacut is being irrigated under 4 Nos of groynes through open head channel system.

The present study Tanks in the cascade are located in Sontyam and Gambhiram villages in Anandhapuram Mandal in Visakhapatnam district. The catchment area of this study tanks is spread in Anadhapuram and Pendurthi mandals.

Location: Anandhapuram Mandal Visakhapatnam District.

Longitude: 83° 14' 13"

Latitude: 17° 54' 11"

Discharge capacity: 19400 Cusecs

Catchment Area: - 25198.528 Acres

Utility:-

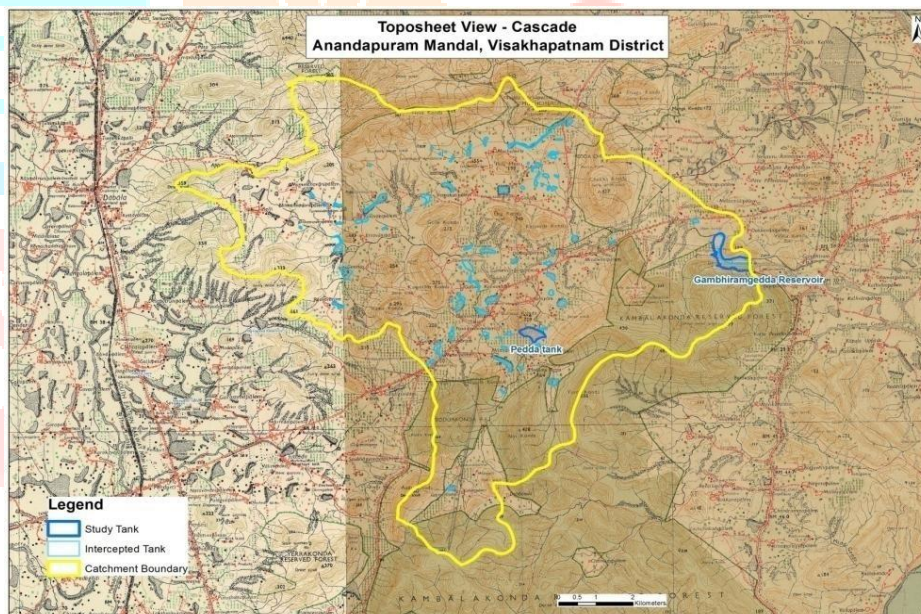
Villages Benefitted: 7

Utilization: 0.95 TMC (2013-14 khariff & Rabi)

Existing Stabilized Ayacut: 250 Acres

New Ayacut: 138 Acres

Mandals Benefitted: Anandapuram, Visakhapatnam(R)



Water Utilization: For Irrigation and Drinking

Cropping Pattern: Paddy and Others

Population Benefitted: 3500 people.

Transformation of LULC Area: -

Agricultural Land-Crop Land-Cropped
More In 2 Seasons

These are the areas which are cropped in more than two cropping seasons. It includes triple cropped areas

(Khariff, Rabi and Zaid), areas under multiple cropping. Long duration crops like sugarcane, cotton, banana, pineapple etc., are considered under this category. It contributes an area of 289.96 (0.11%) Acres in LULC of 2005-06 and Changes to

1708.42 (0.68%) acres in LULC area of 2015-16.

Agricultural Land-Crop Land-Khariff Crop

Agricultural area cultivated between June/July to September/ October coinciding with SW monsoon season is considered as Khariff crop. It is associated with rain-fed crops under dry land farming with limited or no irrigation and areas of rain-fed paddy and other dry crops. Khariff is found to be the second major agricultural category with an extension of 3114.82 Acres (1.24%) in LULC of 2005-06 and changes to 2.84.17 Acres (0.83%) in LULC of 2015-16.

