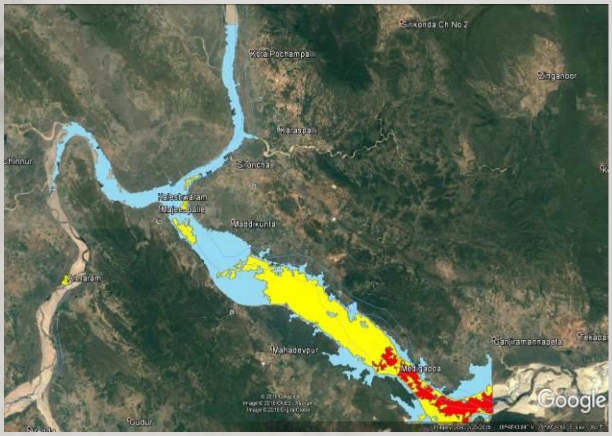
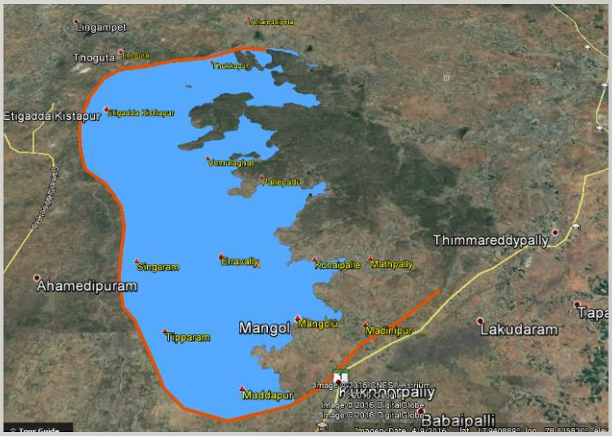
Kaleshwaram Lift Irrigation Project

Will it Benefit Telangana State?





Authors

Dr. Biksham Gujja
Dr. Shiv Kumar
Mr. Raghu Kancharla

Kaleshwaram Lift Irrigation Project

Will it Benefit Telangana State?

This is a draft report. Please send your comments and critical remarks to Mr. Raghu Kancharla at **kancharla.raghu@gmail.com**. The report will be updated after taking into consideration of comments from civil society and publication of DPR by Government of Telangana.

This report has been commissioned by TJAC. The views in this report reflect Authors and not necessarily represent the official position of TJAC on the project.

This report has been prepared by Dr. Biksham Gujja, Dr. Shiv Kumar, and Mr. Raghu Kancharla with help and assistance of Mr. Sraban Kumar Dalai, Mr. Sangameshwar, Mr. Mahesh and Several people have read the draft and made suggestions to improve it. The mistakes and gaps in this report are entirely of the authors. This report has been prepared for assisting the public debate. Those who participated in preparing this report have contributed their valuable time voluntarily and no agency or individual has supported this report preparation.

Report has been prepared in November 2016

Why this report?

This report is a small attempt by individuals and experts to contribute to the process of public debate on large irrigation projects in Telangana. Projects of this magnitude involving tens of thousands of crores and will have implications for generations to come, both good and bad. Public debate on such large projects certainly improves the quality of such project, by reducing the costs, avoiding some social costs; improve the transparency of public spending. That is the experience of the world. There are nationally agreed guidelines before starting such large projects. In case of KLIP, in spite of several times public announcements, there are no project reports and DPRs. In absence of such reports, this report has managed to generate information, analysis and some conclusions about KLIP. The readers may understand the limitation of preparing this report.

This report has several gaps and some inconsistences. The authors are aware of it. For example, certain basic information such as what would be the likely transportation, evaporation and seepage losses at each stage is subject opinion. That information is linked to the power consumption of the project at each stage, then inturn, capital and operational costs. Any figure we mention in this report can be questioned, that is fine. But assuming that there will not be any losses, and every one TMC water lifted at the source will be available for irrigation or drinking at the last point is not correct. But even that aspects seem to be not factored in whatever the information is being released about this project. In absence of any detailed reports, generating information is major challenge. As mentioned earlier, the report is first step towards establish a public debate on this project. We welcome the criticism, content, format, methodology of this report. The report is no way a last word on Kaleshwaram lift irrigation project.

We thank many people who helped the process of putting this information. Sincerely hope, this report will help in understanding the project and participating in public debate.

Your suggestions, views and critical remarks are most welcome. Please contact us at bgujja@hotmail.com or srabandalai@gmail.com

Abbreviation, Explanations, Conversions

KLIP : Kaleshwaram Lift irrigation Project

TMC : Thousand million cubic feet

Ha, ha : Hectares(s), unit of area, which is 2.47 acres

ac : Acre

DPR : Detailed project report

RL : Reduced level, it is height above the mean sea level

MW: Mega Watt, equal to 1,000,000 Watts

MU: Million Units, 1,000,000 Units.

Unit: It is unit of Energy, equal to 1 Kilo Watt Hour. 1 MW power project produces 1000 units every hour.

Water Quantity

TMC or Tmcft: One thousand million cubic feet (1,000,000,000 = 10^9 = 1 billion), commonly used in reference to volume of water in a reservoir

Conversion

Water flow can be converted to quantity of volume

1TMC = 28.316846 MCM

Terminology Ambiguity: Water availability at certain location is popularly expressed in TMC. This means quantity of water flowing at that particular point in one year. TMC is used only in India so it cause major problem in communicating and computing. The CWC data is in cumecs, which is Discharge, means one cubic meter of water is passed through location of measurement in one second. To get one TMC of water in one year, a water flow of 0.9 cumecs every day is required at the gauging station.

Contents

List of Tables

List of Figures

List of Annexures

Details of the gauging stations and proposed pumping stations

Station	Sub basin	Catchment Area (sq.km)
Sirpur	Wardha	47,500
Ashti	Weinganga	50,990
Tummidihatti	Pranahita	
Tekra	Pranahita (53)	108,708
Mancheryal	Pranahita (18)	
Somanpally	Pranahita (39)	
Medigadda	Pranahita (56)	

Executive Summary

Government of Telangana is in the process of constructing Kaleshwaram Lift irrigation Project, KLIP on a priority basis. This project is more or less same as earlier one known as Dr. B.R Ambedkar Pranahita-Chevella Sujala Sravanthi project. This "re-engineered" version of the earlier project has three significant changes (a) Water intake has been changed from Tummidihatti to Medigadda, (b) Increasing the reservoir capacity of Mallannasagar from 1.50 TMC to 50 TMC, and (c) Increase of overall storage capacity from 11.43 TMC to 187.04 TMC by constructing of 22 reservoirs. This project is about pumping of about 180 TMC from Godavari River at the rate of 2 TMC per day from Medigadda and 20 TMC from Yellampally. The water lifted will be transported in order to provide water for irrigation, drinking and for Industry. The height of final pumping is +624 RL, which is almost 525 meters higher than the intake wells at Medigadda (+100RL). The exact quantity of pumping from these locations is constantly changing. The project involves multistage pumping, tunnels, canals, reservoirs and complex web of water transport systems. The distribution system is not clear yet. This is the massive lift irrigation scheme and first of its kind in the country for its height, quantity, stages of pumping, storage systems and the complexity involving in synchronizing all the components.

There is no Detailed Project Report, DPR of the entire project or project reports of its various components. The overall diagram known as 'line diagram', which is very basic and rudimentary. Even this diagram seems to be constantly changing. The project is still evolving at one stage and it is being implemented at another place construction of tunnels is ongoing. In absence of the DPR, several technical, operational and financial aspects of this project are not known. The first challenge for preparing this report is to compile the information which is sketchy and sporadic. Therefore some of the basic figures mentioned in this report do vary from place to place, that is actually the case with available information. It is not about inconsistence of various numbers in this report, but it is more related to lack of information, confusing figures, constant change and no final document from government side. This is seemed to be project with no project document.

The objective of this report is to compile and whatever is available and analyze that information and present it with some observations to assist the public debate.

Water allocations to various uses: The project proposes to provide water to the extent of 225 TMC. Even though the actual pumping is only 200 TMC, the additional water is expected from re-generation (25 TMC) and water from ponds (10TMC). Details and studies about this additional water are not given. There is also an assumption that 10 TMC water is evaporated at various stages. So the net availability through this project for various uses is about 225 TMC, which is very optimistic and actual availability, as and when project is completed will be far less than 225 TMC.

Irrigation: When completed the KLIP, is expected to allocate 169 TMC of water for irrigation. With this water about 18,19,550 acres (7,36,345 ha) in seven districts of Telangana are expected to be irrigated. Again this is far less water, for too much area of irrigation.

Availability of water for pumping: Daily discharge data of CWC has been collected, compiled, analyzed through computer models in order to establish the availability of water. As mentioned earlier, the main change proposed in the KLIP is to pump water from Medigadda, instead of Tummidihatti. This report based on extensive analysis confirmed that there is water at Medigadda for pumping. A calendar has been generated based on last 50 years data. With barrage and storage capacity of about 20 TMC, water can be pumped from 164 days in good rain fall year and 104 days in drought year. So there is water and that water can be pumped to meet the designed pumping requirements. Theoretical studies considering without barrage at Medigadda indicated that 96 TMC of water only can be extracted pumping 46 days @ 2TMC per day.

