KALESHWARAM PROJECT – A GROWTH ENGINE FOR INTEGRATED GODAVARI BASIN DEVELOPMENT PLAN

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ABSTARCT

Kaleshwaram Projects is planned as a multi stage lift irrigation scheme with an investment of Rs.80,190 crores, having seven links and various civil and Electro Mechanical components viz barrages(3),reservoirs(24) with 141TMC storage capacity, tunnels(203 km),pressure pipe lines(93 km),gravity canals(1531 km),pump houses(21), electric sub stations (21) which spread in 13 districts and benefit 2.5 crore population in 23 districts of Telangana State. It lifts Godavari waters from 100 m to 618 m MSL. Apart from providing irrigation and drinking water facilitates to 45 lakh acres, Kaleshwaram project will have manifold impacts on development of inland fisheries, inland navigation, eco and temple tourism, water sports, industries, urban development and sustainability, improving bio diversity and possibility of storing 450 TMC in the existing reservoirs within the radar of Kaleshwaram Project,. Kaleshwaram Project is now termed by the engineering experts as the largest Multi Stage Lift Irrigation Scheme in the world having manifold development impacts. Thus, it is treated as Growth Engine of Telangana State with a comprehensive Godavari Basin Development Plan.

1. INTRODUCTION

Telangana State was carved out of combined state of Andhra Pradesh in 2014 after a 60 years of prolonged movement for statehood. Godavari and Krishna Rivers flow through Telangana covering the entire geographical area of the state. Northern parts of Telangana fall in Godavari basin and southern parts fall in Krishna Basin. Soon after formation of Telangana State, Government of Telangana had taken up the task of providing irrigation facilities to 1.25 Crore acres (including existing irrigated area) as one of its main flagship programs spread throughout the state with the ultimate objective of ensuring 1 lakh acres of irrigation in each of the rural Assembly constituencies to mitigate drought conditions and distress in agriculture sector prevailing in the region for the last 60 years and to make rural economy vibrant and sustainable.

2. GOVERNMENT STRATEGY

To achieve this goal, Govt of Telangana adopted a four pronged strategy i.e.

(i) Completing the ongoing projects commenced by the erstwhile governments by re- engineering of projects wherever necessary to suit to the needs of newly born state of Telangana.

(ii) Grounding and Completion of projects which were sanctioned but not grounded by the erstwhile state of AP in a time bound manner by making suitable changes by way of re-engineering.

(iii) Modernization and restoration of existing major and medium irrigation sources to bring the contemplated ayacut under irrigation bridging the gap between irrigation potential created and irrigation potential utilised.

(iv) Restoration of 46,500 minor irrigation tanks which are considered to be life line of Telangana for ages.

3. GODAVARI RIVER FLOWS

The Godavari is the largest river in south India and the second largest in India. People also call it as ‘Dakshin Ganga’. It rises in the Sahyadris, at an altitude of 1,067 m above mean sea level near Triambakeshwar in Nasik district of Maharashtra and flows across the Deccan plateau from the Western Ghats to Bay of Bengal. It flows for a total length of about 1465 Km in South – Eastern direction through the States of Maharashtra, Telangana and Andhra Pradesh before

it joins the Bay of Bengal. In its course, many large and small tributaries viz., Purna, Pravara, Penganga, Manjira, Wardha, Wainganga, Pranahitha, Indravathi, shabari, Kinnerasani, Manair, Kadem, Swarna, etc join Godavari river. It enters into Telangana at Kandakurthi village of Nizamabad district upstream of Basar and after passing through the Dummugudem anicut in Bhadradri Kothagudem District it enters into Andhra Pradesh. After flowing through Arthur Cotton Barrage merges with Bay of Bengal. In its total length of 1465 kilometres, it flows about 530 Km in Telagnana. Catchment area of Godavari (3,12,812 Sq Km) spreads over seven States and one Union Territory namely, Maharastra (48.6%), Telangana (19.2%), Chhattigarh (12.3%), Madhya Pradesh (8.6%), Odisha (5.7%), Andhra Pradesh (4.3%), Karnataka (1.4%) and Puducherry (0.01%). Out of the Godavari catchment area within the boundaries of erstwhile Andhra Pradesh state, 82% catchment area lies in Telangana state and 18% area only in AP.(See Godavari Basin Map at ANNEXURE-I)

3.1 The Godavari basin has been divided into twelve sub-basins: Upper Godavari (G-1), Pravara (G-2), Purna (G-3), Manjira (G-4), Middle Godavari (G-5), Maner (G-6), Penganga (G-7), Wardha (G-8), Pranahitha (G-9), Lower Godavari (G-10), Indravathi (G-11) and Shabari (G-12). Inflows into Godavari are greatly reduced from upstream sub-basins in Maharashtra and Karnataka as numerous major, medium projects, barrages, anicuts and checkdams were constructed. As a result, flows to Sriramsagar, Nizamsagar and Singur projets are drastically reduced. Water from Kadem and Swarna rivers in the Middle-Godavari sub-basins joins Godavari River downstream of Sri Ram Sagar Project and flows into Yellampalli barrage. There are little flows come from Maner. However, there are about 1500-3000 TMC water flows into the Sea unutilised every year. All these waters of Godavari are mostly from lower Godavari Sub basin (G10) after Pranahitha, Indravathi and Shabari rivers join Godavari. Hence, it is clear that the huge flows in Godavari River are due to the inflows from Penganga, Wardha, Pranahita, Indravati and Shabari sub-basins. Substantial quantity of water is available only after the confluence of Pranahita in Godavari River. As per Central Water Commission, in Middle-Godvari sub-basin, average flows in 40 years at Kaleshwaram i.e, after confluence of Pranahita is 1651 TMC. Monthly average flows, are 50.9 TMC in June, 299.9 TMC in July, 607.1 TMC in August, 423.8 TMC in September, 176.2 TMC in October, 38.7 TMC in November, 17.0 TMC in December, 11.9 TMC in January, 10.9 TMC in February, 7.4 TMC in March, 4.2 TMC in April and 3.1 TMC in May. If we look at these figures, it is clear that ample inflows are available in lower Godavari. Erstwhile Andhra Pradesh has let into these flows into the sea unutilised. The States of Telangana and Andhra Pradesh can utilise those waters for their benefit.

3.2 Naturally a question arises, when abundant water is available, why didn't the Governments so far have tried to utilise them. As we explored the issue, we found that much earlier to the formation of Andhra Pradesh, the then Hyderabad State had designed 'Pranahitha Project' utilising the waters of Pranahitha River. The details are given in Krishna- Godavari Commission Report (1962). A dam on Pranahita River near Tabi and Watra villages was planned consisting of 4,300 feet length, 140 feet height, with a reservoir of 143 TMC storage capacity having FRL of +475 ft, to irrigate 1,50,000 acres (Khariff) and 1,00,000 acres (Rabi) by excavating 140 Km length of canal with a capacity of 3,450 cusecs, along with 300 MW power generation, also to feed 85 tanks in the command to supplement 2,726 acres. After formation of Andhrapradesh state in 1956 merging Telangana and Andhra regions, Pranahita Project was kept in cold storage. later an inter-State agreement was signed for construction of Pranahita project. Subsequently Maharashtra withdrew from it stating that it was not beneficial to them. However, there were no indications of initiating talks by the combined state of Andhrapradesh with Maharashtra on Pranahita project in subsequent years until Pranahitha-Chevella Project was formulated by Telangana retired engineers during period of Telangana movement for statehood. Combined State Governments did not have any plans for utilising Pranahita waters.

3.3 Based on the Godavari Water Disputes Tribunal, erstwhile combined State had estimated 1480 TMC at 75% dependable waters and allocated 954 TMC to Telangana projects. These allocations remained on paper since projects were not completed by combined Andhra Pradesh. At any point of time, actual utilisations were at the range of 400 TMC per year. After thorough analysis, Telangana Government found that Kaleshwaram Project is the best possible way for maximum utilisation of Godavari waters for overall Godavari Basin development. The project would help in achieving the avowed target of at least one crore acres in Telangana. And, the dried course of Godavari river will become live again. The dried up reservoirs of Sriramsagar, Nizamsagar, Singur, Upper Maner, Lower Maner etc are going to get water to fulfil their contemplated objectives. About 170 km stretch of Godavari River in between Yellampalli and Tupakulagudem barrages will be rejuvenated and flora and fauna in and around the project area will be developed.

