International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-3S, February 2019

Identification of Development Dynamics in the Krishna Eastern Delta and its Future Impacts on Water Availability and Quality with Focus on Soil Productivity and its Degradation

Nekkanti Haripavan, Nandyala Sivakishan

ABSTRACT--- Water is a precious resource for life to exist on planet Earth. Already the water demand exceeds supply in many parts of the world. The water resources are finite and currently under tremendous pressure due to vagaries of nature and population growth. The over-exploitation and mismanagement of this resource is exerting detrimental impact both in the catchment and command areas. The Water Use in the Krishna District is likely to increase at least by 50% due to rapid population growth, industrialization and agriculture in the next 20 years. The current emphasis is more on economic development and not on environmental safety and sustainability. Many river basins are becoming closed in South India, in which additional water is conserved at various upstream points affects the people using the water at downstream side and brings in large conflicts between upstream and downstream users. It is evident that the closure of Krishna basin and the resulting drastic shortfall of irrigation water to the Krishna river delta and land use dynamics had their serious impacts on crop, land, soil and environment on a decadal scale. We have already witnessed how the Kolleru fresh water lake ecosystem has deteriorated in a short span of two to three decades. Mismanagement of water resources is causing salt water intrusion in the coastal regions of maritime states. Ingress of sea water deep in to inland aquifers, soil salinity due to use of chemical agricultural inputs and brackish water aquaculture are leading to land degradation. In this view, timely and reliable data of the extent, spatial patterns, and nature temporal behaviour is a pre-requisite. In the light of above, an updated digital spatial database of Krishna district has been generated on lithology, structure, geomorphology and hydrology by adopting geospatial technologies coupled with traditional or conventional data sets for identifying ground water potential zones in Krishna district. This paper aims at highlighting some insights into the groundwater and surface water dynamics of the the Krishna Eastern Delta and the Inter-deltaic plain of Kolleru Lake system.

Key words - GIS, CRDA, NBSS

INTRODUCTION

Remote Sensing and Geographical information system plays a crucial role in identifying the regions and assessing for availability of surface water and ground water. Ground water is already the preferred source for drinking and agricultural practices in a parched delta that is not getting its due share of water from the Krishna river system. Remote Sensing is used to identify the different landforms of the study area by either interpretation techniques or spatial analysis tools in GIS. Krishna district comprises of two agro-climatic zones viz. Upland and Delta region. Nearly 27 mandals fall in delta region. The delta region is fed by ryves, eluru, bandur and Krishna east bank canals of Krishna river from prakasam barrage. The capital region identified for the residual state of AP spans roughly half the area of Krishna and Guntur Districts. The development of the capital and viability of the residual state of AP beyond the 10 years gestation period depends mainly on the four coastal districts that are part of the Krishna and Godavari river deltas. With the capital being part of the Krishna District, the present study focussed on water resources, their availability, distribution and the threats to future development scenarios of this region.

METHODOLOGY

The geometry of the earth's surface and subsurface in any area is determined by the rock type and associated structure. The study of lithology and structure provide vital information in geo-engineering, ground water targeting, hydrological studies, soil and geomorphological evaluation, mineral and oil exploration etc., The spatial database on lithology and rock type and structure been generated through visual interpretation techniques coupled with field information gathered through site visits. In addition to image elements, the terrain parameters such as drainage pattern, drainage density, topography or landform and erosion status have been effectively used in the image interpretation. By combining both morphological and spectral parameters, different lithological units have been obtained. Generally, the morphology of the image indicates the structural and textural variations and the tone represents the compositional variations. Different types of primary and secondary geological structures such as faults, foliation and lineaments, folds, strike and dip etc. has been obtained from the remote sensing image by examining the landform, drainage pattern slope, pattern, individual stream and river courses, soil moisture, alignment of tanks, alignment of vegetation etc.

Manuscript published on 28 February 2019.
***** Correspondence Author (s)
Nekkanti Haripavan, Assistant professor, Gudlavalleru Engineering College, Vijayawada, Andhra Pradesh, India.
Nandyala Sivakishan, Associate professor, Gudlavalleru Engineering College, Vijayawada, Andhra Pradesh, India.

The laconic view of satellite image expedite better recognition of geomorphology and helps in mapping different land forms or geomorphic units. The image interpretation criteria such as texture, shape, size, tone, location, association, physiography, genesis of land forms, nature of rocksand sediments, geological structures etc., have been used in the identification of various land forms or geomorphic units. Based on the origin, lithology and structure, a total of 99 types of land forms or geomorphic units have been identified in the district.

The soil map of Krishna district prepared by NBSS & LUP using integrated remote sensing and conventional technologies on 1:50,000 has been converted into GIS domain and other data sets have been overlaid for integrated analysis.

The northern Upland area still retains the natural drainage pattern, whereas the southern deltaic plain has been modified since colonial times to support extensive agriculture and inland navigation through a tight grid of irrigation canals and natural drainage. This comprises of irrigation network of Prakasam barrage on Krishna and SAC barrage on Godavari. Every stream has been delineated by using interpretation techniques and image analysis.