There is enough water at Tummidihatti based on 50 years discharge data. In the earlier DPR submitted as Dr. B.R Ambedkar Pranahita-Chevella Sujala Sravanthi project also indicated and the same is agreed by CWC. With simple and innovative designs, it is possible draw water from there without leading to submergence of large area in Maharashtra. A storage facility of 10 TMC can be developed with in the territory of Telangana and water can be diverted from Tummidihatti with +148RL barrage. In such case about 200 TMC in 108 days can be drawn with pumping capacity of 2TMC/day with 75% dependability based on the discharge data. By increasing the pumping capacity to 3TMC/day, for 96 days totaling to 288TMC of water can be drawn from Tummidihatti with suitable diversion arrangements. Without storage facility significant decline in the pumping schedule and only about 32 days can be pumped from Tummidihatti. In addition an exercise is carried out whether small barrages with 5.0 TMC storage capacity, further pumping can be taken up downstream of Tummidihatti and Medigadda like the small barrages constructed on Godavari river downstream of Jayakwadi(Paithan dam) in Maharashtra up to SRSP. This report is based on large data, analysis and modeling confirms that there is water and there is enough water for pumping at Tummidihatti, Medigadda and beyond.

The following critical observations have been made on the project which might need additional information, clarity and public discussion

- ***Irrigating 18 lakh ac may be difficult:*** As mentioned earlier, it is not clear how much new area and how much is stabilization of existing area is contemplated in the proposed 18 lakh ac. To understand the magnitude of the proposed irrigation of KLIP, one needs to look into the Annual Statistics of State of Telangana, 2015 year book. For last five years the net canal irrigation area fluctuated between 2,22,928 acres (90,216 ha) and 8,03,876 acres (3,25,317 ha). So the present area irrigated by surface water through canals in entire state is less than 10 lakh ac. All the projects, all the investments so far on major irrigation has resulted in creating less than 8 lakh of net irrigation.. Just one project, KLIP is expected create 18 lakh ac, which is more than the double the area of canal irrigation. For example, in Nizamabad district (before the creation of new districts) itself is expected to get 4,54,000 ac through KLIP. Nizamabad during 2013-14 had net canal irrigated area was 87,428 (35,381 Ha) KLIP will simply increase it by 500%. The existing canal irrigation in Adilabad, Nizambad, Karimnagar, Medak, Warangal, Nalgonda and Rangareddy districts is 4,87,000 ac. This means KLIP is going to increase canal irrigation by 375% in seven districts. That seems to be very ambitious objective! Never before a single project is as ambitious as this to double the canal irrigation with one single project.

- ***The water for irrigation is 160 TMC:*** assuming that this water is available at the end, it would come to 1 TMC of water would serve to 11,370 ac, which is bit of stretch. This is not going to provide irrigation required for paddy, sugarcane or any other serious irrigated crop. So the irrigation will be for the other crops. So while calculating the returns one need to be aware of it. So far Telangana state has created facilities (such as SRSP, Kadam, etc.) to utilize 370 TMC of Godavari water. With this water even in very good monsoon year, never canal irrigation exceeded more than 10 lakh ac that is in all the districts including all the rivers, all the projects. But with 160 TMC of water, that too through pumping want to supply water to more than 18 lakh ac.

- ***Water allocated to sectors may be far more than water available at the end:*** Total water availability for irrigation, drinking and industry at the distribution points of various stages may be far less than what is indicated. Only a meager 10TMC provision for the transport losses, evaporation and the seepages has been made, which could put together, might be around 40%. So the allocated water available for the each purpose might be far less than expected. In order to get 200 TMC of water for various uses, at the starting point of lifting, it should be 40% more, that means in order to get 200 TMC for use, one need to start with 330 TMC or so. This will have implications to capital and operational costs.

- ***Water availability for storage at Mallannasagar?***

  In KLIP it is proposed to augment through Mallannasagar, 90TMC for 8 lakh acres irrigation and 40TMC to Hyderabad and Enroute villages and 16TMC to industry totaling to 146TMC. Assuming 120days of pumping under KLIP, maximum water that can be pumped from Imamabad, where pumping capacity is 0.75 TMC/day, to Mallannasagar would be around 90 TMC. Even if one considers 150days of pumping, only 22.5 TMC of additional water is available falling short of requirement of other uses. Hence there is hardly any possibility of water reaching Mallannasagar reservoir over and above the proposed requirements under KLIP. Thus creation of such large storage to the tune of 50 TMC needs reexamination. In our view, a storage upto 5 TMC meets all the requirements proposed under KLIP.

- ***Structural risks associated with Mallannasagar:*** Normal dam is always across the river, but in this case it is parallel to the stream which would create high hydraulic gradient at the downstream creating water logging and artesian conditions. Major lineament is noticed parallel to the proposed Main bund of Mallannasagar. 40m-60m water column will rejuvenate the entire fracture creating perennial flow that would result in scouring phenomenon from the reservoir. This needs further detailed examination.

- ***Proposed Irrigation in Adilabad and Nizamabad may not be possible:*** It is proposed to draw 32 TMC of water from SRSP foreshore to irrigate about 270000 acres of land in Adilabad and Nizamabad districts, and in lieu of this drop 32 TMC of water at Mid-Manair Dam to reach Lower Manair Dam. When SRSP is already facing acute shortage of water, irrigating 270000 Acre of additional area as proposed, on regular basis, may not be possible.

- ***Cost of the project may be too high***: The total project cost would be anywhere between INR 90,000 to 180,000 crores. This is an estimated cost based on compiling and adding the several components known as packages, which are more than two dozen or so. The yearly pumping cost for KLIP may vary from Rs. 7903 crores to 13172 crores. The capital costs of providing the water for irrigation will be between 5 to 10 lakhs per ac. This is the highest cost per acre basis of any irrigation project in the country. Adding the operational costs, interest rates and other costs each ac might need Rs 1,00,000 to 1,80,000 per acre/crop/year just to operate the system. The KLIP, as and when completed will be one of the most expensive water ever used for irrigation in India and elsewhere. Assuming that all the systems function, assuming that electricity is available, the cost of water delivery may far exceed several times to the entire value of the crop.

- ***Tummidihatti Vs Medigadda:*** The Government of Telangana has shifted the location of intake point of BR Ambedkar Pranahita-Chevella Lift Irrigation Scheme from Tummidihatti to Medigadda indicating inadequate divertible water at Tummidihatti. However present studies on the basis of discharge data it is indicated that around 200 TMC of water is available at Tummidihatti and can be diverted. By increasing the pumping capacity from 2TMC/day to 3TMC/day, additional 60 to 80 TMC can be drawn from Tummidihatti depending on other technical feasibilities. Height of barrage at Tummidihatti (+148m RL) has very little impact on quantity of water that could be diverted.

  Both under the original scheme and re-engineered scheme, water will be delivered from intake point to Yellampalli. However, for lifting the same quantity of water (180 TMC) from Medigadda as compared to Tummidihatti, an additional cost of Rs 1253 crores every year is to be incurred towards electricity supply. This is in addition to the additional investments required for construction of barrages and pumping stations at Medigadda, Annaram and Sundilla.

- ***Pumping Costs are very high*****:** The yearly pumping cost for KLIP may vary from Rs. 7,903 crores to 13,172 crores. Average cost of supplying electricity for each acre/crop/year under KLIP would vary from Rs 43,449 to Rs 72,416. For irrigating one Acre for one crop under Mallannasagar, electricity costs would vary from Rs 50,489 to Rs 84,148. Cost of irrigation under KLIP increases significantly after Mid-Manair reservoir. For KLIP, cost of irrigation under Mallannasagar is almost double as compared to irrigation costs at Mid-Manair. This difference could be even higher as water loss levels at Mallannasagar would be much higher due to longer transportation required in unlined canals and higher surface area of reservoirs.

- ***Bore well Irrigation Vs KLIP*****:** Average electricity costs under KLIP are almost 3 to 5 times to those of well irrigation. Costs of pumping under KLIP are almost comparable to those of well irrigation up to Yellampalli (1.1 to 2.0 times). But Ayacut proposed up to Yellampalli is only 30,000Acres (1.6%) of the total Ayacut proposed under KLIP. Pumping costs under KLIP upto Mid-Manair varies from 1.75 to 3.00times compared to well irrigation costs. Cost of irrigation under KLIP increases substantially after Mid-Manair reservoir. Irrigation cost at Mallannasagar is almost 3.5 to 6 times and for Kondapochamma it is 4.0 to 6.5 times in comparison with well irrigation costs.

- ***Impact of Re-engineering on pumping costs***: For lifting the same quantity of water (180 TMC) from Medigadda as compared to Tummidihatti, an additional cost of Rs 1253 crores every year is to be incurred towards electricity supply. This is in addition to the additional investments required for construction of barrages and pumping stations at Medigadda, Annaram and Sundilla. In the re-engineered scheme of KLIP, pumping station at Rangampet village, Karimnagar is deleted. This would result in additional pumping costs to the tune of Rs 180 cr/year.
- ***Stranded costs cannot be ignored:*** In all the estimates on electricity requirement for large scale Lift Irrigation Schemes, stranded costs of power projects on account of non-operation of pumps for most part of the year, almost 8 to 9 months, are not considered. These costs significantly increase overall pumping costs.
- ***Reducing power costs may be difficult:*** As Telangana Power Distribution companies have already tied up with buying expensive power on long term basis; possibility of accessing cheaper power in future to reduce overall pumping costs for KLIP is remote, even though cheaper power is available in the open market. Review of overall power policy for supply of electricity to Lift Irrigation Schemes is the need of the hour.
- ***Social costs may lead to conflicts***: The social costs of, just one component of this project, known as Mallannasagar has raised controversy, public protest and even law and order issues. Mallannasagar dam likely to submerge and displace people in 19 villages of that 13 villages are completely submerged. The total area for this single component is going to submerge around 21000 ac. For entire KLIP the total area requirement may be close to 100,000 ac of private and public lands for canals and other infra structure. Every 8 ac irrigated need one ac of land for submergence and for canal systems. This figure could be as high as 5:1. For every 5ac of irrigation, at least one person is displaced or affected in one way or other.
- ***Benefits may be too small***: It is not clear, at this stage, what would be the estimated benefits of the irrigated water. Assuming that project will provide water for 18 lakh ac and assuming that all the area is cultivated with high value crops, assuming that there is market for it, still the total value generated may be around Rs 5000 crores. After considering all the factors, KLIP may at the best generate, close to RS. 2000 to 4000 crores/year. However annual costs of the projects range from Rs 17876 cr to Rs 33070 cr. This is 15% to 25% of the current annual budget of our state. Pumping costs alone vary from Rs 7903 cr to Rs 13172cr. The costs and benefits shown in this report have wide range that is due to lack of exact information about this project. Even the lower end of the costs and upper end of the benefits computed in the report may not meet the BC ratio of the guidelines on irrigation projects.