4. RE-ENGINEERING OF IRRIGATION PROJECTS

After formation of Telangana State in June 2014,Hon'ble Chief Minister Sri K Chandrasekhar Rao conducted detailed review of the on-going major projects with engineering experts and Dr.B.R.Ambedkar Pranahita Chevella Suajala Sravanti was one among many projects. During elaborate discussions, these projects were found to be having deficiencies in terms of location, unresolved inter-state issues, hydrology, storage requirements, issues in regard to forest clearance, Railway and Road crossings, R&R issues etc. It was, therefore, felt necessary to re-design and modify these projects to move forward and obtain contemplated benefits in a stipulated period. After detailed discussions and reviews of with all concerned, Pranahita Chevella Project was re-engineered to suit to the needs of Telangana state and utilize state's share in Godavari Waters to maximum extent. Accordingly, WAPCOS, a Govt of India undertaking was assigned to finalise

the proposed changes and prepare DPR. For early completion of survey and investigation Govt permitted to adopt latest technology, Light Detection and Ranging (LiDAR) survey all along Godavari river and project areas. First time in India LiDAR technology was adopted for survey and investigation in an irrigation project. it is known as aerial laser surveying aimed at the acquisition of 3D point data and creation of Digital Surface Models (DSM) i.e. 3D maps. The advantages of LiDAR survey are quick data collection, high accuracy, no geometric distortions, collect elevation data in dens forests, data collection in day or night, easy integration with other data sources

5. EVOLUTION OF KALESHWARAM PROJECT

Earlier, Dr. B. R. Ambedkar Pranahita - Chevella Sujala Sravanthi project was contemplated to divert 160 TMC of water to irrigate 16.40 lakh acres of ayacut in 7 districts of Telangana State by constructing a barrage with FRL +152.00 m across river Pranahita near the confluence of Wainganga and Wardha Rivers at Tummidihetti (V), Koutala (M), Adilabad District. Besides irrigation, drinking water (30 TMC for twin cities & 10 TMC for enroute villages) & water for industrial use (16 TMC) was also proposed. Erstwhile Government of AP accorded administrative approval for the project for Rs.38,500 Crores in 2007.Government of Maharashtra raised objections on submergence in their territory due to construction of barrage with FRL +152.00 m and requested to reduce the FRL to +148.00 m. Further, the Central Water Commission, New Delhi had assessed the net water availability at the barrage location (Tummidihetti) on Pranahita River was about 165.38 TMC out of which the divertible quantity was only 44 TMC at FRL +148.00 m as against the proposed allocation & utilization of 160 TMC. In order to make the project functional and achieve the contemplated benefits and effectively utilize the Telangana state's share in Godavari Basin, an alternate location of barrage across river Godavari has been identified at 20 km downstream of Confluence of Pranahita and Godavari at Medigadda near Abatipalli (V), Mahadevpur (M) of Jayashankar Bhupalapalli District. with FRL +100 m.

5.1 After Re-Engineering, the project has been divided into two parts. (1) Dr.B.R.Ambedkar Pranahita Project to divert 20 TMC of water by constructing a barrage across river Pranahita near the confluence of rivers Wainganga and Wardha at Tummidihetti (V), Koutala (M), Adilabad District for irrigating an ayacut of 2 lakh acres in East Adilabad district against the original proposed ayacut of 56,500 acres in the district. (2) Kaleshwaram Project which envisages diversion of 195 TMC of water by construction of barrage across river Godavari at Medigadda near Kaleshwaram, and two more barrages between Medigadda and Yellampally Project at Annaram & Sundilla villages and to convey water to the command area spread over in 13 districts of Telangana through components such as canals, tunnels, open and under ground pump houses, pressure pipelines, lift systems, reservoirs, and distributary network for irrigating an ayacut of 18.25 lakh acres and stabilisation of another 26.76 lakh acres under existing projects viz Mid Manair (2,20,000 Ac), Singur Project (40,000 Ac). Nizamsagar Project (2,31,339 Ac), Sri Rama Sagar Project (SRSP) Stage-I and II (13,66,000 Ac), Kadem (68,000 Ac), Flood Flow Canal (1,00,000 Ac), Yellampalli Lift (1,51,000 Ac) Minor Irrigation tanks and Check Dams (5,00,000 Ac) Storage capacity of online reservoirs in earlier proposal was only 14.73 TMC. CWC made it clear in 2008 that capacities of online reservoirs should be increased or some more artificial reservoirs had to be created to fulfil the objectives of the project. The suggestion of CWC was ignored by combined state of AP. As suggested by CWC, in order to overcome the deficiencies, the storage capacities of proposed 18 online reservoirs had been increased to 141 TMC. The water required for the project is proposed to be drawn from the main Godavari River near Medigadda and will be transferred to Yellampally Balancing Reservoir. Under this, water conveyance system of three barrages and three Pump houses are proposed for drawing 2 TMC per day initially and 3 TMC per day subsequently. Accordingly, the Pump houses and the conveying systems have been designed. The total cost approved for these barrages, pump houses, Reservoirs, Tunnels, Open and Underground pump houses and associated water conveyance systems in 7 links is Rs. 80,190 crores. A memorandum of understanding was signed on 8th March, 2016 by the Chief Ministers of Telangana and Maharashtra states. This agreement has facilitated for the construction of barrage at Medigadda on river Godavari from where pumping of river water is planned. A three tiered institutional mechanism at Technical, Administrative and Political levels was constituted under this agreement. This agreement has been acclaimed as land mark in collaborative spirit to settle water disputes among the riparian states.

6. KALESHWARAM PROJECT

The conveyance system of Kaleshwaram project has been divided into seven links and works are being executed accordingly (see the line diagrams at ANNEXURE-II & III). All the works connected with these barrages and pump houses in links 1 & 2 have been completed in record time of three years and works in other links are under hectic progress. Consortium of Public Sector Banks led by Andhra Bank and Punjab National Bank and Power Finance Corporation are extending financial support to Kaleshwaram Project. A Special Purpose Vehicle by name of Kaleshwaram Irrigation Project Corporation Ltd. has been set up for this purpose. Taking the topographical advantages in to consideration reverse pumping is planned to pump water against the flow the Godavari river and store water in three barrages well within the river banks. To restrict water spread area within the banks guide bunds are constructed on either side of Godavari river. Higher rating pumps of 139 MW and 124 MW have been installed in underground pump houses to pump 2 TMC per day. These pumps are considered to be the largest capacity pumps installed in any of the lift irrigation projects in the world. Underground 400 KV gas insulated substation is constructed in link-II of the project.

6.1 Water Utilisation in the Kaleshwaram Project

- For Irrigation of new Ayacut : 134.5 TMC
- For Stabilisation of Ayacut under Existing projects i.e. SRSP, Nizam Sagar, Singur, FFC, Kadem, MI Tanks (to meet 25% deficit) : 34.5 TMC
- Water Supply to Hyderabad City : 30 TMC
- Drinking Enroute Villages and Towns : 10 TMC
- Industrial Usage : 16 TMC
- Evaporation losses : 12 TMC
- TOTAL : 237 TMC

6.2 Salient Features of Kaleshwaram Project

Sl.No	Items	Features
1	Total Length of the Conveyance System (km)	1832Km
	(a) Gravity Canal (km)	1531km
	(b) Tunnel Gravity (km)	203km
	(c) Pressure Mains (km)	98 km
2	Lifts & Static lift	20 & 520 m
3	Pump Houses	21
4	Power Demand	4959 MW
5	Maximum capacity of Pump installed	139 MW
6	Energy required	13558MU
7	No of existing online balancing reservoirs	5 no's
8	Proposed new online reservoirs	15 with total capacity 141 TMC
9	No. of Barrages	3
10	Works Spread over	13 Districts, 7 Links, 29 Packages
11	Irrigation benefits	18.25 lakh Acres (New) 26.76 lakh Acres (Stabilization)
12	Estimated Cost Approved by CWC	Rs. 80,190 Crores
13	Benefit Cost Ratio	1:1.51

6.3 Material Used in Kaleshwaram Till June - 2019

- Cement : 42.60 Lakh MT.
- Sand : 80.76 Lakh Cubic Mtrs.
- Steel : 4.08 Lakh MT
- Coarse aggregate : 161.54 Lakh Cubic Mtrs.
- Concrete : 175.58 Lakh Cubic Mtrs.
- Earth Work : 2602 Lakh Cubic Mtrs.
- Man Power Employed (Maximum) : 58454
- Land Acquisition : 51782 Acres

7. MALLANNA SAGAR - THE MOTHER RESERVOIR

It is proposed to irrigate 18.25 lakh acres of new ayacut and 26.76 lakh acres of stabilization under the existing Projects of SRSP, Nizamsagar, Singur, FFC, Kadem and Minor Irrigtion tanks in Kaleshwaram Project. Irrigation needs of 62 % of new ayacut under Kaleshwaram project are to be met from Mallanna Sagar, an online artificial reservoir. Apart from irrigation it is proposed to supply 30 TMC to Hyderabad city needs and 16 TMC for industrial needs and these are to be met from Mallanna Sagar reservoir. For the realization of contemplated benefits, it is thought that there is need of a Mother Reservoir having higher capacity. Mallanna Sagar reservoir is chosen as mother reservoir as it is located at an altitude of 557 m above MSL. There is a need of 100 TMC water beyond Mallanna Sagar. Therefore, Mallanna Sagar reservoir capacity has been enhanced to 50 TMC from 1.5 TMC in anticipation that 50 % of required water is stored at a higher altitude. Beyond Mallanna Sagar there is another reservoir called Konda Pochamma Sagar having capacity of 15 TMC. This increase of Capacity of Mallanna Sagar reservoir led to a debate.

