

## International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

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Vol. 7, Issue 11, November 2018

# Study on Coastal Road Development in Godavari Basins in Telangana

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**ABSTRACT:** Coastal lands around Bay of Bengal in Central Godavari Delta are mainly agriculture fields and two times annually paddy crops putting in the study area. Canals of Godavari River are the main source of water for irrigation. Geophysical and geochemical investigations were carried out in the study area to decipher subsurface geologic formation and assessing seawater intrusion. Electrical resistivity tomographic surveys carried out in the watershed-indicated low resistivity formation in the upstream area due to the presence of thick marine clays up to thickness of 20–25 m from the surface. Secondly, the lowering of resistivity may be due to the encroachment of seawater in to freshwater zones and infiltration during tidal fluctuation through mainly the Pikaleru drain, and to some extent rarely through Kannvaram and Vasalatippa drains in the downstream area. Groundwater quality analyses were made for major ions revealed brackish nature of groundwater water at shallow depth the fossiliferous limestone bed is a representative horizon for the K-T boundary mass extinction caused due to intense volcanism. Inter trappean sediments exhibit weathered soil profiles (palaeosols) with limestone beds denoting a distinct time gap during various phases of lava eruption. Evaluation of the palaeo geographic scenario of the Krishna and Godavari Rivers does not provide any evidence for the existence of Cretaceous palaeovalley which would have provided pathway for lava transportation from the Deccan volcanic province of western India to the K-G Basin situated along the east coast. The present study opens up an alternative approach to explain the origin of basalt flows at Rajahmundry. In all probability the lavas could be intrabasinal. NW-SE and NESW faults or their intersection zones are probable pathways for lava eruption in the K-G Basin

### I. INTRODUCTION

The Godavari basin extends over states of Maharashtra, Andhra Pradesh, Chhattisgarh and Odisha in addition to smaller parts in Madhya Pradesh, Karnataka and Union territory of Puducherry having a total area of 3,12,812 Sq.km with a maximum length and width of about 995 km and 583 km. The Godavari River rises from Trimbakeshwar in the Nashik district of Maharashtra about 80 km from the Arabian Sea at an elevation of 1,067 m. The last major tributary is the Sabari, which joins the Godavari, 100 km. up-stream of Rajahmundry. The largest tributary of the Godavari is the Pranhita with about 34.87% coverage of drainage area. The Pravara, Manjira and Maner are right bank tributaries covering about 16.14%, the Purna, Pranhita, Indravathi and Sabari are important left bank tributaries, covering nearly 59.7% of the total catchment area of the basin. The Godavari in the upper, middle, and lower reaches make up for the balance 24.16%. The major part of basin is covered with agricultural land accounting to 59.57% of the total area and 3.6% of the basin is covered by water bodies. The basin spreads over 51 parliamentary constituencies (2009) comprising 21 of Maharashtra, 18 of Andhra Pradesh, 4 of Madhya Pradesh, 3 each of Chhattisgarh and Odisha and 1 each of Karnataka and Puducherry.

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## Itinerary of Godavari River:

The river is an important stream in central India, rising in the Western Ghats Mountain Range. The name of the origin is Trimbakeshwar and it is situated in the Nashik District or Subdivision in the state of Maharashtra and runs towards the east over the Deccan terrain through the Maharashtra state. The river is also named as Southern Ganges or Dakshin Ganga. The river moves into Andhra Pradesh at Kandhakurthi in Nizamabad district of Andhra Pradesh, moves past the Deccan terrain and subsequently bends to run according to a southeasterly course till it pours into the Bay of Bengal via two mouths

## Proposed Link Canals Between Godavari and Krishna:

The NWDA had taken up and completed scientific hydrological analysis of various river basins to assess the water balance position in the basins at the ultimate stage of development Based on these studies, it has been estimated that, considering the ultimate development scenario in these basins, the Mahanadi basin will have a net surplus of 11176 Mm<sup>3</sup> at 75% dependability at Manibhadra and the Godavari basin will have a surplus of 15020 Mm<sup>3</sup> at 75% dependability at Polavaram

## II. LITERATURE REVIEW

**Bhakar, P. and Singh, A.P. (2018)**.this river gave its name to an entire districts that covered the delta region in its entirety and part of the reason was the Godavari ani cut, or the Dowlaiswaram barrage or the Sir Arthur Cotton barrage, which besides being the first major colonial reservoir built in this region, also happened to have brought with it, an entire administrative mechanism around Godavari river and its 'utilisation' for purposes of irrigation and

**P., Kanuganti, S., Sarkar, (2017)** the Krishna river was said to be inadequate to meet the demand of irrigation of Krishna delta farmlands, the Godavari river has been linked to Krishna through the Polavaram Right Bank Canal with the help of Pattiseema Lift scheme. The project was commissioned in 2015 and recently the Chief Minister of AP, Chandrababu Naidu had a symbolic inauguration of the interlinking of these two rivers.