What are the alternatives to use Godavari water for irrigation? That is certainly a valid question. But that is not in the scope of this report. It is also not responsibility of civil society or those who are analyzing the Government projects to provide alternatives. However, it is possible to find out better ways of spending public money on irrigation to get far greater and far better return than this project. It requires an open and transparent process and independent assessments. At later date, a process and a methodology for finding better alternatives will be suggested. This report is about looking at the Government project and its viability based on available information

Finally, it is important to mention here, three things a) more information from Government about this project will help in understanding its benefits and costs b) even if KLIP is not fitting in benefit cost ratios of guidelines, still Government of Telangana can continue with the project, but knowing all the costs and the benefits and articulating it publicly those costs and benefits c) Governments should encourage the public debate in the larger interest of the state's sustainable development.

This document clearly is not the last word. That is not intention. We do hope this document will help in public debate about such large spending.

Chapter 1

Godavari Basin: Discharge data and Water allocations

1.0 Introduction

Godavari is the largest river in India after Ganges. Drainage area of Godavari River is 312,812 sq. km of which 48.6% lies in Maharashtra, 19.04% in Telangana, 4.76% in Andhra Pradesh, 18.7% in Chhattisgarh, 5.5% in Orissa, 2% in Madhya Pradesh and 1.4 % in Karnataka. Godavari basin in Telangana is 59,559 sq.km and 53 % of the Telangana state forms part of Godavari basin. Godavari basin is three times larger than Telangana state.

Principal tributaries of Godavari are Manjeera, Manair, Pranahita, Indravati and Sabari. Some of these tributaries drain water from high rainfall areas (i.e. more than 1000mm annual rain fall) but main Godavari after originating at Nashik passes through some low rain fall areas. Therefore, the upper part of Godavari has less water, until the confluence of Pranahita. In upper reaches of Godavari, water has been almost used and even over used. Godavari basin along with its tributaries is given in Figure 1.1. The average annual flow in Godavari is nearly 110 billion cubic meters. This means 110 billion cubic meters of water (3885 TMC water) is theoretically can be utilized. This figure, based on recent data, CWC has revised figure to 113.09 km^3 (Rao et al 2014).Of this, utilizable surface water is about 76.3 km^3, replenish-able ground water is about 45 km^3. That means the from Godavari river about 76.3 billion cubic meters (which is 2,695 TMC) water is utilizable.

1.1 CWC guidelines for assessment of water in River basins a review

CWC has developed a protocol for the approval of new irrigation projects such as dams, barrages and weirs that have to be constructed in the river basins. The project needs to be described and discussed in detail in stages such as (a) Concept, (b) Site identification, (c) Pre-feasibility study that includes the components empirical flow estimates, flood designs, rainfall-runoff models, complete resource system models, (d) Designing Engineering that includes components such as flow estimates, rainfall runoff models, flood frequency, sedimentation rates etc., (e) Operational modeling, and (f) Evaluation of the project. At all these stages, various tools and practices are used that are acceptable internationally and some are modified to suit to the Indian context. Various options are available for models and forecasting of water resources in a river basin one has to optimize them depending on the availability and accessibility to the data.

1.1.1 Data collection and validation

Overall assessment of water resource of a basin, data of runoff (i.e., discharge or flows) for about 20 years are considered for preparing a feasibility report/concept note, whereas for preparing detailed project report (DPR) requires longer period is needed. In case observed data for the entire period needed are not available, the gap is filled in by interpolation or extrapolation, as needed, based on rainfall-runoff equations.

Data validation is done by several statistically significant tests such as time series, graphs methods that include time series, residual series, residual mass curves, moving averages and water balances. The consistency tests such as Double Mass Curve, Arithmetic serial correlation coefficient, Wilcoxon W test and Student t-test: a test on difference in the mean between two series and Linear trend test are to be done.

1.1.2 Data availability and Collection

At present there are about 88 gauging stations on Godavari river basin, that measure water discharge, sediment discharge, flood forecasting and flood flow etc. These 88 stations are spread over entire Godavari basin including its tributaries (Figure 1.1). The data is collected on daily basis. Some of the raw data is available in the public domain through the website Water Resources Information System (WRIS). In the context validation of discharge data steps such as Graphical Plot of Discharge with time, Residual series plot, Trend line Plot, Moving Average, Flow Mass curve, other statistical tests are carried out.

been verified by comparing with adjoining stations and other discharge points upstream and downstream. All the anomalies are explained and the interpretations are based on these observations. Another important point regarding the external consistency of the data has been verified by comparing the discharge data with available rainfall data. Comparing the downstream and upstream discharge distributions the data has been verified for the consistency. CWC further developed and suggested that at the Project Planning and Detailed Project Report stage

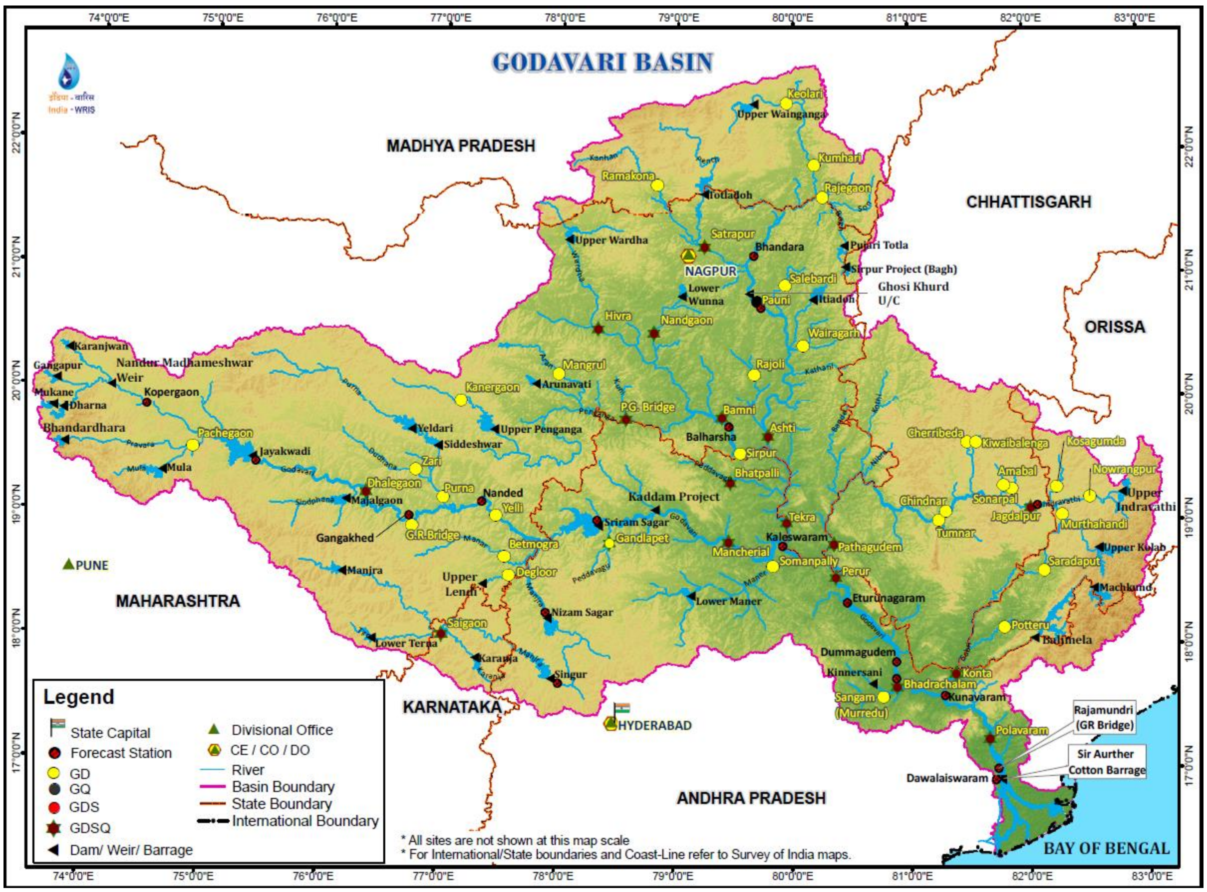


Figure 1.1 Godavari basin with discharge stations

The downloaded data has been normalized to uniform unit as MCM per day of discharge at all discharge stations. Data has been checked for internal consistency by plotting the time series for a specified period at different locations of the Godavari basin. As per the guidelines of CWC the data errors have been removed. Large variations have

the data needs to be verified by following graphical plots and time series plots for internal consistency and comparison plots, residual plots, double mass curve, rainfall-runoff plots and regression techniques have been followed to ascertain the external consistency of the data. The plots and tables of the statistical data for highest and lowest year rainfall years are given. Ashti and Tekra data (1983-84 and 1984-85) has been correlated and regression equation has been developed. With good correlation (R=0.86) indicates a good external consistency of the river discharge data. Similarly the low rainfall year 2004-05 and 2005-06 data also shows good correlation with good correlation (R=0.766).

All the statistical data is given in the Annexure. Based on the time series analysis forecasting has been done. But this type of forecasting is not much meaningful because of large variability and high intercepts on the regression plots. This requires additional data on the monsoon fluctuation data, rainfall data and other atmospheric uncertainties associated with El Nino and La Nina which are not carried out in the present study.