7.1 The apprehensions were related to submergence and displacement of people, the location of reservoir got sub surface lineaments and the proposed high earth bunds susceptible to breaches. The reasons for hue and cry over Mallanna Sagar from the critics of the project is mainly on submergence and displacement of people and as it is an artificial reservoir being constructed at a location supposed to be having sub surface lineaments and with huge earth bunds which are susceptible to breaches. While designing Mallanna Sagar reservoir utmost care has been taken so that submergence and displacement is as minimum as possible. Mallanna Sagar is designed meticulously to minimize submergence and displacement. The smaller reservoirs having less capacity had submerged large areas and displaced more number of villages and families than Mallanna Sagar. Therefore the concerns expressed by the critics on the submergence and displacement has no rationale.

7.2 It is a fact that Mallanna Sagar is an artificial reservoir. It is not new in the country or in the combined state of Andhra Pradesh. Many artificial reservoirs viz Kandaleru Reservoir with 68 TMC capacity, Gorakallu Reservoir with 10 TMC capacity,Veligonda Resevoir with 41 TMC capacity, Velugodu reservoir with 17 TMC, Brahmamgari Matham Reservoir with 17 TMC capacity, Owk Reservoir with 7 TMC capacity, Alugunuru Reservoir with 3 TMC capacity were built in combined state of Andhra Pradesh across small streams in Jalayagnam Program in Rayalaseema region of the state having storage capacities much more than the yields of those streams. CWC had categorically suggested to increase capacities of online reservoirs in the project either by creating artificial reservoirs or by increasing the capacities of existing online reservoirs. The suggestion of CWC is complied with while planning Kaleshwaram Project. Considering other technical parameters and requirements Mallanna Sagar capacity has been increased to 50 TMC from 1.50 TMC as discussed above. With the phenomenal advancement of science and technology, now, large scale pumping of water is not a big issue. Telangana State due to various historical, political, climatological and geographical reasons has to depend invariably on big lift irrigation schemes. Hence, the big storages are also essential. It is to be kept in mind that the proposed capacity of 50 TMC is a minuscule quantity when compared to such other reservoirs elsewhere in India and the world.

7.3 The Critics of Mallanna Sagar say that the reservoir is located where sub surface lineaments are supposed to be existing. A reservoir of 50 TMC capacity and standing water column to a height of about 50 m would induce tremors in the reservoir area which inturn cause heavy damage to lives and properties around the reservoir in case it is breached. They are citing Koyna dam in Maharashtra State where, they say, standing water in the reservoir induced tremors occurred in 1967. This is baseless allegation. Govt got examined the sub surface strata at the Mallanna Sagar dam area by the Central Water and Power Research Station (CWPRS), Pune and ruled out the existence of lineaments as claimed by the critics. Prior to the detailed sub strata examination by the CWPRS, reconnaissance and LiDAR survey was conducted in and around the reservoir area by WAPCOS, a Govt of India Organization, which prepared Detailed Project Report for Kaleshwaram Project. Analysed borehole data extracted from hundreds of boreholes driven on dam line and within in the submergence area. No lineaments and loose strata were found to be existing in the reservoir area. It is a normal practice to rule out such lineaments, faults, and loose sedimentation strata beneath the dam line for safe foundation. Project authorities had carried out all mandatory geological tests under the guidance of Geological Survey of India to confirm that sub surface strata beneath the dam line is safe for formation of gigantic earth dam of 50 m height. Engineers of Central Designs Organization of Telangana State Irrigation Department had visited similar earth dams constructed at Brahmamgari Matham reservoir in Rayalaseema region of Andhra Pradesh State and Turial Dam in Mizoram in North Eastern India. They have meticulously studied the problems encountered in the design and construction those high earthen dams before finalizing the designs of Mallanna Sagar earth dam.

7.4 As far as history of earth quakes is concerned, Telangana Region had no history of earth quakes or tremors. In India, Himalayan ranges, North Eastern region, Western and Eastern Ghats, Vindhya Hill ranges had history of earth quakes and tremors. Telangana State is centrally located in Deccan Plateau which is having thick igneous rock strata which are stated to be less prone to tectonic movements. Seismologists classified India into five zones in terms of magnitude of possible earth quakes. Areas which fall in Zones 1, 2 and 3 are less prone to seismic effects and areas which fall in zones 4 and 5 are highly seismic. 80 % of Telangana region falls in zone 2 and 20 % areas in zone 3. Location of Mallanna Sagar falls in Zone 2.(See the map of Seismic Zones of India at ANNEXURE-IV).

8. BIG RESRVOIR PROJECTS – AGITATIONS & REPERCUSSIONS

Whenever governments plan to construct major irrigation development projects, environmentalists are raising voice against these projects. Agitations were launched against these projects, some of which continued for decades. They propose development of minor irrigation sources, watershed schemes as alternatives to major dam projects. Agriculture in India is dependent on monsoon rains and Indian rivers have inflows in four months of monsoon season viz June to September only except small inflows in Himalayan rivers after monsoon season due to melting of snow in Himalayan mountain ranges. During these four months Indian rivers receive heavy inflow and by end of October they become dry. To harvest these heavy inflows we need to have dams of bigger capacity to sustain irrigation needs of Rabi crops and drinking water needs of millions of people.

8.1 Till the end of 17 th century, there was no technology to harvest these monsoon inflows by building big dams and resorted to building of minor irrigation tanks on local streams. Tank building was age old tradition in India, especially in South India. Small tanks cannot sustain agriculture in rabi season and drinking water needs in summer season. Whenever monsoon failed country faced acute drought conditions. After the advent of Dam building Technology in early 18 th century, construction of big dams, Anicuts across major rivers like Ganga, Yamuna, Godavari, Krishna, Cauvery etc began. By the end of 20 th century thousands of major and medium dams were built on all major and medium rivers in India. In Telangana region big dams like Nizamsagar across Manjira River, Kadem Dam across Kadem River, Anicuts like Sadarmatt across river Godavari, GhanpurAnicut across Manjira, Medium Projects like Pocharam, Paleru, Wyra, SaralaSagar, Dindi were built during Nizam era. After independence big dams like NagarjunaSagar, SriramSagar, Srisailam, Jurala, Yellampalli dams were built by erstwhile State of Andhra Pradesh displacing hundreds villages and thousands of people. Big dams like BhakraNangal, Hirakud, DamodarVally projects were built in other Indian states. There were no major agitations erupted against these projects. Projects which were planned in the last two decades of 20 th century had to face strong resistance from the environmentalists and Project Displaced Families (PDF) as well. Among these, agitations against Tehri dam across Bhagirathi river in Uttara Khand region and SardarSarovar, Indira sagar and Omkareshwer dams built across Narmada river in Madhya Pradesh and Gujarat Statesattracted the attention of the nation and got much publicity in national and international media. The agitations could halt the construction of dams for a decade or so and costs of these projects were increased manifold. Ultimately with the political will of the state governments, these dams were completed and started giving their contemplated benefits in staged manner. The icons of these agitations were felicitated with International awards and got the celebrity status.

8.2 Countries like India, which are dependent on monsoon rains for its water needs, invariably have to construct big multipurpose storage reservoirs. Small tanks and watersheds can satisfy local needs limited to a village or two. These small water resources cannot guarantee huge power requirements, food security of vast increasing population of the country and cannot mitigate devastating flood damages being experienced by country every year in monsoon season. To face drought situations and to mitigate the flood damages big storage dams on big rivers are necessary.

8.3 It is a fact that if big storage projects like Bhakra Nangal, Nagarjuna Sagar, Sriram Sagar, Hirakud, Damodar Vally Project, Koyna dam and big diversion anicuts like Arthur Cotton Barrage on Godavari, Prakasham Barrage on Krishna River, Grand Anicut on Cauvery river were not built, the country would not have attained self-sufficiency in food production and hydro power generation. Big storage dams have multipurpose benefits such as assured water supply for irrigation, hydro power generation, flood mitigation / regulation, development of inland navigation, Fisheries, tourism etc. Apart from these benefits big dams too have some environmental effects and displacement problems. Governments did not address the problems of displaced families and did not implement the environmental impact management plans properly. The failures of governments in addressing the above issues had attracted the attention of civil societies, NGOs, Peoples organizations to launch agitations against the big dam projects in later decades of 20 th century. They got sympathy and empathy from the communities outside the dam affected areas. Due to the vigorous campaigns of these groups Govt of India had to enact Land Acquisition, Rehabilitation and Resettlement Act (LARR Act) in 2013.Inspite of agitations construction of big dams continued in the country.