**Jain and Kothyari (2000)** proposed and demonstrated a Geographical Information System (GIS) based method for the identification of sediment source areas and the prediction of storm sediment yield from catchments. Data from the Nagwa and Karso catchments in Bihar (India) have been used. The Integrated Land and Water Information System (ILWIS) GIS package has been used for carrying out geographic analyses.

## III. METHODOLOGY

The Godavari basin is bounded on the north by the Satmala hills, on the south by the Ajanta range and the Mahadeo hills, on the east by the Eastern Ghats and on the west by the Western Ghats. Except for the hills forming the watershed around the basin, the entire drainage basin of the river comprises rolling and undulating country – a series of ridges and valleys interspersed with low hill ranges. The upper reaches of the Godavari drainage basin are occupied by the Deccan Traps containing minerals, hypersthene, augite, diopside, enstatite, magnetite, epidote, biotite, zircon, rutile, apatite and chlorite. The middle part of the basin is principally Archean granites and Dharwars composed of phyllites, quartzites, amphiboles and granites.

## Rainfall pattern in the Basin:

The Godavari basin receives its maximum rainfall during the Southwest monsoon. The monsoon currents strike the West Coast of the peninsula from West and South-West, meet the Western Ghats or Sahyadri Range which present almost an uninterrupted barrier ranging from 600 m. to 2100 m. in height. Before surmounting this barrier the currents deposit most of their moisture on its windward side, and then sweep across the interior of the peninsula on the Easterly course. Rainfall is governed largely by the orography of the area, which leads to variation in the amount of precipitation.

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**Figure: River Overview Map**

The Godavari receives the water from a length of about 129 km. of the high rainfall zone in the Western Ghats. The months of January and February are almost dry in the Godavari basin, the rainfall during these two months being less than 15 mm. During the next three months, up to end of May, it varies from 20 mm to about 50 mm, in most parts of the basin.

### Ground water resources:

Ground water level data is temporal and dynamic in nature. It is mainly controlled by rainfall pattern in relation to the aquifer material. A large part of agricultural irrigation depends on ground water availability. The Central Ground Water Board has explored aquifers in various States/UTs under its scientific exploratory drilling programmes by utilizing latest studies and technologies which includes remote sensing and geophysical techniques. The Board is monitoring the ground water levels in the country, four times a year (Jan/May/Aug/Nov) through a network of Ground Water Observation Wells. In the basin observation wells are there to assess the ground water potential in different hydrogeological set up. Priority was accorded to drought affected and tribal areas, hard rock areas, pollution affected areas, etc. Godavari Upper Sub Basin comprises of the least number of observation wells (93), with the maximum (346) in Wardha Sub Basin. The distribution of observation wells is quite uniform across the basin.

**Table: Sub-basin wise number of ground water observation wells**

Sub Basin	No. of Observation Wells
Godavari Lower	214
Godavari Middle	<b>212</b>
Godavari upper Sub Basin	93
Indravati Sub Basin	215
Manjra Sub Basin	<b>229</b>
Pranhita and others Sub Basin	303

### Hydro-met observations:

Designing and execution of water resources projects and river management requires time series data on hydrological aspects. River management being one of the key issues for political and economic affairs of the country, Central Water Commission (CWC) collects and process the basic hydrological data on gauge, discharge, silt, and sedimentation and water quality. The hydrological observation stations of CWC on a regular basis monitor the parameters and transmit

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this information to CWC regional offices, which is then documented in the form of Water Year Book, Sediment Year Book and Water Quality Year Book.