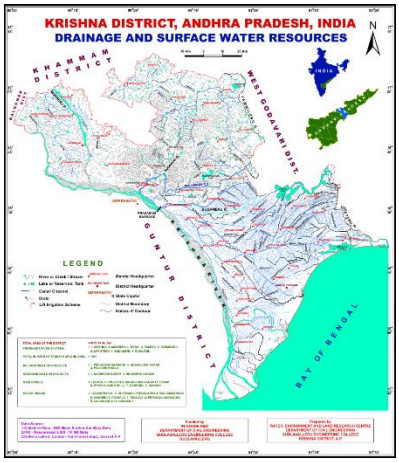
The three parameters Lithology/ structure, Geomorphology and Drainage has been overlaid to identify the ground water potential zones using overlay analysis in ArcGIS.

RESULTS AND DISCUSSIONS

Drainage pattern

The northern Upland area has natural drainage pattern, whereas the southern deltaic plain comprises of irrigation network of Prakasam barrage on Krishna and SAC barrage on Godavari. The northern part of the drainage represents dendritic drainage pattern of major river systems. All of the natural drainage is controlled by geological structures such as faults, fractures and lineaments. The drainage in the northern Upland is intercepted by construction of several tanks and two medium irrigation systems. Further, the irrigation is supplemented by Nagarjunasagar left bank canal system in the Upland. Kolleru lake, which is the largest fresh water lake in the country is situated in the eastern central part of the district. It receives water from northern hill streams and irrigation systems of Godavari and Krishna and has only one outlet, Upputeru, which joins the Bay of Bengal. Gogileru creek, a recently evolved shallow sea water depression is located very close to Bay of Bengal. It is due south of Kolleru in the central part of Inter-deltaic plain.

The Krishna delta is short of water due to highly depleted discharges particularly during Rabi season. To some extent, this is being augmented by diverting water from Godavari through Pattiseema lift irrigation scheme. The expansion of agriculture and aquaculture and over use and pollution due to salt water intrusion threatens these irreplaceable resources in the district.

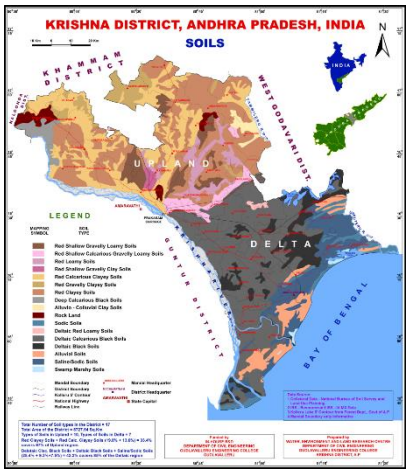


Agriculture aspect

The agricultural activity in the northern Upland mainly depends on irrigation canals, bore wells, tanks, and medium irrigation sources due to unreliable rainfall because of vagaries of monsoons in the area. Whereas in the southern deltaic plain, the agriculture is mainly relied on delta irrigation network of Godavari and Krishna rivers. In general, majority of the area in the district is nearly level and thus facilitating good irrigation prospects in the district.

Soil characteristics

A good understanding of the soils and their nature and spatial distribution is essential to formulate any land based production system. The area experiences a wide range of soil conditions as it exhibits a variety of lithological formations, structure and geomorphological processes. Further, it displays both upland and deltaic / coastal environments. A total of 17 types of soils have been identified in the district.



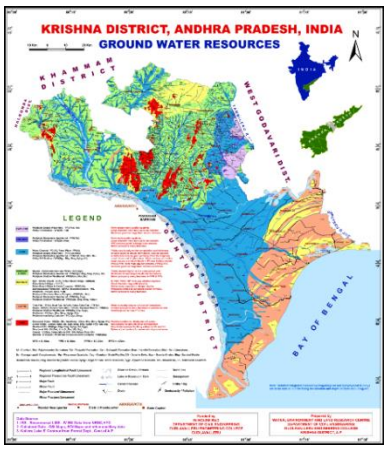
Environemntal degradation is the most dramatic in the inter-deltaic plain. The plain has a large extent under Saline Sodic soils and sodic soils. Prior to the adoption of brackish aquaculture, the region had limited economic opportunities through horticulture and silviculture. However, they still had access to fresh water from ground on the beach ridges and paleo channels. With extensive adoption of brackish water aquaculture, the ground water has become saline.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

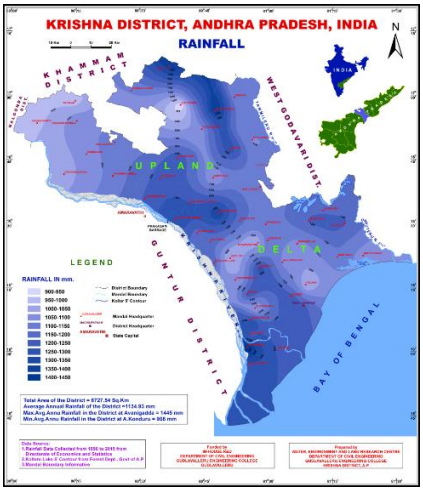
Added to this the environmental flows of the Kolleru system and the Krishna system have declined due to abstractions in the basin. This has additionally prompted ocean water interruption into the crisp water aquifers. Today, these villages have to depend for everything from water, milk, food, vegetables on the district towns such as Bantumilli, Bhimavaram or Kalidindi. Their economic self reliance beyond brackish water aquaculture is a big concern.