8.4 As a part of Integrated Godavari Basin Development Plan Govt. of Telangana is constructing a mother reservoir – MallannaSagar with a storage capacity of 50 TMC with minimum submergence and displacement. As usual Environmentalists raising voice against this reservoir. Kaleshwaram Project is a gigantic multi stage lift irrigation project which caters the agriculture, drinking water, industrial needs in 20 districts of Telangana State a mother reservoir like MallannaSagar is required. Facing all kinds of agitations and legal hurdles Govt is going ahead with the construction of MallannaSagar Reservoir.

9. SERIES OF BARRAGES ON GODAVARI RIVER

Downstream of Medigadda barrage Govt proposed another barrage at Tupakulagudem village on Godavari River after the confluence of Indravati. The purpose of this barrage is to create pondage to Devadula lift irrigation scheme which was commenced long back. Earlier there was no pondage for the scheme and pumping is possible only when Godavari flows at +71 m and above. Project was contemplated to lift water for 170 days but hardly 90 – 100 pumping days are available in Godavari and the project is unable to serve its purpose. Now there will be a system of series of 5 barrages from Yellampalli to Tupakulagudem on river Godavari which will rejuvenate Godavari for a length of 170 km and 61 TMC of water will be stored well within the banks of river Godavari throughout the year. Sadarmatt barrage is under construction on river Godavari 42 km downstream of Sriram Sagar Dam. Back waters of Sadarmatt barrage extends to a length of 17 Km. SRSP back water extends to a length of 90 km. Downstream of Sadarmatt barrage upto fore shore of Yellampalli there is a gap of 140 km. In this reach Godavari bed fall is very steep and to keep the submergence within the river banks we need to construct another 10 barrages to have continuous water storage. Similar gap is there downstream of Tupakulagudem barrage to existing Dummugudem Anicut in Khammam district. From Kandakurti in Nizamabad district upto Dummugudem anicut in Khammam district, the length of Godavari is about 500 km. Out of this, Godavari river will be rejuvenated in a length of 275 km with the completion of proposed barrages i.e Sadarmatt, Sundilla, Annaram, Medigadda, Tupakulagudem and existing dams i.e SRSP and Yellampalli having a storage capacity of 154 TMC within the river banks. (See map at ANNEXURE-V)

10. NEED TO INCREASE PER CAPITA WATER AVAILABILITY & PER CAPITA STORAGE CAPACITY

Rapid climatic changes are occurring across the globe. One of the main reasons for the phenomena is degradation of vast forest cover year after year. It is estimated that between 2000 and 2012 , 2.30 million sq. km of forests around the world were cut down. An area size of a football pitch is cleared from Amazon rain forests every minute. It is estimated that in 2018 3.60 million hectors of tropical forest was lost. Deforestation is a major contributor to global warming and effects water cycle. This has got tremendous impact on the South Asian Countries like India, Bangladesh, Pakistan, Sri Lanka, Nepal, Myanmar and others. The economies of these countries are dependent on South – West Monsoon and due to rapid climatic changes monsoons are delayed or rainfall distribution has become erratic. A few decades ago monsoon rainfall used to be uniform and evenly distributed during the four months of monsoon period. Now, though quantum of annual rainfall is same, rainfall days are drastically reduced to 25 to 30 days. Rainfall do not occur for two months continuously and people have to face drought. Torrential heavy rainfall occurs for few days, rivers would receive heavy inflows and floods ruin the properties and lives of people. Again rains go away for weeks and months. People again have to face drought. Author categorically pointed out that this kind of Drought-Flood-Drought phenomena is being faced by the people regularly across the country for many years. This year we have seen this situation. No rains in June, July and till mid-August. Heavy rains since mid-August and September. Rivers received heavy Inflows and severe floods occurred in north Indian Rivers like Ganga and Brahmaputra. Most of the north Indian and north eastern States crippled in the floods.

10.1 To overcome these Drought-Flood-Drought situations, we need to increase Per capita Water Availability and Per capita Storage capacity. In India it is far less than the countries like Russia, Australia, America, Brazil, China etc. The below table gives the details.

Country	Per Capita Water Availability (Cubic Meters)	Per Capita Storage Capacity (Cubic Meters)
Russia	31,883	6103
Australia	21,764	4733
Brazil	41,865	3145
USA	9802	1964
Turkey	2890	1739
China	2060	1111
India	1545	210

Source : A.B. Pandya, Role of Storages and Basin Management Strategies in India

10.2 If the per capita water availability comes down to 1700 cubic meters it is an indication of water stress situation. If the per capita water availability comes down to 1000 cubic meters, it indicates there is water scarcity. Russia has four times more per capita water availability per year than the water stress indicator of 1700 cubic meters and it can sustain four consecutive drought years. Australia can sustain three consecutive droughts. Whereas India can sustain drought situation for 3-4 months only as its per capita water availability and per capita water storage is very less. We have no sufficient storage reservoirs on major rivers in India like Ganga, Brahmaputra and other rivers. Water in huge quantities is going waste into the seas unutilized every year. Brahmaputra River is estimated to be about 18,600 TMC. The irony of the situation is that in spite of these two rivers having huge dependable yields, due to lack of storage reservoirs on these rivers, water in huge quantities going into Bay of Bengal creating havoc during floods. Though the Godavari and Krishna Rivers, the peninsular rivers, are small in size when compared to Ganga and Brahmaputra, storages are much better. It unbelievable that river Brahmaputra which has 18600 TMC dependable yield has storage capacity of about 84.72 TMC only. Similarly Ganga having 18000 TMC dependable yield has a storage capacity of about 1992.68 TMC only. Whereas the Godavari having 4156 TMC dependable yield has storage capacity of 1541 TMC and Krishna having dependable yield of 3143 TMC has storage capacity of 1920 TMC (slightly less than Ganga). North Indian and North Eastern rivers do not have sufficient storage reservoirs and hence the people of these regions are inevitably subjected to Drought-Flood-Drought kind of situations every year.

10.3 If sufficient storage reservoirs are not built across major rivers in India, country has to face severe threat to water security (both drinking water and irrigation water) and thereby threat to food security. India's National Water policy gives first priority to Drinking Water and then Irrigation and other needs. In this respect, it is to be noted that Telangana State is going in a right path which would enhance per capita storage capacity in the state thereby ensuring reliable drinking water to entire population in the state and irrigation water for one crore acres in Telangana State as envisaged in National Water Policy. Hon'ble Chief Minister KCR has appropriately realized the need of storage reservoirs in the lift irrigation schemes at the time of re-engineering of projects. Peninsular rivers do not have inflows after monsoon period and they are almost dry for eight months. After monsoons recede we need to supply water to all kinds of human needs viz drinking water, irrigation, industrial use etc from these storages. It is to be mentioned here that combined state of AP

did not consider formation of storage reservoirs while formulating lift irrigation schemes in Telangana. After formation of Telangana, as a part Re Engineering, reservoirs are proposed with sufficient storage capacities. Kaleshwaram project is having storage capacity of 141 TMC after re-engineering against to 14.73 TMC in Pranahita- Chevella. Similarly 68 TMC storage reservoirs are proposed in Palamuru–Rangareddy Lift Irrigation Project and 25.56 TMC storage reservoirs are proposed in Dindi Lift Irrigation Project. Chief Minister has issued instructions to search for suitable locations for formation of storage reservoirs in all the projects. 5.36 TMC Kupti reservoir on kadem River upstream of Kadem Project, 10 TMC Lingampalli reservoir in Devadula Lift Irrigation Project, 1.50 TMC Pippalkoti reservoir and 0.70 TMC Gomutri reservoir in Penganaga project were already approved by the Govt. Investigation for identifying suitable locations for formation of reservoirs in Kalwakurti Lift Scheme is going on. A proposal of enhancing the capacity of existing Dummugudemanicut is under study for reliable water supply to ayacut in Khammam district under Sitarama Lift Irrigation Project. 1.80 TMC capacity Sadar Matt Barrage (below SriramSagar Dam) and 7 TMC capacity Tupakulagudem barrage (below Medigadda barrage) are under construction on Godavari River. There is possibility of storing about 450 TMC within the radar of Kaleshwaram Project which is designed as a part of an Integrated Godavari Basin Development Plan. This may be considered as an activity undertaken by Govt of Telangana in accordance with the debates being held at International level in regard to per capita storage and per capita water availability.