Hydro-meteorological observations in the basin are carried out by the Central and State Governments. The Godavari Circle is functioning with its headquarter at Hyderabad under the Administrative Control of Superintending Engineer, Godavari Circle, KGBO, CWC, Hyderabad. The Circle comprises of two Divisions viz., Upper Godavari Division and Lower Godavari Division at Hyderabad and their 7 Sub Divisions (including a Mechanical Sub Division at Hyderabad) for managing the works at Hydrological Observation Sites and Wireless Stations. There are 18 Flood Forecasting Stations in Godavari Basin and 88 CWC Hydrological Observation

### Integrated State Water Plan For Godavari Basin:

Manage disasters better at the ground level immediately, during the time taken for the government machinery to set in motion. However, care has to be taken that the process of grouping and forming such local level 'committees', does not become expensive, time consuming and cumbersome. More importantly, it should not lead to fragmentation in local water resources management. For this, an ideal and practical solution would be to form a single committee at village level which deals with not only disaster management, but also with other aspects of water, such as groundwater and surface water management, water quality management, fisheries, navigation and water-related tourism, WUAs etc. Such a committee, in fact, will be in a better position to obtain and disseminate information, handle disasters, and implement DM strategies more effectively due to its comprehensive understanding of the entire water sector at the village level.

## IV. RESULTS

The environmental problems also enhanced due to sever soil erosion at the catchment as well as the agricultural lands. The information on the soil erosion is necessary for protecting the agricultural lands against land degradation. The results obtained during the research study, such as land use land cover classification and its change detection rainfall runoff modeling and its error functions, NDVI classification and soil erosion estimation around the Godavari River in Andhra Pradesh are presented in this chapter. The predicted results are also compared with Central Water Commission (CWC) data at Polavaram gauging site. In this study a methodology consisting of preparation of inputs and running the hydrologic model with calibration And validation was adopted to generate water balance components of Godavari basin for Executed in water balance mode, the VIC model estimates the water balance components. As we all know that the climate conditions are changing with time, the effect of change in meteorology on water balance components is studied. To study the effect of climate change on hydrology of the Godavari basin, the model was setup with meteorological forcing like maximum and minimum temperature, precipitation and wind speed. The model was forced with 3 years data on this parameter

### Performance of the rainfall-runoff model:

It showed remarkable agreement between results predicted by the model and measured data. The value of Nash-Sutcliffe coefficient ranged from 0.785 to 0.938, it indicates that the model performed well. The value of index of agreement ranged from 0.962 to 0.987, which is almost 1, indicates that the model was in agreement. The percentage deviation in peak varies from 20.56% to 36.59% which suggested that model predicted actual discharge at gauging site.

**Table: Details of the Validation results of the model at Polavaram**

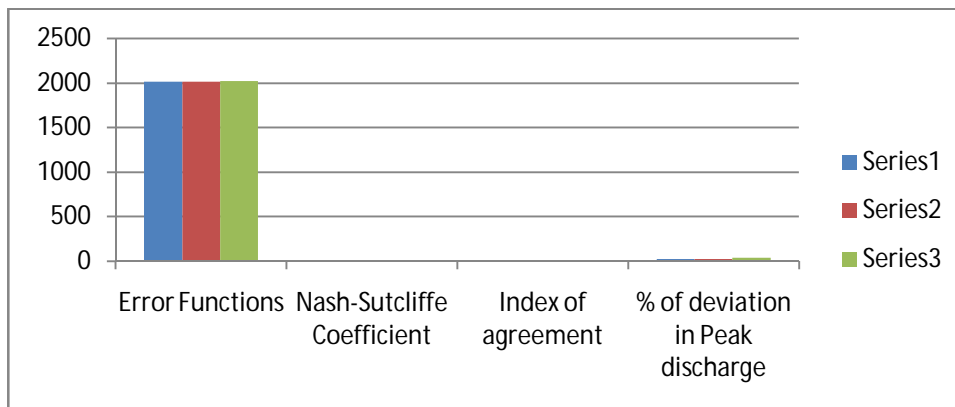
Error Functions	2014	2015	2016
Nash-Sutcliffe Coefficient	0.904	0.938	0.785
Index of agreement	0.981	0.987	0.962
% of deviation in Peak discharge	24.58	20.56	36.59