In India all the water allotments are done based on the 75% dependability of discharge flows and or water yield. This concept does not address the variability of water availability, the quantity of water that flows within short period, shorter intervals/spells within the monsoon period and during critical times. The adjustment of flows to natural and virgin conditions for historical use in the upper reaches requires withdrawal data, reservoir operation data and irrigation statistics. Where adjustments due to upstream storage are made, storage changes and evaporation losses are to be accounted for. Apart from adding upstream withdrawals, return flows have to be subtracted.

1.2 Water allocation for Telangana state

"The Godavari Water Dispute Tribunal" has allocated water for each state. Each state within the Godavari basin has been allocated with certain quantity of water Until recently the state Andhra Pradesh, in which Telangana was part of, is permitted to utilize nearly 1480 TMC (Thousand Million Cubic feet) out of the 75% dependable yield). Of that Telangana state share is 855 TMC and Andhra Pradesh share is 625 TMC. However, the exact allocations might differ slightly based on dependability, flood water allocations etc.

There is water in Godavari within the state boundaries of Telangana, but it is at far lower elevation than where it is required. So water allocated for Telangana is not specific to where it is available and drawn within the basin. For example, though water is allocated for SRSP to the tune of 121 TMC, but that water will not come there continuously for several years, while during the flood year, such as in 2016, even in one day more than 100 TMC of water is flown out after filling the dam. Therefore, water allocations to the state, does not guarantee for its utilization every year. That is the source of water disputes in India, which are increasing year after year.

1.2.1 Godavari water use by Telangana State

As mentioned, Telangana state has right to use 855 TMC (24,211 MCM) of water from Godavari basin. Further, the allocation to each state will have to be approved by CWC for specific projects. Table.1.1 shows the allocations to Telangana and water allocated to projects completed, ongoing and contemplated.

Telangana state faces a peculiar issue related to Godavari water. There is water after confluence of Pranahita, which is about 100m RL, but water need for irrigation is much higher, between 350 m to 650 m RL. So water allocation and its availability for the state are not matching geographically.

1.2. 2 Completed projects

Telangana state has technically completed projects with capacity 370 TMC of water, which is about 43% of its allocated water. Of this SRSP is the biggest with 121 TMC of water allocation and 90 TMC of storage capacity. After that the Nizamsagar project has capacity of 58 TMC of water. Details of the completed project and its water allocation have been given in table 1.1.

It is important to mention three things about the completed projects.

- Even though water has been allocated to these completed projects and the projects have been built but actual water for these projects depend on many factors such as a) rain fall b) upstream storages c) recently build barrages in Maharashtra.
- Telangana state has completed projects with water allocation of 370 TMC of water, but in reality these projects might not provide even half of it. Some years, the projects are completely dry without providing any water for irrigation or other purposes.
- Telangana is using far less water than its share, due to historical reasons of combined AP state and the geographic reason of its elevation.

Table 1.1: Godavari River Water Allocations

GODAVARI WATER ALLOCATION (in TMC)	
Telangana	855
Andhra	625
Total	**1,480**

GODAVARI WATER ALLOCATION IN TELANGANA	
Completed (in TMC)	
SRSP	121.00
Singur	11.00
Nizamsagar	58.00
Kadem	18.65
Kinnerasani	13.42
Manjeera	3.00
Medium	43.30
Minor	102.00
Total	**370.31**
Ongoing (in TMC)	
SRSP II	25.00
FF	20.00
Yellampally	63.00
Devadula	50.00
Rajiv sagar LI	6.50
Indiramma LI	6.50
Gutpa	6.00
Med+Minor	31.29
Total	**208.29**
Contemplated (in TMC)	
Lower Penganga	5.12
Lendi	3.00
Pranahita-Chevella	160.00
Ichampally	85.00
Singereddipally	3.00
Med+Minor	20.00
Total	**276.12**

Source: http://www.slideshare.net/umeshvarma1/pranahita-chevella-lift-irrigation-project-proposal-by-institute-of-engineers

1.2.2.1 Ongoing projects

In addition to completed projects, Telangana state is in the process of completing projects which can technically store or divert about 208 TMC of water. Of these two major projects Yellampally and Devadula together are with 113 TMC.

1.2.2.2 Contemplated

Another 277 TMC of water has been allocated to the projects which are being contemplated. Of this the Pranahita-Chevella has allocation of 160 TMC. This is now the re-engineered with new name Kaleshwaram Lift Irrigation project, KLIP.

Chapter: 2
Kaleshwaram Lift Irrigation Project, KLIP

2.0 Introduction

The Kaleshwaram lift irrigation project, proposes to draw 180 TMC from Medigadda and 20 TMC from Yellampalli. Already this project has allocation of 160 TMC (see table 1.1, with earlier name of Pranahita-Chevalle). Yellampally project has another 63 TMC of water already allocated. Together the KLIP has about 223 TMC. This can be drawn from Medigadda and Tummidihatti. KLIP is based on assumption that water is available for pumping 2 TMC water per day from Medigadda just after confluence of Pranahita and Godavari.

2.1 Medigadda

Medigadda is small village located on the right Bank of Godavari in Karimnagar district (Figure 2.1 and 2.2). Its geographic location on Google map is (latitude 18^0.42’.11’’ and longitude 80^0.03’.31’’). The river bed elevation is around 90meters. However, this could slightly vary depending where exactly the proposed site is located and also the silt deposit in particular year. Medigadda is about 70km downstream of Yellampalli and close to Mahadevapur mandal headquarters. The major Tributary of Pranahita merges with main Godavari about 20 Km north of Medigadda at Kaleshwaram (latitude 18^0 49’ 29’’ and longitude 79^0.54’.59’’).

In the present study availability of water for pumping at Medigadda is being examined, as this station is likely to be the starting point for the pumping for this lift irrigation project. Data has been obtained from Central Water Commission (CWC) for analysis. But before that some terminology issues which are mentioned below need to be understood. In addition, required electricity and cost analysis is also attempted.

2.2 Water Availability Assessment at Medigadda

As mentioned earlier, one of the main objectives of this study is to look at the availability of water at the proposed site. In order to establish water availability it is necessary to collect and do the analysis of

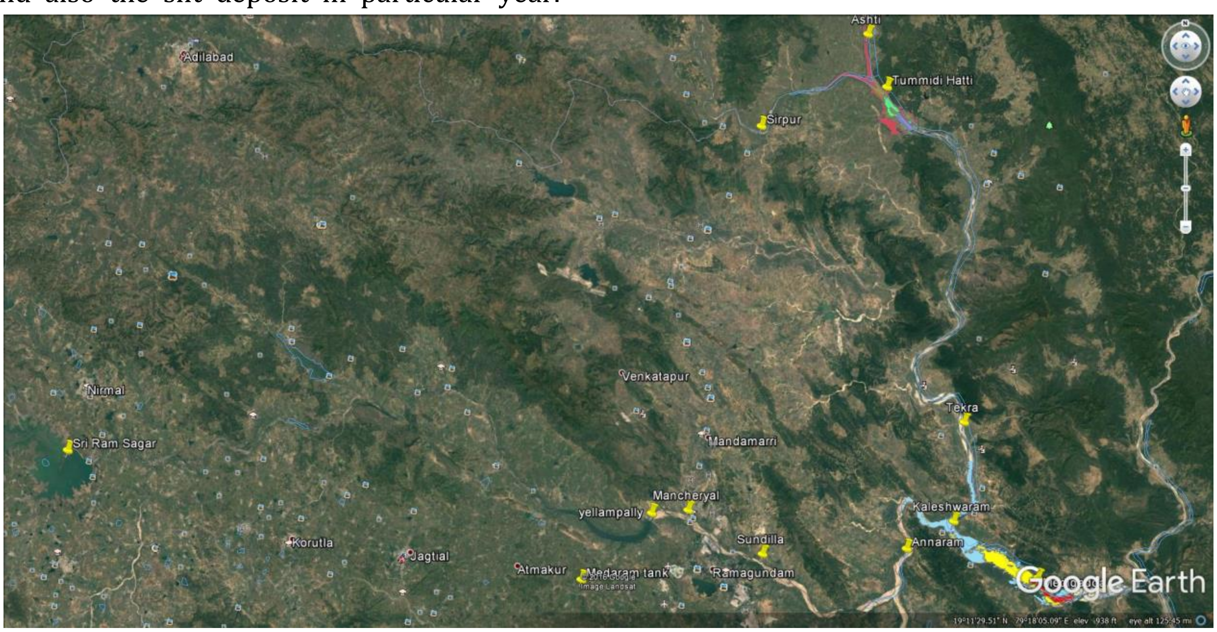


Figure 2.1 Locations of Medigadda, Kaleshwaram, Tekra, Tummidihatti, Sirpur, Somanpur and Manchheryal

Central Water Commission (CMC) discharge data. The maps (Figure 2.1 and 2.2) indicate the CWC gauging stations on Godavari, Pranahita around Medigadda area. The following data has been used for the analysis.