11. DEVELOPMENT OF INLAND NAVIGATION

Newly proposed barrages in Kaleshwaram Project have been designed with a provision of ship locks. Govt of India has identified Godavari River as one of the potential rivers for developing in land navigation from Sri Ram Sagar Project to Bay of Bengal. Govt of Telangana has already taken up 5 barrages on river Godavari. To fill up the gaps as explained above, Govt of India need to invest for development of in land navigation in Godavari River. As of now, with the rejuvenation of Godavari River, there is a big scope for development of in land navigation from Yellampalli to Tupakulagudem in length of 170 km. With the completion of these barrages 61 TMC storage is possible in this reach which enable to develop fishing activity and establish fish food processing industries. The then Union Minister for Road Transport and Water Resources Sri Nitin Gadkari had announced in a public meeting in Hyderabad on 5 May ,2018 that Govt of India is keen for development of inland navigation in Godavari river from Nasik to Bay of Bengal. To carryout preliminary works GOI has allotted 2000 Crores. Govt of Telangana has already started investing about 15,000 crores on the barrage structures for its irrigation needs which can also be utilized for in land navigation in future as contemplated by Govt of India.

12. DEVELOPMENT OF TEMPLE AND ECO TOURISM

Kaleshwaram temple town on the banks of Godavari is believed to be Triveni Sangamam of Godavari, Pranahita and Saraswati, a river which joins here underground (Antarvahini). Kaleshwara Mukteshwara temple in Kaleshwaram is an old pilgrim place and thousands of pilgrims visit the temple every year to pay tributes to their departed family members and have a darshan of Shiva Linga. The speciality of this Shiv Linga is two Lingas on one panapatta and it is believed that lord Yama installed this Shiv Linga here because of which it is called Kaleshwara Mukteshwara Temple. Vemulawada Raja Rajeshwara temple is very near to Yellampalli barrage in Karimnagar district. Vemulawada temple town is known as Dakshina Kashi. A famous Laxmi Narasimha Swamy temple is located in Dharmapuri on the foreshore of Yellampalli reservoir on river Godavari. Many Buddist sites like Kotilingala and Dhoolikatta are very near to the project site. Therefore, there is big scope for development of Temple tourism and Eco Tourism in Kaleshwaram Project area.

13. MANCHESTER OF THE EAST

Establishment of Industries and development of Tourism in the area will enhance employment opportunities to the local people. Erstwhile Hyderabad Nizam rulers had plan to develop an industrial corridor in Ramagundam coal belt area which was described as Manchester of the East. Soon, with construction of Kaleshwaram Project the dream of Industrial development in the backward districts of Telangana State is becoming a reality. Govt allocated 16 TMC for Industrial use from Kaleshwaram Project.

14. DEVELOPMENT OF AGRICULTURE, DRINKING WATER & FISHRIES

Fishing communities in this area will largely get economic benefits. Bio diversity, Flora & Fauna will be increased in and around the area with the rejuvenation of Godavari River. 18.25 lakh acres of new ayacut and 18.82 lakh acres under existing projects in various districts will get irrigation water from Kaleshwaram Project. Hundreds of villages and towns will get assured and safe drinking water supply from Kaleshwaram Project under Mission Bhagiratha drinking water supply scheme as 10 TMC is allocated for drinking water in Kaleshwaram Project.

15. BENEFIT-COST RATIO (BCR)

Benefit-Cost Ratio (BCR) of a project is an indicator used in cost-benefit analysis that attempts to summarize the overall value for money of a project or proposal. The higher the BC Ratio the better the investment. General rule of thumb is that if the benefit is higher than the cost the project is a good investment. It is estimated that Total Annual Benefits from the project would be Rs. 21,521.25 Crores and total annual cots on the project would be Rs.13, 923.11 Crores.

Thus the benefit cost ratio of the project is worked out to 1:1.51. CWC has also agreed to the calculations of BCR of the project. When the project is completed and start giving benefits, metamorphological changes will take place in the socio economic conditions of people in Telangana state especially in project benefitted areas. Social Scientists say that the critics of Kaleshwaram Project are deliberately ignoring the larger socio-economic benefits of Kaleshwaram project, for example, development of fisheries, inland water ways, tourism, biodiversity, Hyderabad Urban Development etc. Terming Kaleswaram Project as a white elephant by the critics, thus, looks like a narrow presentation of facts while ignoring the social and environmental benefits of the project for good of the people of Telangana."

16. URBAN DEVELOPMENT AND INDUSTRIAL SUSTAINABILITY:

Apart from Irrigation Development, urban Development and industrial sustainability is also envisaged while planning the Kaleshwaram Project. 30 TMC of water is allocated to the future needs of Greater Hyderabad city, 16 TMC of water is allocated to the industrial needs and 10 TMC of water is allocated to the drinking water needs of en route villages which is made available to the people through Mission Bhaghiratha, an ambitious flagship program of Govt. of Telangana being implemented with an objective to supply safe drinking water to every house hold in the state. Now 10 TMC of water is being supplied to Hyderabad city from Yellampalli Project which is an important balancing reservoir in Kaleshwaram system through a separate pipeline for Hyderabad Metro Water Supply & Sewerage Board. Hyderabad today is one among the leading cities and one of the fastest growing cities in the country. Greater Hyderabad Municipal Corporation area spreads in 620 sq. km and the Hyderabad Metropolitan Region is spread over 7200 sq kms. Hyderabad city is an economic hub for the state and the country as well which houses IT and Pharma industries. It also generates around Rs.60,000 crores revenue every year through taxes of different kinds GST, Excise, Transport and Registrations etc making it an economic power house of Telangana State. The 1991 population of Hyderabad (broadly municipal area) was around 4 Million. By 2001 it went up to around 6 million. As per the 2011 Census, population is around 8 million within the limits of GHMC. The overall population in the Metropolitan Region spread around 7200 sqkms is estimated to be around 14 million as on 2018. Keeping in view the envisaged economic growth pattern of Hyderabad the population is bound to grow steadily. It is projected that the Hyderabad metropolitan city region will have around 24 million population by 2031 and around 32 million by 2041. Availability of water will play a key role for sustaining this tremendous growth.

16.1 It is estimated by the Hyderabad Metro Water Supply and Sewerage Board (HMWS&SB) that the total water requirement for projected population of 32 million in the year 2041 would be around 94 tmc (@150 lpcd. It is pertinent to mention that Hyderabad Metropolitan Region lies within the Krishna basin. Presently, about 16.5 TMC is drawn from main river Krishna for the domestic needs of the city region. Further, it is planned to draw more water from ongoing schemes on river Krishna. However, keeping in view of the rapid growth of Hyderabad Metropolitan Region and to meet the exigencies, it is also planned to draw water from Godavari River through Kaleshwaram Project. With depleting resources worldwide, lack of water becomes a major hurdle for economic growth and sustainable urbanization. Climate change, change in rainfall patterns, droughts and large scale urbanization need to be factored in to plan the future requirements of water. 30 TMC water from Kaleshwaram projects would certainly be a great support for the sustainability of Hyderabad urban development and industries in the coming decades.

17. GROWTH ENGINE OF TELANGANA STATE

It is envisaged by the engineering experts and economists that Kaleshwaram project would become a growth engine of Telangana State as Three Gorges dam to China though it is very small in magnitude when compared to China's TGD. It is a gigantic lift irrigation project in India which can lift 2 TMC (Civil structures are designed for future expansion to create lifting capacity of 3 TMC per day) per day to a static head of 520 meters. 139 MW Capacity pumps and motors are installed in the project. Nowhere in the world such high capacity pumps and motors are used in the world in any project, as per Lift irrigation Experts. Construction of Kaleshwaram Project is going in a record pace. More than 20,000 cubic meters of concrete was laid day in the project in a day which is second largest concrete consumption in a day after Three Gorges dam which consumed 22000 cubic meters of concrete in a day. More than 1,50,000 cubic meters of earth was excavated daily in the project.

17.1 Various ministries of Govt. of India have already accorded all important clearances like Interstate, Hydrology, Ground Water, Environmental, Forest, Irrigation Planning, Cost Estimates etc. within a record time of one year. Re-engineering of project made this possible. Three Gorges dam in China and Aswan High Dam in Egypt were built against all odds and tremendous opposition from environmentalists world over. With the strong determination and political will of the then Chinese Premier Li Peng and Egypt President Abdel Nasser, these two gigantic projects could stand on the earth and became growth engines of their respective countries. Kaleshwaram Project is being built against all odds similar to TGD and Aswan High dam. Though the environmental and social impacts of Kaleshwaram Project are very minimal when compared to TGD and Aswan High dam, 197 court cases were filed on Kaleshwaram Project in various courts upto Supreme Court. Two cases were filed in National Green Tribunal. It might be a record that so many cases were filed on a single project in the country which got all clearances from Got. of India. With the unbeatable determination and political will of Hon'ble Chief Minister Sri. K. Chandrasekhar Rao and continuous persuasion and monitoring of the then Irrigation Minister Sri T. Harish Rao, the project is moving ahead with a definite time schedule. As programmed,

pumping of water from Godavari at Medigadda has commenced on 21 June, 2019 and filled up Yellampalli and Mid Maner reservoirs. Kaleshwaram Project started giving partial benefits to the farmers. By December 2020 most of the works are programmed to be completed and Telangana will witness a tremendous economic progress and will stand on top in the country in all development indicators. Kaleshwaram Projects will play a key role in achieving the goal of Govt i.e providing irrigation facilities to one crore acres in Telangana state. It is beyond doubt that Kaleshwaram will be the Growth Engine of Telangana State.