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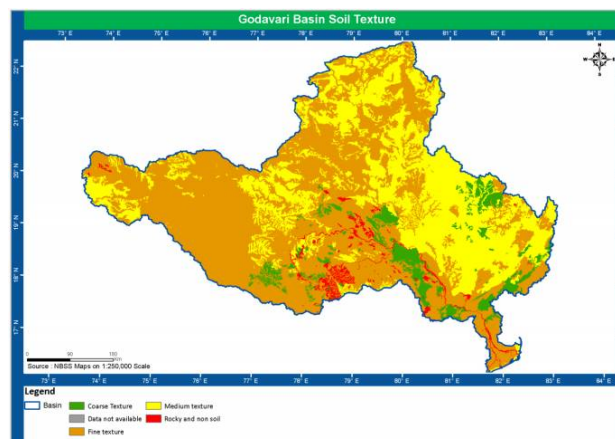
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**Graph:** the Validation results of the model at Polavaram

### Godavari river Trends and variability:

Rainfall is governed largely by the orography of the area, which lead to variations in the amount of precipitation. The Godavari basin receives its maximum rainfall during the south-west monsoon. The monsoon strike the west coast of the peninsula from the west and south-west, meet the Western Ghats or Sahyadri range which present almost an uninterrupted barrier. Before surmounting this barrier the currents deposit most of their moisture on its windward side, and then sweep across the interior of the peninsula on a westerly course. In crossing the Ghats, the monsoon winds lose a large part of their moisture. The monsoon currents follow the eastward slope of the country from the crest of the ghats which form the watershed. Conditions in the interior are therefore somewhat unfavorable for heavy precipitation except in association with the depressions from the Bay of Bengal. The north-east part of Godavari basin also receives some rain in association with monsoon depressions, which move west-north-west across the Odisha coast. January and February are almost entirely dry in the Godavari basin, the rainfall during these two months being less and the next three months, up to end of May, it varies from less than 1 mm to 50 mm in most parts of the basin. The actual rainfall varies widely from year to year. There are also variations in the incidence and distribution of rainfall in time and space. Mean Daily evaporation varies from about 5 mm near coastal region to 16.6 mm in upper region



**Figure: Soil texture**

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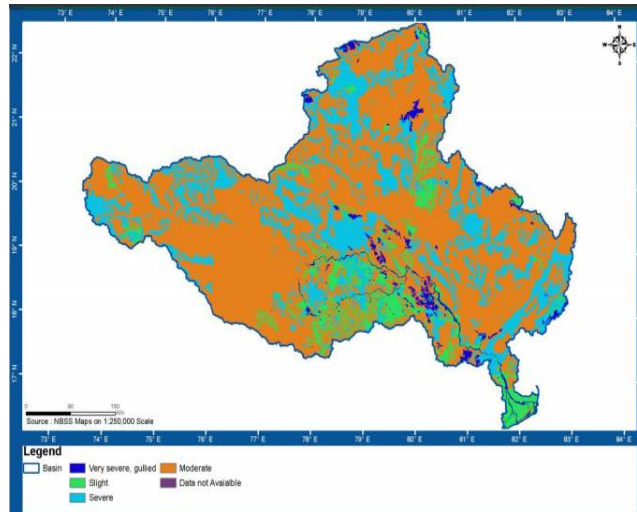


Figure: Soil erosion

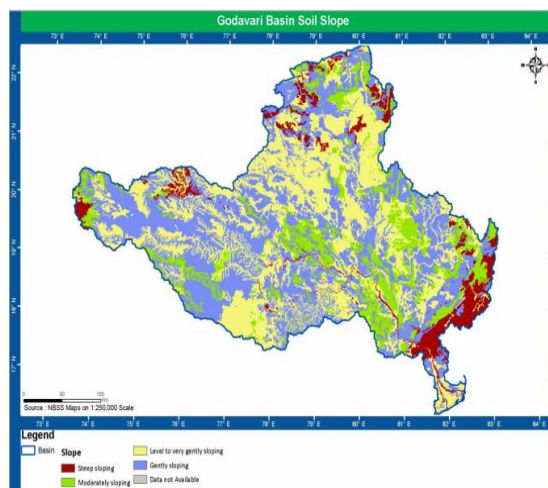


Figure: Soil slope

**Godavari river Sub-basins:** Hydrological unit wise assessment of water resources is a prerequisite for its proper management as it is fast becoming scarce in India. Semi-automated approach for delineation of hydrological units (basin, sub-basin and watershed) uses SRTM DEM, topomaps on 1:50K, IRS P6 LISS-IV & CARTOSAT1 merged data, drainage network, surface water bodies, rail/road network and other ancillary data. Drainage divides from contour/ridge lines are used to demarcate the boundary of hydrological units. The divide has been marked where flow is in opposite directions. Knowledge of terrain as well as DEM is essential for accurate demarcation of boundary. Hydrological boundary has been validated with reference to contours and drainage network. Hydrological unit boundary cuts perpendicular to the contour lines but it does not cross the drainage line at any location except its outlet. This approach is potentially more objective, repeatable, and cost-effective. The Godavari basin is divided into 8 sub-basins (Map 13a to Map 13h), each of which represents a different tributary system. The area distribution of the each sub-basin The Dudhana, Kapra, Sindphana and Siddha rivers originate in Godavari Middle Sub Basin. The Kadva,