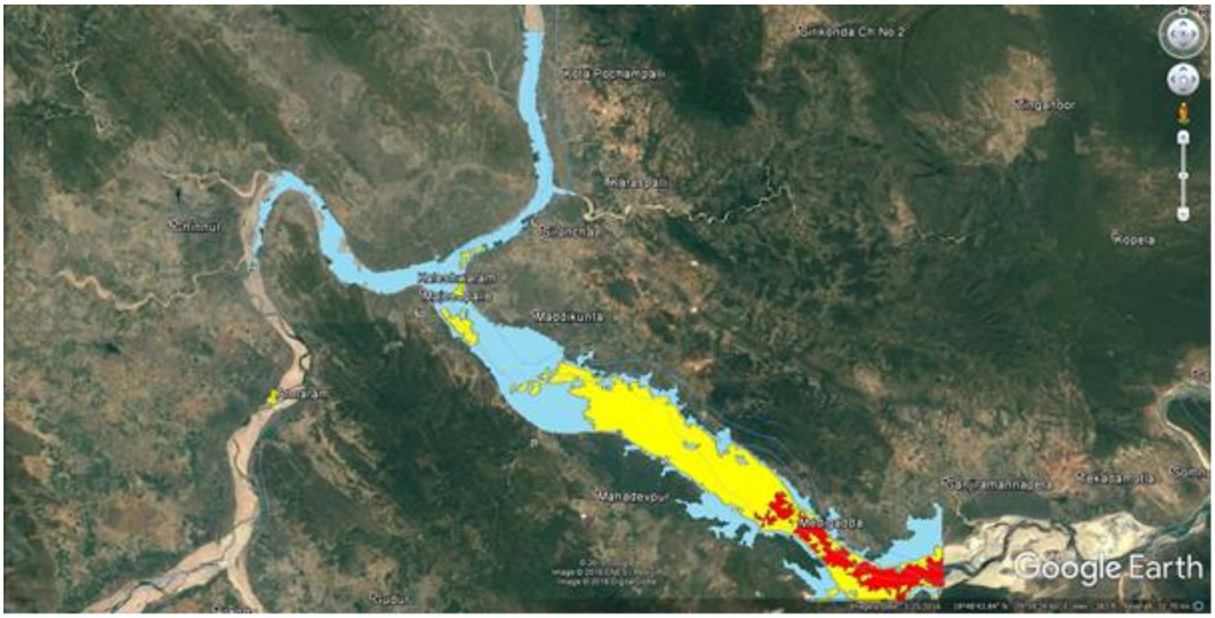


Figure 2.2 Submergence area at Medigaddda with 90-95 m red, 95-100 m yellow and 100-105 m blue colour

Daily water discharge data from stations (a) Ashti, (b) Sirpur, (c) Tekra, on Pranahita tributary and (d) Mancherial on Godavari River, and (e) Somanpally on Manair tributary have been studied for the present work. Since there is no gauging station right at the Medigadda, we have considered the three gauging stations just upstream. The first one is Tekra on Pranahita, which is about 20 km north of Medigadda, second one is at Mancherial about 50 km west of Medigadda on main Godavari and the third station is at Somanpalli which is located about 30 km west on Manair river. The water discharge data on daily basis of these three stations have been added and the total sum is used to find out the water availability at Medigadda. As a conservative estimate, water discharge data on daily basis of only Tekra also has been used to find out the water availability at Medigadda. As mentioned earlier, we have collected daily discharge data in order to determine the water availability for pumping. The data collected from CWC is further processed into annual, seasonal and daily discharge data sets and are presented in the tables Annexures 1 ,2 and 3.

Unlike the gravity based irrigation systems, the lift irrigation projects need water every day. Water availability at annual level at pumping station is not useful information since the river flow is not uniform through the year. For understanding the water availability, it is essential to look at the fluctuations at seasonal level, monthly and daily basis. Those analysis have been done and data has been presented in tables and figures. In order to establish water availability for pumping at intake point, a daily discharges at that particular point and for several years need to be analyzed.

For the purpose of this study, Mancheryal, Somanpally and Tekra discharge stations data of daily discharges have been taken into consideration. A total of around 55000 (fifty five thousand) data points of daily discharges have been analyzed, A computer model has been developed to understand the possible water pumping at various storage capacity at intake points. Based on that computer model a pumping calendar has been developed for each year in the past to show that if the discharges are similar to the last 15 years, then the likely days on which the pumping can take place.

2.2.1 Annual discharges

The table 2.1 gives the average, maximum and minimum flows at Tekra, Mancheryal, Somanpalli and Medigadda and the year wise annual water discharges of the all the stations mentioned above from 1966 to 2015 are given in the annexure (Table 2.1A). There are some gaps in certain year, but overall most of the data has been collected for processing and interpretation. In the entire report TMC has been used for convenience. However, we have given the data in Million Cubic Meters (MCM), which is standard international convention and also converted to TMC and given in the tables provided in Annexure.

The table indicates that a) year to year variations of water discharge at the same location could be several folds b) average discharge at any given place is not the useful information for planning c) allocation of water based on average annual discharges may not be much use for designing lift irrigation projects.

2.2.2 Water availability based on annual discharges

Detailed annual level, water availability has given in table in the annexure. It indicates the total annual water discharge from each of the location in TMC and as well as Million Cubic Meters. As per the guidelines of CWC dependability of water at the project locations as well as at important gauge stations have been calculated based on the discharge data.

Table 2.1 Water discharge range at Mancheryal, Somanpally, Tekra and Medigadda

Water Discharge from 1965-2015 (in TMC)				
	Mancheryal	**Somanpally**	**Tekra**	**Medigadda (M+S+T)**
Maximum	**1607**	**252**	**3008**	**4034**
Year	1984	1984	2014	1984
Minimum	**10**	**0**	**387**	**438**
Year	2005	2005	1988	2005
Average	**378**	**51**	**1269**	**1681**

Table 2.2 Water discharge (in TMC) at 75% dependability at Mancheryal, Somanpally, Tekra and Medigadda with time

Years	Mancheryal	Somanpally	Tekra	Medigadda(M+S+T)
50	139	20	892	1108
45	95	20	829	999
40	94	21	875	999
35	83	20	806	936
30	79	16	805	936
25	91	20	806	999
20	79	11	805	869
15	79	11	892	999
10	79	25	1015	1120

Dependable water is calculated at 75% dependable discharge from the data collected over the last 50 years. If 50 years data is considered at Mancheryal 139 TMC is available, At Somanpally it is 20 TMC and at Tekra 892 TMC is available. These values would reflect the pristine or the virgin flows.

In due course of time water allotments have been done and water utilities have gone up with lot of withdrawals enroute the availability of water has come down over the years. Since the construction of SRSP is completed and other small barrages on the upstream have taken place therefore the dependable water at Mancheryal has come down from 139 to 79 TMC. Similarly, the water availability in the Manair tributary also has come down from 20 to meagre 11 TMC over the past forty years. Similarly with construction of several small and medium projects such as Mid Manair and Lower Manair from 20 to 11 TMC which has reduced to 50%. Therefore it is mentioned in the DPR of BR Ambedkar Pranahita Chevalla Sujala Srvanthi that there are No surplus water from Mid Godavari Sub basin (sub-basin-6).

Table 2.3 Water utilization in G7 (Penganga), G8 (Wardha), G-9 (Pranahita) sub basins upto Ashti (all data in TMC)

Years	Madhya Pradesh	Maharashtra	Telangana	Total
Existing	23.84	101.71	11.23	133.95
On-going	75.82	96.59	2.05	174.45
Proposed	114.42	136.56	23.24	274.18
Total	214.08	334.86	36.52	582.58

Source: DPR submitted by WAPCOS

Tekra discharges have not changed over time indicating that usage of water from Pranahita has not affected the water flows and discharges over the years. It remained around 900 TMC for the last 50 years. But, as per the records the existing projects are utilizing to the tune of 134 TMC in the upstream states (Table 2.3) and around 175 TMC is under ongoing projects. Even half of the ongoing projects water is being withdrawn, significant change in the discharge of Tekra is not visible. Therefore, there is a necessity of more detailed study on availability, awards and other related aspects.

Net yields assessed by project authorities and submitted to CWC at project site is 273 TMC at 75% dependability (CWC Lr. Dt: 04-03-2015) would be on the lower side may be because of the deduction of the quantity of water allocated for the ongoing and future contemplated projects by upstream states.

Present study based on the actual discharge data the water availability at 75% dependability it is found to be for Medigadda (considering Tekra discharge only) around 850 TMC and for Tummidihatti around 800 TMC (Table 2.2) which coincides with WAPCOS discharge study. It indicates that water availability at Medigadda would be around 50 TMC or about 5% higher than the water available at Tummidihatti. Even data for Medigadda considering the total of Mancheryal and Somanpally(contributions from Godavari and Manair) would be around 1025 TMC which is around 10-12%higher than Tummidihatti, However, this water can be exploited within Telangana before it reaches Medigadda. This option need to be examined based on the cost benefit analysis.

The existing, ongoing and contemplated projects withdrawals (Table 2.3) need to be subtracted from the above water availability calculated on the basis of discharge studies. However, as per GWDT (Table 2.4) out of this available water, Telangana can draw only the quantity which is allocated to its share. The variations in both these values which need to be a focus of future study.

The availability of water more than 273 TMC is a very positive sign for considering the project at Medigadda. The present study based on the daily discharge analysis emphasizes that the most conservative figure submitted by the state government, WAPCOS and agreed by CWC is

165 TMC can be drawn efficiently by proper planning as shown in the pumping schedule.

The important aspect to note is "out of this dependable water, most of the water is flowing in only few months, leaving no water in certain months, even in those months within few days the entire water is flowing. So water available for human use and water flowing in the river are two different things".

Therefore, we need to further look closely the water availability on daily basis, particularly when the pumping is being planned to be from Medigadda and Tummidihatti. The lift irrigation requires water availability on daily basis. Since the large reservoirs are not allowed(unlike gravity dams) the water should be present every day to pump and the limitations of the pumping capacity and later storage facility determine how much water can be extracted.