18. BENEFITS OF KALESHWARAM PROJECT

- Telangana state can utilise its share in Godavari river water.
- Can lift 2 TMC per day for at least 5 months in a year and 3 TMC per day in future.
- Can store 141 TMC in online reservoirs and supplement to Sriramsagar, Nizamsagar, Singur, Upper Manair, Mid Manair & Lower Manair, reservoirs and minor irrigation tanks in the command areas of above projects as and when there is defecit.
- Irrigation facilities to 45 lakh acres in 13 districts of Telangana State
- Drinking Water supply to Hundreds of enroute villages and towns through Mission Bhageeratha scheme which cater to the drinking water needs of 13 Districts of Telangana State.
- Water supply to Greater Hyderabad City and Industrial use.
- 150 Kms of Godavari River is rejuvenated which would contribute for rising of ground water, development of Inland Navigation, Fisheries, Temple and Eco Tourism, Water Sports and flora and fauna in around project areas.
- Employment and income generation to the local communities

19. CONCLUSION

Kaleshwaram Project is now termed by the engineering experts as the largest Multi Stage Lift Irrigation Scheme in the world having manifold development impacts. Thus, it is treated as Growth Engine of Telangana State with an Integrated Godavari Basin Development Plan.

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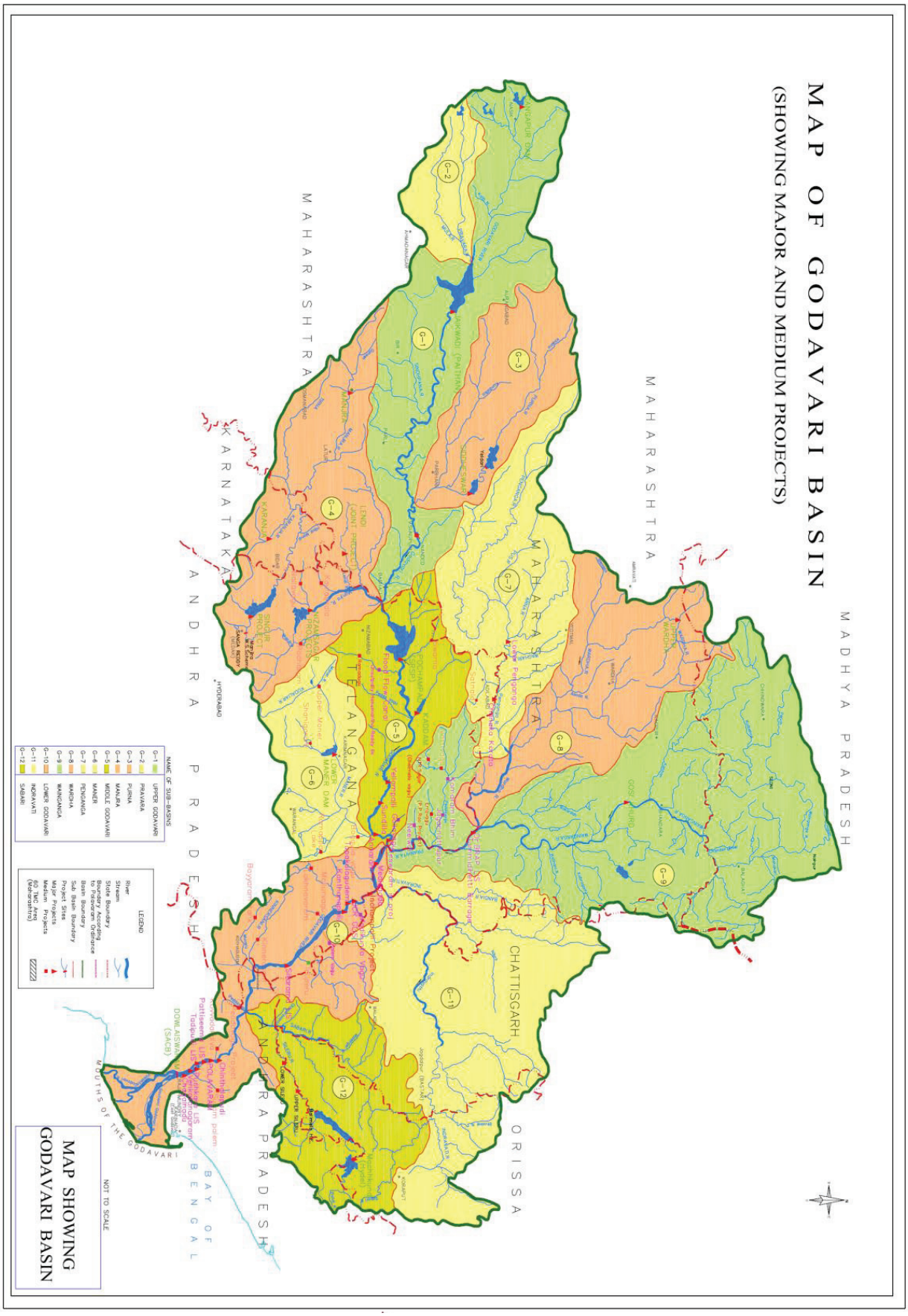
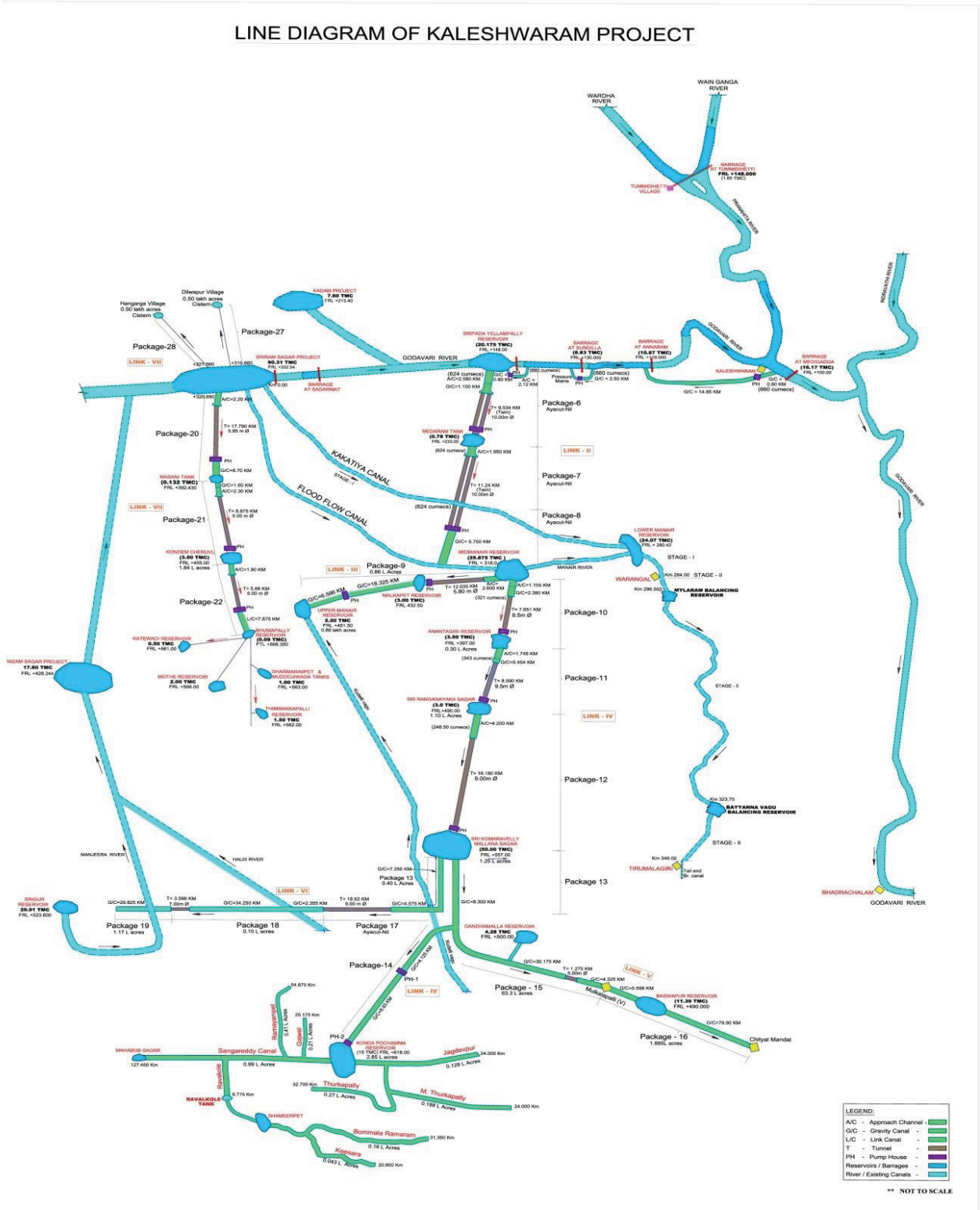
10. WAPCOS, Detailed Project Report of Kaleshwaram Project, on behalf of Govt. of Telangana, 2016.