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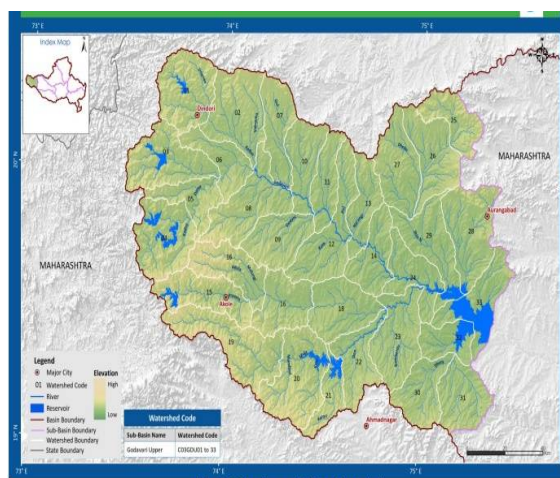
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Pravara, Shivna, Mula and Godavari rivers originate in Godavari Upper Sub Basin. The Penganga, Kayadhu, Arunavati, Aran, Wardha, Vena and Yashoda rivers originate in Wardha Sub Basin.

**Watersheds:** Sub-basins could be sub divided into smaller hydrological units namely, watershed for water resources management at larger scale. Watershed is a natural hydrological entity that covers a specific areal expanse of land surface from which rainfall flows to a defined drain, channel, stream or river at any particular point. Watershed should be delineated purely on the basis of hydrological principles. Size of the watershed is governed by the size of stream and its boundaries. Eight sub-basins have been further clustered into 466 watersheds each of which represents a different tributary system for size ranging from 304 Sq. km to 993 Sq. km with maximum number of watersheds falling in Weinganga sub-basin. Number of watersheds and the range of size for the sub basins The distribution of watersheds over the 8 sub-basins of Godavari basin has been shown in Map 13a - Map 13h. Each watershed is given an 8 digit alphanumeric code for identification. Each letter in the code has a description.

**Table : Sub-basin wise watersheds**

Sub Basin	Area (Sq. km)	Size Range of Watershed (Sq. km)	No. of Watersheds
Wardha	46242.09	361 - 946	69
Weinganga	49695.40	305 - 972	<b>80</b>
Godavari Lower	44492.93	304 - 990	<b>87</b>
Godavari Middle	36290.47	325 - 955	56
Godavari Upper	21443.23	331 - 988	<b>33</b>
Indravati	38306.10	343 - 993	<b>60</b>
Manjra	29472.88	421 - 981	44
Pranhita and others	36119.60	326 - 982	<b>57</b>



**Figure: Godavari upper sub-basin and watersheds**

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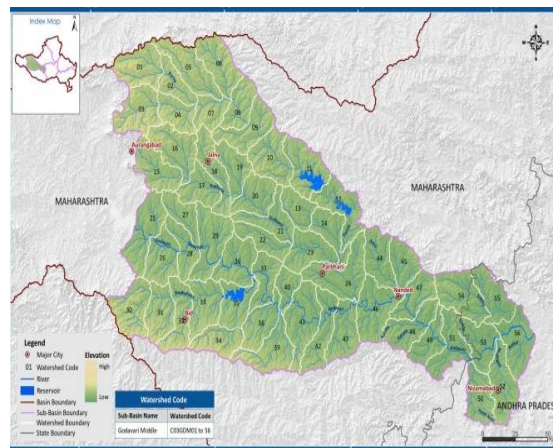