Agricultural Land-Crop Land-Rabi Crop: -

These areas are cultivated between November/December to February/March. It is associated with areas under assured irrigation irrespective of the source of irrigation. However, rabi cropped areas also occur in rain-fed regions, under residual soil moisture conditions especially in black soil areas with high rainfall during Khariff season. There is no extent of Rabi cropped area in LULC of 2005-06 but it extended up to 231.71 Acres (0.09%) in LULC of 2015-16.

Agricultural Land-Crop Land-Zaid Crop: -

These are the areas that are cropped during summer (April – May) which are mostly associated with irrigated areas with

fertile soils, confined to plains/delta areas. There is no extent of Zaid cropped area in LULC of 2005-06 but it extended up to 6.24 Acres (0.002%) in LULC of 2015-16.

Built-Up (Rural): -

These are the regions of human habitation that have a front of structures, transport and communication, utilities in relationship with water, vegetation and vacant lands. It comprises built-up (Compact and Sparse), Vegetated/Open Area, Rural, Industrial and Mining/Quarry. It involves a region of 423.44 Acres, which is around 0.17% of the total catchment area of the Tank in the LULC of 2005-06 and 437.36 Acres (0.20%) in LULC of 2015-16.

Industrial: -

Non-linear impervious surfaces are included in this class which are related to trade, manufacturing, distribution, and commerce. These are areas where the human activity is observed in the form of manufacturing along with other supporting establishments for maintenance. It involves a region of 7.54 Acres, which is around 0.003% of the total catchment area of the Tank in the LULC of 2005-06 and change in to 106.09 Acres (0.04%) in LULC of 2015-16.