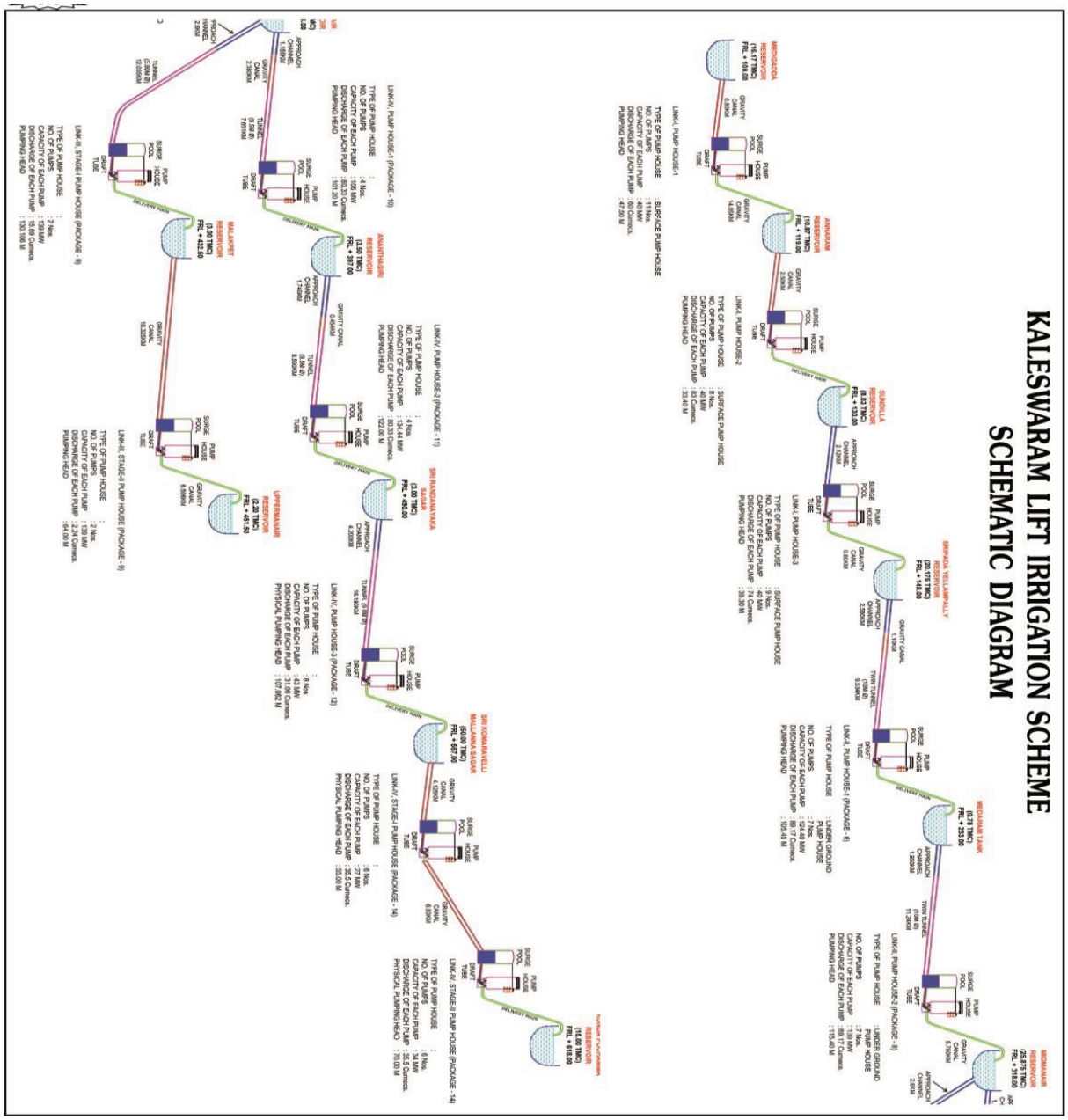
ANNEXURE-I


MAP OF GODAVARI BASIN
(SHOWING MAJOR AND MEDIUM PROJECTS)
MAHARASHTRA
KARNATAKA
ANDHRA PRADESH
TELANGANA
CHATTISGARH
ORISSA
MADHYA PRADESH
BAY OF BENGAL
MOUTHS OF THE GODAVARI
NOT TO SCALE
MAP SHOWING
GODAVARI BASIN