2.2.3 Annual variations

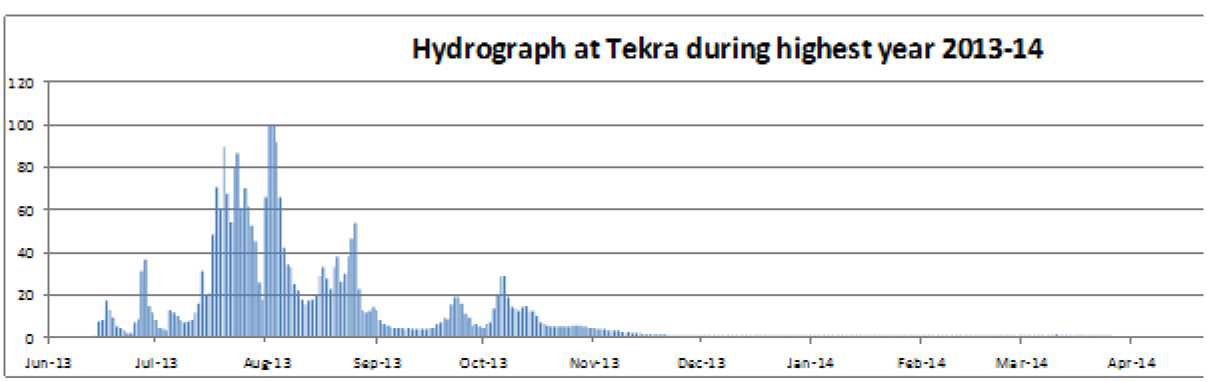
The annual water discharge at Medigadda has been presented in the table 2.1. It indicates that at annual level the water discharge at Medigadda ranged from 438 TMC during the very dry year 2005 to 4036 TMC during the flood year 1984. Even at Tekra during the highest rainfall year (2014) water of 3008 TMC and lowest rainfall year (1988) water of 387 TMC discharge has been recorded. That means the annual discharge at this station could vary almost 10 times.

Table 2.4 Water availability, abstract of GWDT award

Water availability at 75% and GWDT award to Telangana								
Sub Basin	Water availability		Telangana share					
			Award		Regeneration		Total	
	MCM	TMC	MCM	TMC	MCM	TMC	MCM	TMC
Penganga	3840	136	1101	39	99	4	1200	42
Wardha	4282	151	811	29	0	0	811	29
Pranahita	23633	835	7731	273	294	10	8025	283
Total	**31755**	**1121**	**9643**	**341**	**393**	**14**	**10037**	**354**

Further analysis about the variability of river discharges have been presented in other papers for detailed understanding of the water availability at each station. Further it is important to note that within a year, almost 90% of the water is discharged during the monsoon period. For more than 180 days from 1st December to 31st May, there is no water flow. Even during the flood years the summer flow (flow during non-monsoon period, i.e. from 1st December to 31st May) is less than 3% of the annual flow. Similarly during the very dry year 2005, more than 92 % of the flow is during monsoon, leaving entire non monsoon flow to only just 33 TMC.

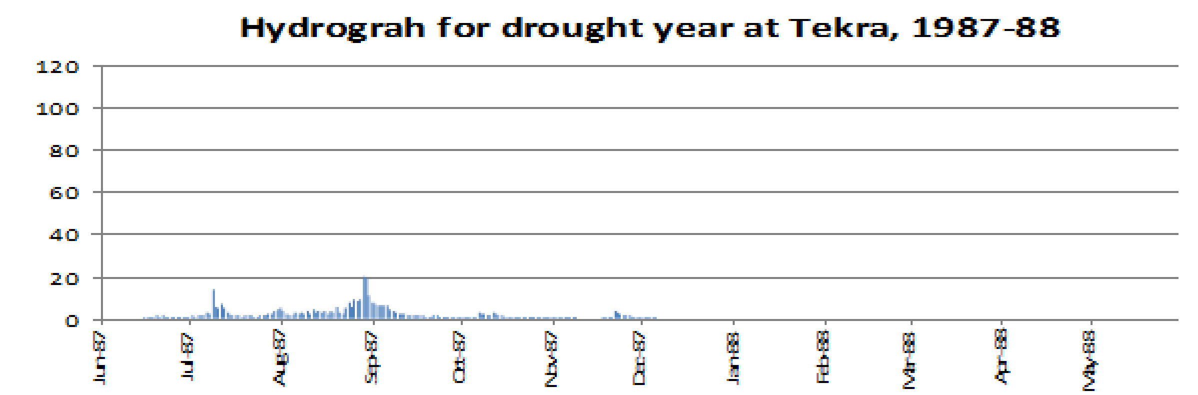
Figure 2.3 Hydrograph at Tekra highest rainfall year



Detailed hydrographs are plotted for Tekra, for high and low rain fall years (Figures 2.3 and 2.4). Detailed hydrographs are plotted for Mancheryal, Medigadda for high, medium and low rain fall years in the Annexure 1.

is flown in just few days during few days. This is the case even during other flood years and also for dry years. Summary of seasonal variations for Tekra, Mancheryal, and Medigadda for high and low rain fall years is given table 2.5. Detailed monthly variations are quiet high from year to year and within a year. Monthly variations observed are shown in table (Annexure 2).

Figure 2.4 Hydrograph at Tekra during lowest rainfall year



2.2.4 Variations in the seasons

Even within monsoon period, the water discharge is only during few days. Further analysis indicated that during the flood year, when annual discharge is more than 4,036TMC, just in 10 days' time 1,000 TMC of water was discharged, in 24 days 2,000 TMC was discharged in 100 days 3800 TMC was discharged leaving just 200 TMC for rest of the year. If we look at further closer into the data, during the monsoon months June to October 3,933 TMC was discharged leaving 100 TMC for the rest of 7 months period. During April and May months it was found to be only 15 TMC of water was discharged. It is clearly indicates that river flow is highly seasonal and most of the water

2.2.5 Daily variations

Daily variations are quiet significant. At Mancheryal for example the highest discharge is 2749 MCM or around 10 TMC in the year 1995 which is about 14 % of the annual discharge. The lowest rainfall year 2005 the highest discharge in a day is 21MCM which is around 10 % of the annual discharge. In six years out of the 48 years data the highest single day in the particular year is about 100MCM which is around 3TMC of water per day.

Table 2.5 Seasonal distribution of discharge at Tekra, Mancheryal, Medigadda for high and low rain fall years

Seasonal distribution 1965-2015 (Data in TMC)

	Mancheryal		Somanpally		Tekra		Medigadda	
	Monsoon	Non-monsoon	Monsoon	Non-monsoon	Monsoon	Non-monsoon	Monsoon	Non-monsoon
Max	1,570	38	241	11	2,933	167	3,939	173
Year	1984	1984	1984	1984	2014	1998	1984	1998
Min	0	0	0	0	372	10	405	10
Year	1966	1979	2005	2014	1988	1966	2005	1966
Average	361	10	49	2	1,233	37	1,642	55

At Somanpally the discharge is 549 MCM during the year 1984 and in other years it is mostly less than 100MCM. The lowest discharge of 2 MCM is recorded during the draught year 2005.

At Tekra the highest single day discharge is 4026 MCM (142 TMC) on 15th August 1986 in (1986-87 year) which is around 8% of the annual discharge. The lowest discharge is 422 MCM in the year 1997. During the draught year 2005 at Tekra water discharge was declined and recorded only 534 MCM which is about 10 % of the annual discharge. Similarly rainy days continue for couple of days in a month or even more than once occasionally. Highly variant rainy days (continuously) are shown in the table 2.6.

Table 2.6 Daily variations of discharge data

Daily Variation			
Mancheryal			
20th Oct 1995	97 (29%)	18th – 26th Oct	207 (60%)
Tekra			
15th Aug 1986	142 (8%)	7th - 19th Aug	826 (49%)
Medigadda			
15th Aug 1986	154 (8%)	7th - 19th Aug	954 (50%)

For designing a barrage that can with stand the highest flood flow in the upstream and at discharge stations is being considered. For this purpose, highest combined flood 62,231.27 m^3/sec or 5,376 MCM or 170 TMC was considered by CWPRS Pune based on the combined floods from Wardha and Wainganga as 100 year return period for spillway design. Probably this may the highest daily flood computed and CWC suggests that for constructing any barrage this figure need to be considered for the project site.

In good monsoon year in one day more than 75 TMC of water is being discharged (Table 2.7). The amount of flow would be three times of the capacity of Nizamsagar reservoir or 75% of SRSP. In some years such high discharge days are continuously observed for couple of days. During the year 1995 for 11 days more than 75 TMC of water has flown at Medigadda. Similar high discharge days are tabulated year wise for Tekra and Tummidihatti. For other discharge stations they have been tabulated in Annexure 3.

The table 2.7 clearly indicates that (a) during the rainy season, large quantities of

Table 2.7 Daily discharge more than 75 TMC per day at Medigadda, Tummidihatti and Tekra

Daily discharge more than 75 TMC per day						
	Medigadda		Tummidihatti		Tekra	
Year	No. of Days	Highest	No. of Days	Highest	No. of Days	Highest
1967	4	125	0	0	1	79
1971	8	122	4	82	1	81
1974	2	87	0	0	1	84
1976	3	81	1	78	2	76
1979	3	108	3	116	2	103
1980	3	3	3	102	2	88
1982	3	106	2	84	3	103
1987	5	154	5	128	5	142
1991	10	134	2	101	3	80
1993	1	78	1	97	1	76
1995	11	110	11	120	10	110
2001	5	120	3	137	3	119
2008	1	78	1	77	1	78
2011	1	82	1	77	0	0
2014	7	118	9	115	6	100

water is flown in single day, (b) whatever might be the quantum of the flow, but for lift irrigation at those locations, only quantity can be drawn is capacity of the pumping, and (c) even attempt to create storage for pumping is not able to be much use, when large quantities of water is discharge in a single day.

So water available for pumping is limited to the capacity of the pumps not water availability at given place. Therefore computer models need to be developed in order to understand the flow, required storage and the pumping and water flow downstream after pumping etc.