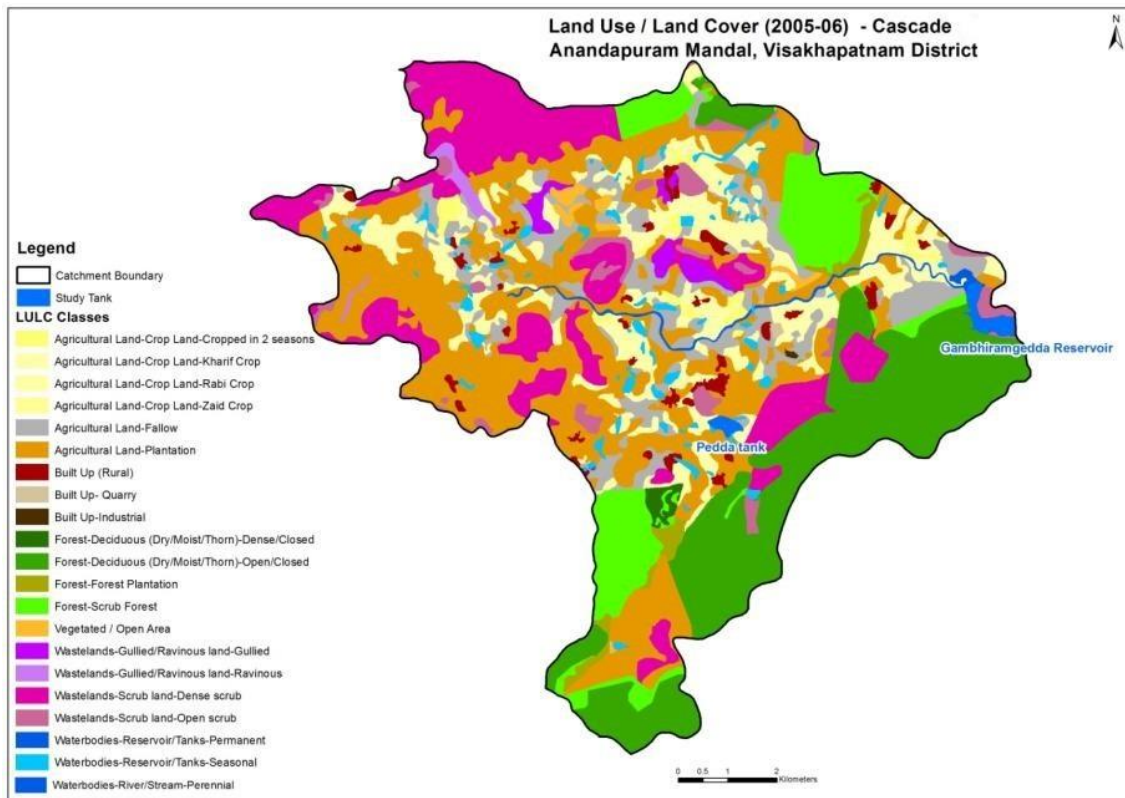
Vegetated / Open Area:-

These are vegetated areas within urban agglomeration (situated within or in contact with urban areas). Vegetation cover of trees, shrubs, and herbs covers at least 0.33% of the total surface area, which has been delineated. Parks, sport and leisure facilities, camping grounds, sports grounds, leisure parks, golf courses, race courses, including formal parks etc are considered in this category. It involves a region of 163.43 Acres, which is around 0.06% of the total catchment area of the Tank in the LULC of 2005-06 and change in to 325.62 Acres (0.13%) in LULC of 2015-16.

Reservoir/Tanks-Permanent: -

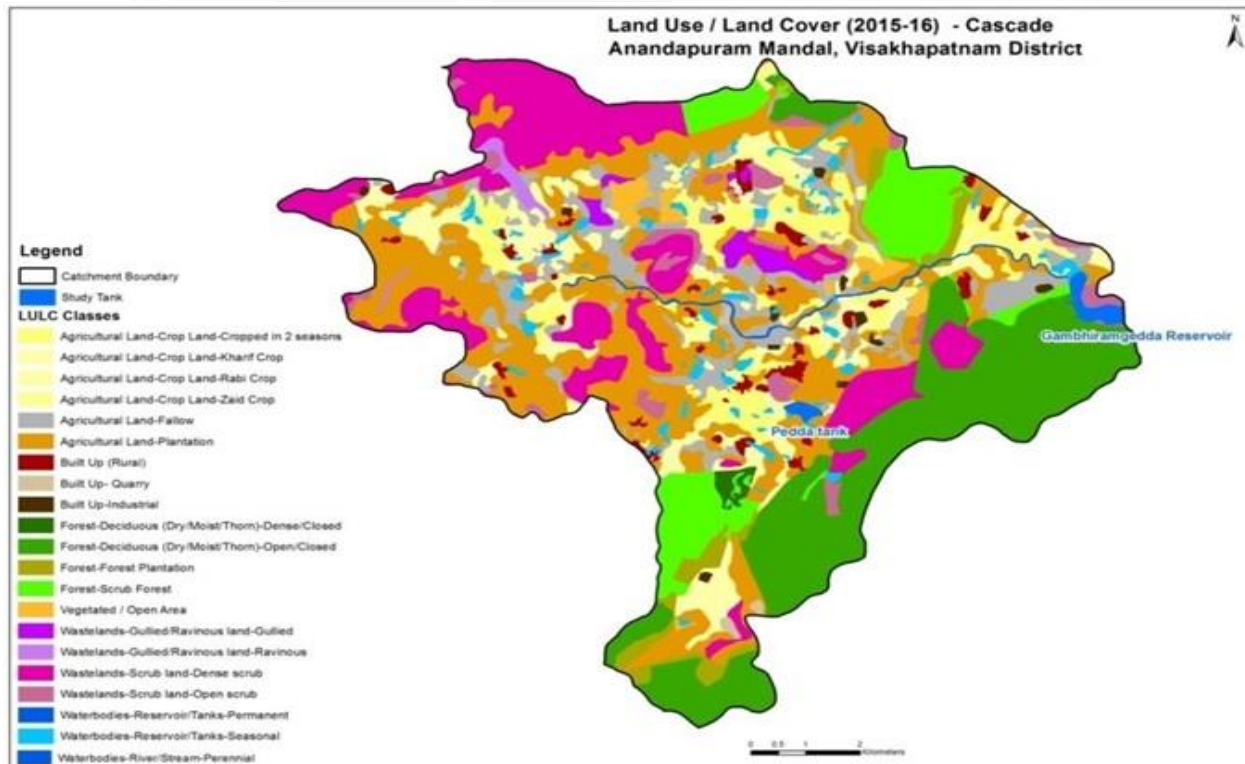
The reservoir is an artificial lake created by the construction of a dam across the