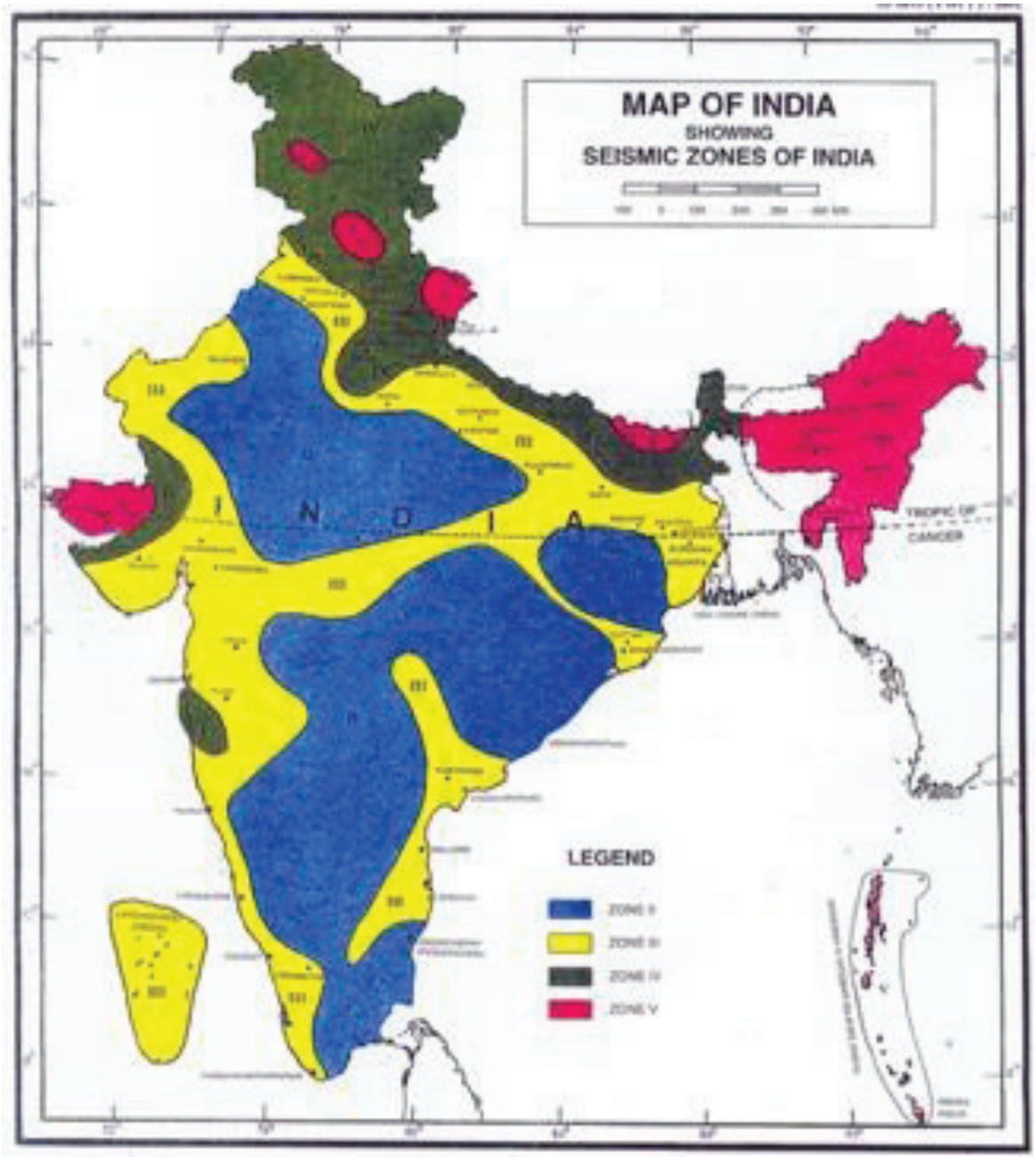
ANNEXURE-II


LINE DIAGRAM OF KALESHWARAM PROJECT
WAIN GANGA RIVER
WARDHA RIVER
PRANHITA RIVER
GODAVARI RIVER
KALESHWARAM
BARRAGE AT MEDIGADDA (16.17 TMC) FRL +100.00
BARRAGE AT ANNARAM (10.87 TMC) FRL +119.000
BARRAGE AT SUNDILLA (6.83 TMC) FRL +130.000
BARRAGE AT TUMMIDIHETTI FRL +148.000 (1.85 TMC)
TUMMIDIHETTI VILLAGE
SRIPADA YELLAMPALLY RESERVOIR (20.175 TMC) FRL +148.00
SRIRAM SAGAR PROJECT 90.31 TMC FRL +332.54
BARRAGE AT SADARMAT
KADAM PROJECT 7.60 TMC FRL +213.40
Dilwapur Village 0.50 lakh acres Cistern
Hanamga Village 0.50 lakh acres Cistern
Package-27
Package-28
Package-20
Package-21
Package-22
Package-6 Ayacut-Nil
Package-7 Ayacut-Nil
Package-8 Ayacut-Nil
Package-9 0.86 L Acres
Package-10
Package-11
Package-12
Package 13 0.40 L Acres
Package 19 1.17 L acres
Package 18 0.15 L acres
Package 17 Ayacut-Nil
Package-14
Package - 15 63.3 L acres
Package - 16 1.885L acres
LINK - I
LINK - II
LINK - III
LINK - IV
LINK - V
LINK - VI
LINK - VII
KAKATIYA CANAL
STAGE-I
FLOOD FLOW CANAL
MEDARAM TANK (0.78 TMC) FRL +233.00
MASANI TANK (0.132 TMC) FRL +392.430
KONDEM CHERUVU (3.50 TMC) FRL +405.00 1.84 L acres
MALKAPET RESERVOIR (3.00 TMC) FRL 432.50
UPPER MANAIR RESERVOIR 2.29 TMC FRL +451.00 0.66 lakh acres
ANANTAGIRI RESERVOIR (3.50 TMC) FRL +397.00 0.30 L Acres
SRI RANGANAYAKA SAGAR (3.0 TMC) FRL+490.00 1.10 L Acres
SRI KOMMAVELLY MALLANA SAGAR (50.90 TMC) FRL +557.00 1.25 L acres
MIDMANAIR RESERVOIR (25.875 TMC) FRL + 318.0
LOWER MANAIR RESERVOIR (24.07 TMC) FRL + 280.42
MANAIR RIVER
WARANGAL
MYLARAM BALANCING RESERVOIR
BAYYANNA VAGU BALANCING RESERVOIR
TIRUMALAGIRI
BHADRACHALAM
GODAVARI RIVER
STAGE - I
STAGE - II
KATEWADI RESERVOIR 0.50 TMC FRL +561.00
MOTHE RESERVOIR 2.00 TMC FRL +568.00
RAVINDRAPALLY RESERVOIR (5.09 TMC) FRL +568.300
DHARMARAOPET & MUDDOJIWADA TANKS 1.00 TMC FRL +563.00
THIMMAKKAPALLI RESERVOIR 1.50 TMC FRL +552.00
NIZAM SAGAR PROJECT 17.80 TMC FRL +428.242
SINGUR RESERVOIR 29.91 TMC FRL +523.600
MANJEERA RIVER
HALDI RIVER
Kakatiya canal
GANDHAMALLA RESERVOIR 4.28 TMC FRL +500.00
BASWAPUR RESERVOIR (1.39 TMC) FRL +490.000
Chityal Mandal
MAHABUB SAGAR
Sangareddy Canal
Jagdevpur
Thurkapally
M. Thurkapally
Bommala Ramaram
Keesara
RAVALKOLE TANK
Ravelkole
Ramasamudram
Gajwel
KONDA POCHAMMA RESERVOIR (15 TMC) FRL +618.00 2.85 L acres
PH-1
PH-2
LEGEND:
A/C - Approach Channel
G/C - Gravity Canal
L/C - Link Canal
T - Tunnel
PH - Pump House
Reservoirs / Barrages
River / Existing Canals
** NOT TO SCALE

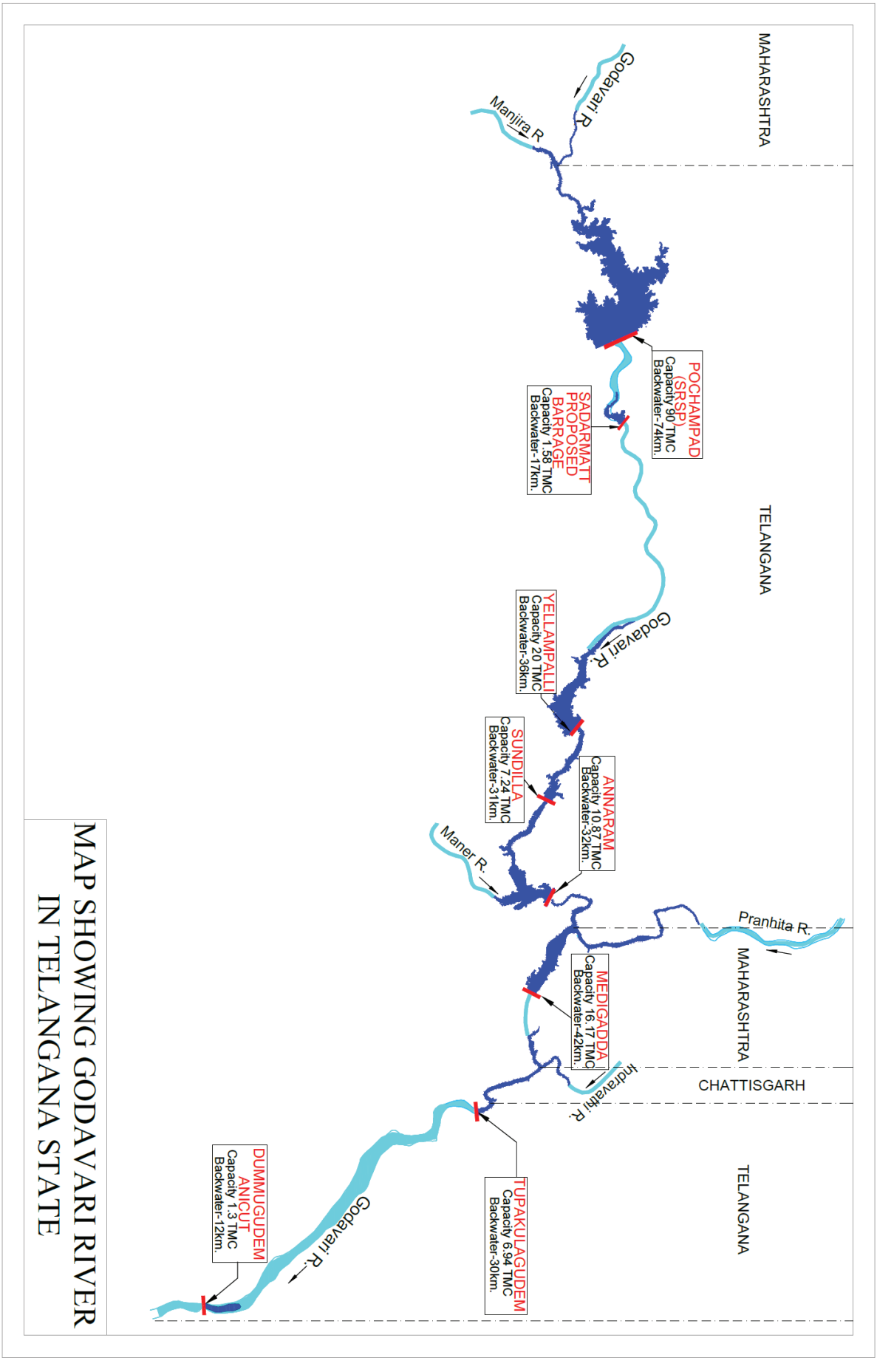
ANNEXURE-III



ANNEXURE -IV


MAP OF INDIA
SHOWING
SEISMIC ZONES OF INDIA
INDIA
TROPIC OF CANCER
LEGEND
ZONE II
ZONE III
ZONE IV
ZONE V

ANNEXURE-V


MAP SHOWING GODAVARI RIVER
IN TELANGANA STATE
MAHARASHTRA
TELANGANA
CHATTISGARH
Godavari R.
Manjira R
POCHAMPAD (SRSP)
Capacity 90 TMC
Backwater-74km.
SADARMATT PROPOSED BARRAGE
Capacity 1.58 TMC
Backwater-17km.
YELLAMPALLI
Capacity 20 TMC
Backwater-36km.
SUNDILLA
Capacity 7.24 TMC
Backwater-31km.
ANNARAM
Capacity 10.87 TMC
Backwater-32km.
Maner R.
Pranhita R.
MEDIGADDA
Capacity 16.17 TMC
Backwater-42km.
Indravathi R.
TUPAKULAGUDEM
Capacity 6.94 TMC
Backwater-30km.
DUMMUGUDEM ANICUT
Capacity 1.3 TMC
Backwater-12km.