Ground water prospectus

In general majority of the Upland area represents good to moderate conditions of ground water. However, good prospects are expected in the valleys of metamorphic rocks. Excellent to very good quantities are expected in the sandstones of Gondwana formations occurring in the upper eastern part of the district along Tammileru river. In the coastal deltaic plain, the flood plain regions act as shallow aquifers yielding good quantities of ground water. The southern most part of the district comprising fluvio-marine sediments yield limited quantities and the water is mostly saline and brackish. However, the beach ridges act as shallow aquifers yielding moderate quantities of water. The hills, inselbergs and pediments of different rock types in the upland area act as run-off zones.



Rainfall is the principal source of recharge to the ground water. However, the canals in the area contribute good recharge to the ground water. The over-exploitation of this resource causes salt water intrusion in the coastal region. The underground aquifers are under stress in many regions. Also, the climate change will have serious impacts on water resources.



The Krishna district is considered as one of the richest granaries and one of the most densely populated regions. It is pivotal of socio-economic development in the newly carved state of A.P. Nearly 50% of the state capital region falls within the study area. The preparation of the digital information database for land use land cover, topography and slope, soils and soil erosion, rock types and structures, landforms / geomorphic units, coastal erosion etc. using satellite imageries on ArcGIS platform helps in creating a repository on various land and terrain characteristics. Though the systems are aptly designed, it is not properly used and not exercised optimal land use practices. As the population continues to increase the per capita availability of land decreases and the demand for food and fodder further increases. The parts of elevated regions in Upland Area experience severe to extreme soil erosion causing siltation of minor irrigation systems / tanks and medium irrigation projects and also sedimentation Kolleru lake. There is a phenomenal development of pond aquaculture in the deltaic region. If this trend continues the Gogileru Creek and mangroves swamps, which are the most potential areas for aquaculture, may soon disappear. We have already witnessed how Kolleru lake has been subjected encroachments and deterioration.

The updated large scale spatial database generated on various water resources parameters provide information on the present status of this resource use in the district as well as in the upstream catchment. The integrated spatial analysis forms the basis for preparation of water conservation plans for existing and planned future. The impounding of water in the Upper reaches of the catchment or Upper States is casting a shadow over the irrigation prospects in Krishna district both in delta as well as upland for the last couple of decades. Regular monitoring of catchment and command areas for analysis of inputs versus yields using RS and GIS techniques coupled with traditional wisdom. The Hydro-economic conjunctive management models are to be implemented for better management of river basins.

Though the district is endowed with rich water resource potential substantiated by good rainfall, the rampant use for different purposes is posing serious implications in the form of scarcity of drinking water, depletion of ground water resources, sea water intrusion, etc., The district covered with part of CRDA has to be provided with sustainable water resources and has to be augmented by inter-basin transfer of water from Godavari either through Pattiseema Lift or Polavaram project. The introduction of tapping brackish water from deeper zones for prawn culture in the deltaic region promotes pollution in both vertical and lateral directions and thus cause salinization and irreversible damage to shallow fresh water alluvial aquifers. Further, the soils also become saline due to this aquaculture. Further, the human intervention in the form of over-exploitation and mismanagement of water resources is causing detrimental impact on the coastal ecosystems in the district that include Kolleru lake, Gogileru Creek, Upputeru river estuary, mangroves etc.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Kolleru Lake which is recognized under Ramsar Convention (Iran 1971) covering 250,000 acres up to its +10 ft. contour. It is a Ramsar Site along with Chilka lake in Orissa. It is now threatened under Montreux record blacklist due to unrestrained anthropogenic activities of aquaculture in the lake. The deliberate blockage of water inflow and outflow for pond aquaculture and wet paddy cultivation leading to disastrous consequences of floods in the foreshore areas of lake. The data generated can be provided as baseline data to many Government organizations, NGOs, faculty research, student's dissertation work etc. It fulfils the strong need of appropriate database for water resources management and environmental planning to handle complex problems of resource allocation and decision-making in the Krishna district.

REFERENCES

1. Venot, Jean-Philippe & Sharma, Bharat & V. G. K. Rao, K. (2008). Krishna Basin Development. The Journal of Environment & Development. 17. 269-291. 10.1177/1070496508320532.
2. Nageswara Rao, K & Vaidyanadhan, R. (2003). Geomorphic features of krishna delta and its evolution. 120-130. Journal of Environment & Development
3. Reddy, K.M. & Shah, B.M.. (1991). Evolution of the Krishna Delta, Andhra Pradesh. 22. 57-64.
4. An assessment of groundwater resources and management by d.chandra shekaran, s.k.singh