Figure: Godavari middle sub-basin and watersheds

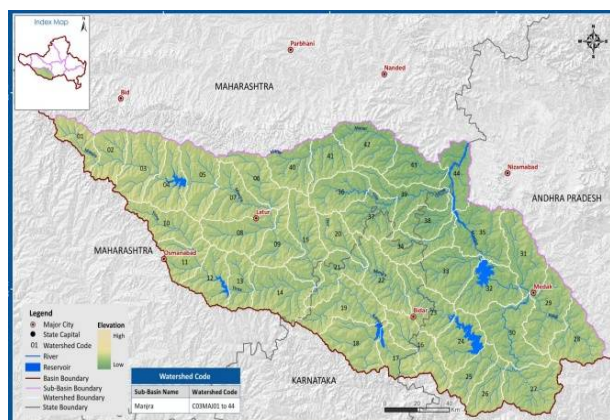


Figure: Manjra sub-basin and watersheds

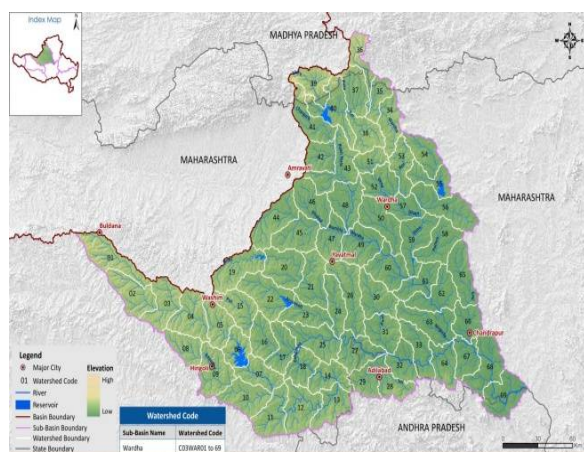


Figure: Weinganga sub-basin and watersheds



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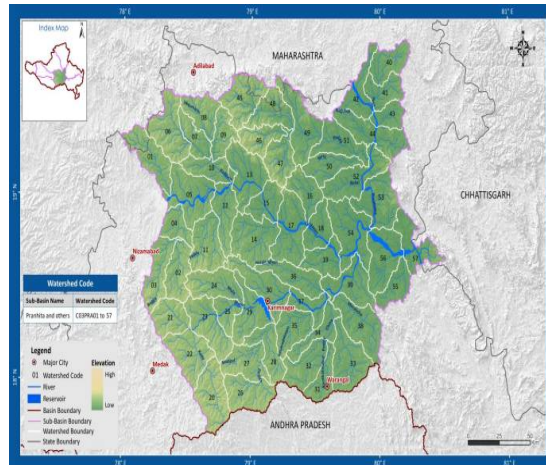


Figure: Pranhita and others sub-basin and watersheds



Figure: Godavari Lower Sub-basin and watersheds

## Features of Godavari Basin:

Construction of Major, Medium and Minor Projects in Ahmednagar, Nashik and many districts of Marathwada has given impetus to the cultivation of sugarcane crop in the command areas. The cooperative sugar industry is one of the most significant indirect socio economic impacts of water sector in the State. They have also created trusts and corpus funds by diverting a share of one or two rupees per tonne of sugarcane and established several educational institutes ranging from ‘SakharShaalas’ for children of sugar factory workers to Medical and Engineering Colleges with state-of-the-art infrastructure and research facilities. These are largely visible in the western and more developed regions of the Godavari basin, i.e. Nashik, Ahmednagar and Aurangabad districts, and also in Marathwada to a large extent. Sugar factories have also established hospitals and charitable institutes. At the same time, many sugar factories across the basin have invested in research for higher productivity and higher water use efficiency, the results of which get shared with local farmers.

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## V. CONCLUSION

The Godavari river, an interstate river, originates near Trimbak in Nasik district of Maharashtra state and flows east across the deccan plateau and discharges at Bay of Bengal. The total length of the river is 1465 km. The principal tributaries of the river are Penganga, Pranahitha, Indravathi, Manjira, Sabari and Manair. The study area is confined from Mancherial to Polavaram comprising a length of 463.2 km along the reaches of the river.

- Total Number of projects in Godavari Basin where R & R is applicable: 185
- Total number of villages affected within the Godavari basin is: 636
- Total number of families affected or displaced: 232506

Total area affected: 3.35 lakh ha. However, these studies are fragmented; they do not cover the entire Godavari basin and have been conducted over multiple and irregular time periods. A series of uniform and comprehensive socio-economic surveys of the entire basin need to be carried out, simultaneously in the same year, and every ten years, to compare the status and to evaluate the extent of improvement in terms of various parameters and to take corrective measures where necessary. This would reduce the 'trust deficit' towards the State among them and pave the way for further growth and development.

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