2.2.6 Augmentation of water at Medigadda

As it is observed in the above tables most of the water is flowing in only few months, leaving no water in certain months, even in those months within few days the entire water is flowing. So water available for human use and water flowing in the river are two different things. It further indicates that augmentation of this excess water flown during few days need to be transported and stored for future use. CWC suggests building enough storage tanks/ structures/reservoirs in the inland if government plans for lifting of the excess water and transported for future use. Therefore we need to further look closely the water availability on daily basis, particularly when the pumping is being planned to be from Medigadda and transported to appropriate places for future use.

Based on the daily discharge data, a programme has been developed to know the water availability for pumping on daily basis. Since reservoir with capacity of around 20 TMC is going to be built (Figure 2.2) at Medigadda, we simulated the data to know how many days in a year water would be available for pumping @ 2 TMC of water per day. The table indicates about 107 days in 2005 was available. This particular year was chosen, since it is the lowest water in last 50 years. During a low rain fall year, it is possible to pump107 days, out of those, 80 days continuous (1st August to 19th October) and other days intermittently.

It is essential to establish this calendar of water pumping from this point. An attempt has been done to schedule the pumping calendar with certain assumptions.

2.3 Barrage to modulate the flow for pumping

The planned first intake point, on the River Godavari for the entire lift irrigation is from Medigadda. A barrage has been proposed at this location. The pumping modulation is carriedout on water discharge data calculated at Medigadda (total of Mancheryal, Somanpally and Tekra), and considering only the discharge data of Tekra.

At Medigadda the barrage length would be about 1632 meters across the river and this is expected to store water and facilitate for pumping. Water after barrage is expected to be 19.73 TMC at FRL. A diagram has been simulated to show the water spread and submergence of the area around Medigadda when barrage is built (figure 2.2). With almost 20 TMC, the total area with water would be more than 80 Sq.Km.

A computer model has been developed in order to determine the number of days, water would be available for pumping from Medigadda. This computer programme has been designed to see the dates on which pumping is possible from 1st June to 30th of October of each year. The methodology has been described below.

Daily discharge data of Tekra gauging station from 1966 to 2015 has been used for the computer analysis. Only monsoon data from 1st June to 30th November 180 days (9000 data points) have been used for the analysis. Year wise pumping data, excess water discharged to the river and number of days pumping can be done are given in table 2.8. The detailed year wise data is given in the Annexure 4. The following observations have been made. Brief summary indicating number of days during the high and low rainfall years is given in the table 2.8.

2002 the total monsoon flow is just 1,071, almost one third of the flood

Table 2.8 Number of days pumping during high and low rainy years at Medigadda (only Tekra data)

At Medigadda considering only Tekra discharge data (TMC)					
With Barrage 20TMC; Pumping 2.16TMC/day; Initially starts at 10 TMC; stop-restart at 3 TMC					
Year	**Yearly Discharge**	**Pumping**	**Days Pumping**	**Flow into river**	**% water utilized**
2014 (Max)	3008	352	**166**	2578	12
2005 (Min)	428	220	**104**	173	56

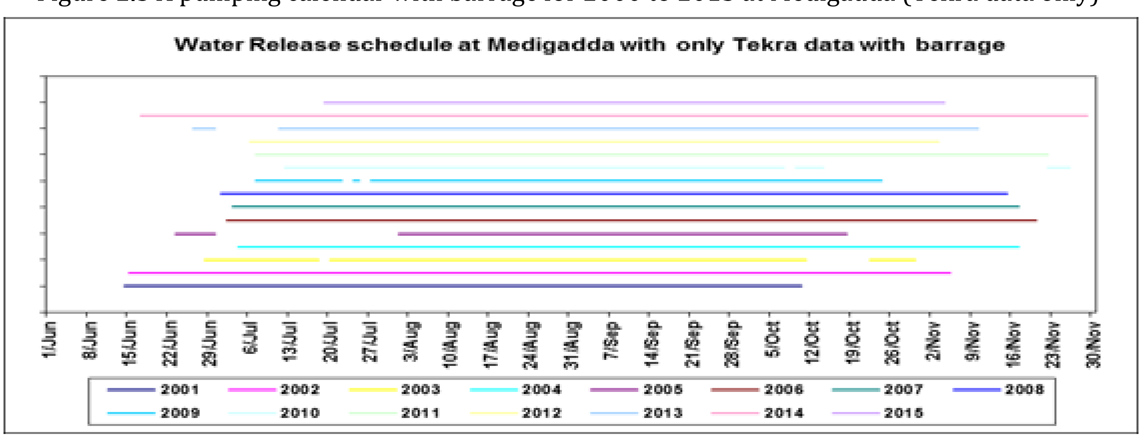
Table 2.9 Number of days pumping during high and low rainy years at Medigadda (Tekra data) without barrage

At Medigadda, considering only Tekra discharge data (TMC) Without Barrage					
Year	**Yearly Discharge**	**Pumping**	**Days Pumping**	**Flow into river**	**% water utilized**
2014	3008	314	148	2620	11
2005	428	97	46	298	25

- At the daily pumping of 2.0 TMC from Medigadda, with storage of 20 TMC at the barrage, availability of water ranged from as high as 170 days in 1971 to as low as 107 days in 2005.
- Total water can be pumped from Medigadda ranged from 360 TMC (1971) to 227 TMC (2005). The percentage of water pumped to the total water flow ranged from 52% (2005) to just 8% (1984).
- After pumping water flown over the Barrage at Medigadda may vary from 52 TMC to 3605 TMC.
- It is important to note that the flood year with monsoon flow of 3942 TMC does not give any greater advantage of pumping than much more medium flow year. For example during the year 1984. But in terms of pumping and total water withdrawal it will not make much difference (Table in annexure 4).
- The most important factor is the even flows during the year are important than the total water flow in the monsoon period.
- Constructing the barrage storing 20 TMC will further modulate the flow and facilitate the pumping regardless of the flow in day.
- Even after pumping of 2 TMC a day, there will not be any impact downstream.

Similar exercise was carried out considering that there is no barrage (Table 2.9). In such case, the technology of pumping

Figure 2.5 A pumping calendar with barrage for 2000 to 2015 at Medigadda (Tekra data only)



should be like that is to be followed by KLIP at Annaram, Sundilla, and Medaram(in all three locations small barrages or impounding of water of 6.22, 2.16 and 0.8 TMC is proposed in the project). For fifteen years daily release schedule has been computed and plotted graphically for considering a storage barrage and without barrage at Medigadda(Figure 2.5 and 2.6).

In another scenario it was attempted to know how many days water can be pumped from Medigadda with combined Tekra, Mancheryal and Somanpally discharge data. The summary is given in table 2.10; the details are in Annexure 4. The daily schedule of release for fifteen years is computed and plotted graphically figure 2.7 and 2.8.

A pumping calendar with barrage for the fifteen years period 2000 to 2015 has been given in the figure 2.5 and 2.6 and the data is given in the annexure. A pumping calendar without barrage for the fifteen years period 2000 to 2015 has been given in the figure 2.7 and 2.8.

It has been observed in the Upper Godavari basin small barrages have been constructed and water is being diverted from Godavari River after Jayakwadi (Paithan dam). A small exercise has been done whether such small barrages can be constructed after Tummidihatti, Medigadda and beyond. Initially it is explored what is the scenario after utilizing water at Medigadda, if excess water can be available for exploitation.

Figure 2.6 A pumping calendar without barrage for period 2000 to 2015 at Medigadda (only Tekra)

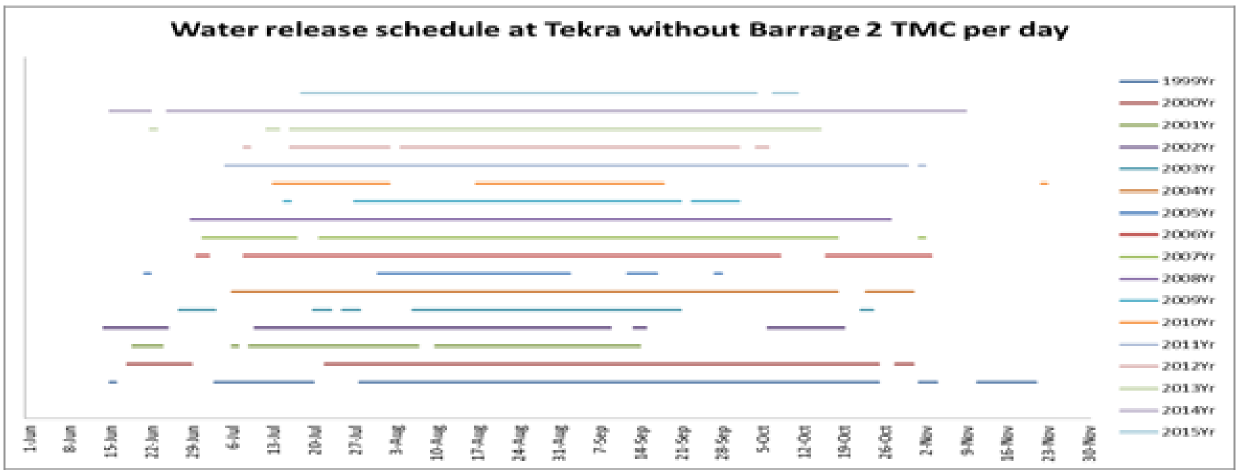


Table 2.10 Number of days pumping during high and low rainy years at Medigadda (Manchryal+Somanpally+Tekra) with and without barrage

With Barrage 20TMC; Pumping 2.16TMC/day; Initially starts at 10 TMC; stop-restart at 3 TMC					
Year	Yearly Discharge	Pumping	Days Pumping	Flow into river	% water utilized
1991 (Max)	3,325	358	169	2,863	11
2005 (Min)	438	227	107	176	52
Without Barrage					
1991 (Max)	3,325	324	153	2,908	10
2005 (Min)	438	102	48	303	25