river specifically for hydel power generation, irrigation, and water supply for domestic/ industrial needs, flood control, either singly or in combination. Tanks are small lakes of impounded waterways constructed on land surface for irrigation. They are associated with croplands, low lands and reservoirs surrounded by hills without vegetation. This includes all reservoirs/tanks with water spread seen at least during one season in a year is considered under the permanent category. This category occupies an area of 157.91 Acres (0.062%) in LULC of 2005-06 and changes to 3.10 Acres (0.001%) in LULC of 2015-16.



Reservoir/T
anks-
Seasonal:-

Dry
reservoirs/ta
nks are
those which
do not have
water spread
throughout
the year are
considered
seasonal. It
is found that



decreased to 2.47 % in 2015-16.

- The LULC class of Built Up- Quarry is 1.24 % in its catchment area in 2005-06 it was decreased to 0.83 % in 2015-16.

CONCLUSIONS

- The study gives comprehensive information with regard to the existing water bodies and its temporal changes in its vicinity.
- The feeder channels of the water bodies are either choke with vegetation or disruptive with local constructions through illegal operations which results in low inflow into existing water bodies.
- The reduction in the ayacuts observed as the existing farm lands are diverted either into real estate business or industrial purpose.

• Gambhiramgedda Reservoir	LULC of 2005- 06	LULC of 2015- 16	Changes	Changes in %
Agricultural Land-Crop Land-Cropped In 2 Seasons	289.96	1708.42	1418.46	83.03
Agricultural Land-Crop Land-Kharif Crop	3114.82	2084.17	-1030.65	-49.45
Agricultural Land-Crop Land-Rabi Crop	0	231.71	231.71	100.00
Agricultural Land-Crop Land-Zaid Crop	0	6.24	6.24	100.00
Agricultural Land-Fallow	2236.18	2168.06	-68.12	-3.14
Agricultural Land-Plantation	7038.79	6274.18	-764.61	-12.19
Built Up (Rural)	423.44	437.36	13.92	3.18

Built Up- Quarry	15.28	55.09	39.81	72.26
Built Up-Industrial	7.54	106.09	98.55	92.89
Forest-Deciduous (Dry/Moist/Thorn)- Dense/Closed	93.44	93.27	-0.18	-0.19
Forest-Deciduous (Dry/Moist/Thorn)- Open/Closed	4462.81	4502.17	39.36	0.87
Forest-Forest Plantation	306.58	566.11	259.53	45.84
Forest-Scrub Forest	2008.63	1744.64	-263.99	-15.13
Vegetated / Open Area	163.43	325.62	162.19	49.81
Wastelands-Gullied/Ravinous Land- Gullied	261.20	229.48	-31.71	-13.82
Wastelands-Gullied/Ravinous Land- Ravinous	130.82	130.57	-0.25	-0.19
Wastelands-Scrub Land-Dense Scrub	3466.91	3398.04	-68.87	-2.03
Wastelands-Scrub Land-Open Scrub	707.20	666.13	-41.06	-6.16
Waterbodies-Reservoir/Tanks-Permanent	157.91	3.10	-154.81	-98.03

- Conclusions can be drawn from the maps on the nature of land use and land cover changes.
- From this study, it is also observed the discharges from the residential areas are causing change in water bodies which in turn alter in the biodiversity in the area.

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