Figure 2.7 A pumping calendar with barrage for 2000 to 2015 at Medigadda (Man+Som+Tek)

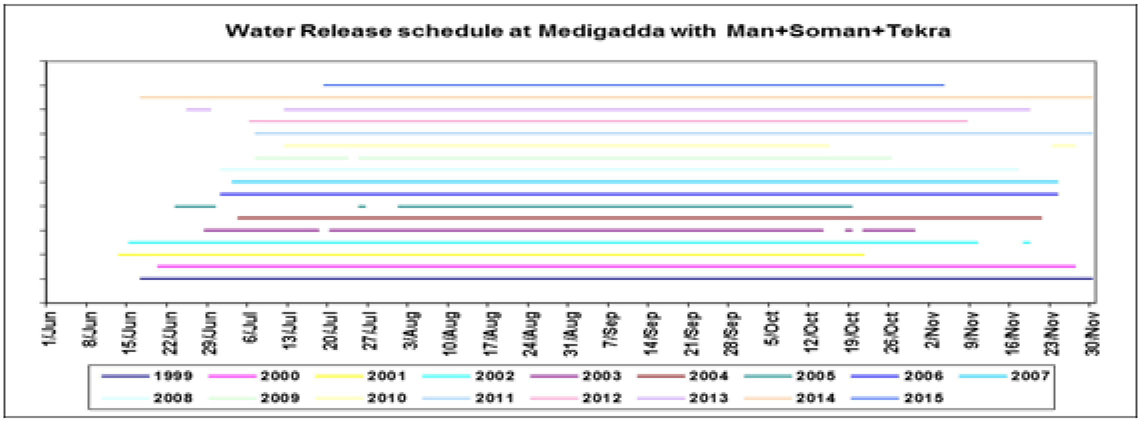
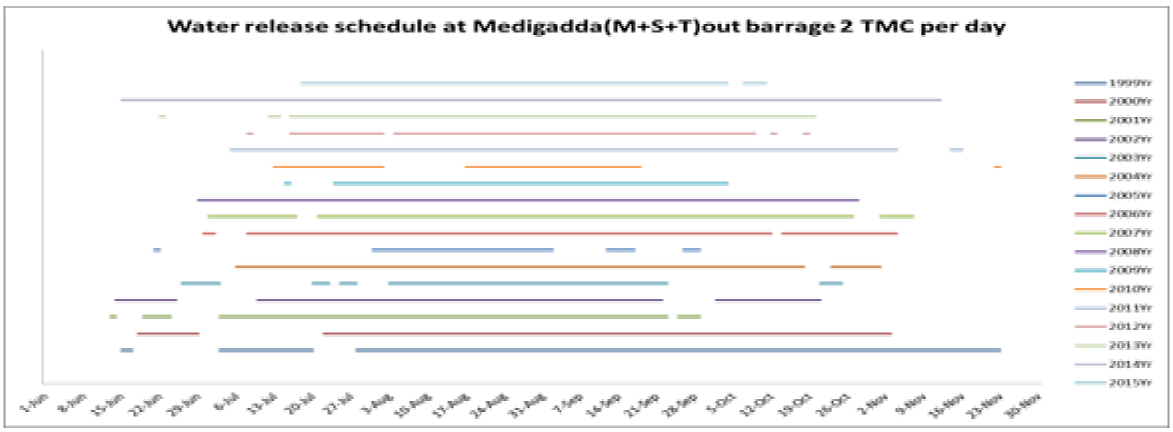


Figure 2.8 A pumping calendar without barrage for the fifteen years period 2000 to 2015 at Medigadda (Man+Som+Tek)



An attempt is done to consider additional small barrage further downstream of Medigadda. The suitable site can be selected based on other geo-environmental conditions about 20-30 km downstream. A theoretical calculation has been modulated considering a small reservoir as part of the barrage with 5 TMC capacity and lifting provision for 1 TMC per day. Based on the data it is estimated that 148 days can be pumped during the good rainfall year and a minimum of 33 days can be pumped during the lowest rain fall year (Table 2.11 given in Annexure 5).

2.4 Tummdihatti Reservoir

Proposed reservoir at Tummidihatti has been calculated based on the countour and extracted DEM from SRTM data. The river bed is not uniform and the exact location of the proposed barrage is not avialble to study

Table 2.11 Pumping downstream of Medigadda

Water availability downstream of Medigadda for pumping @ 1 TMC/Day				
Storage of 5 TMC: Pump starts at 3 TMC and stops and restarts at 2 TMC				
Year	**Water inflow**	**Pumping**	**Days Pumping**	**Water flow into River**
1991 (Maximum)	1808	148	140	1659
1988 (Minimum)	121	33	31	86

in detail. The calculations are given below with detailed contour lines, area, volume and other details (Table 2.12). The detailed map including the submergence is shown in figure 2.9.

The present excersize indicates that a barraige of 15 meters height would fecilitatte to store about 10 TMC of water. However there would be errors in the location of the proposed site. In the recent communication Telangana Government has reduced the capacity of the barrage quiet significatnly to bear minimum of 1.85 TMC.

Table 2.12 Area and volume of the proposed barrage at Tummidihatti

Tummidhatti proposed Barrage with about 10 TMC capacity								
Sr. No	**Lowest contour**	**Highest contour**	**Area (m²)**	**Volume (m³)**	**Cum. Volume**	**MCM**	**TMC**	**Cum. TMC**
1	130	135	51,76,348	25,881,740	25,881,740	25.88	0.91	0.91
2	135	140	82,34,871	41,174,355	67,056,095	67.06	2.37	3.28
3	140	145	132,51,828	66,259,140	133,315,235	133.32	4.71	7.99
4	145	150	288,03,111	144,015,555	277,330,790	277.33	9.79	17.78

Figure 2.9 Computer generated barrage at the proposed site Tummidihatti

2.4.1 Water availability at Tummidhatti

Water availability at Tummidhatti has been calculated based on the discharge data of Ashti(Contribution from Wenganga and from Sirpur contribution from Penganga and Wardha tributaries of Godavari. Both these tributaries confluence at Tummidihatti lattitude longitude loaced in Adilabad district, Telangana. Maximum and minimum Yearly discharge distribution is given in the following table 2.13 for other years in Annexure 1.

Yearly variarion is almostt 10 times is observed. However a minimum of 336 TMC is availble at Tummudihatti even during the draught year. The highest flood year shown a discharge of around 3000 TMC. Maximum contribution is observed from Wanganga tributary. The water availability at 75% dependability is the minimum 700 TMC (if only 20 years data is considered) which more than the CWC estimate because upper raparian states share is not considered (Table 2.13). However based on the daily discharge data major portion of Telangana share can be extracted which is discussed below.

Table 2.13 Water availability (TMC) at Tummidhatti for highest and lowest years

	Sirpur	Ashti	Tummidi hatti (A+S)
Maximum (TMC)	**1067**	**2136**	**2923**
Year	1991	1995	1995
Minimum (TMC)	**39**	**204**	**336**
Year	2010	2005	1988
Average (TMC)	**428**	**748**	**1158**

Table 2.14 Variation in 75% Dependable water (TMC) at Tummidihatti over 50 years

Years	Sirpur	Ashti	Tummidihatti (A+S)
50	221	603	806
45	191	569	790
40	243	597	806
35	191	538	776
30	191	533	776
25	221	597	891
20	191	538	806
15	300	538	909
10	300	755	1055

2.4.2 Daily variation

Daily variation is found to be very high. At Tummudihattai a maximum of 137 TMC in a day was obsrved. In fifty years daily data in thirteen years there was a significanlty high discharge was recorded. The following table 2.16 indicated number of days in a year water flow was more than 75 TMC per day.

Table 2.16 Daily discharge more than 75 TMC/day at Tummidhatti

	Tummidihatti	
Year	**No. of Days**	**Highest**
1971	4	82
1976	1	78
1979	3	116
1980	3	102
1982	2	84
1987	5	128
1991	2	101
1993	1	97
1995	11	120
2001	3	137
2008	1	77
2011	1	77
2014	9	115

Table 2.15 Seasonal variation at Tummidihatti

Seasonal distribution 1965-2015 Data in TMC						
	Sirpur		Ashti		Tummidihatti	
	Monsoon	Non-monsoon	Monsoon	Non-monsoon	Monsoon	Non-monsoon
Max	1288	30	2096	121	3012	151
year	2014	1998	1995	1998	2014	1998
Min	37	0	198	3	232	3
year	2010	1968	1988	1966	1966	1966
Average	431	11	735	19	1140	30

Seasonal variation of discharge at Tummidihatti has been computed with Ashti and Sirpur discharge stations for the period from 1964 to 2014. As expected there is a lot of varration in their distribution. The summary is presented in table 2.15 deatails in annexure 2.

2.4.3 Barrage to modulate the flow for pumping

In the initial disccussions of proposed Pranahita – Chevalle project it is noted that the Chief Enginner informed Maharashtra Government that " number of days discharge exceeding 583 cumecs (50 MCM or 1.77 TMC) at the project site is only 77 days at 75% dependability due to which it is imperative to go with the FRL +152 to allow a minimum of 1.896 TMC of water storage above the Full Canal Supply Level" (Minutes of the technical meeting of Dr BR Ambedkar Pranahita Chevalla Sujala sravanthi Project held in the chambers of the Enigineer in Chief (Irrigation) on 16-08-2014 at Hyderabad).

In the project proposal at Tummidihatti a barrage with a storage capacity of 10 TMC has been planned. With avialble daily data similar to Medigaddda simulation of the water availbility for lifting has been carriedout. It is calculated that 164 days can be pumped from Tummidihatti @ 2TMC per day in very good rain fall year. During the leas rainfall year also about 82 days water can be extracted.

In order to avoid submergence in Maharashtra, Telangana Government can design intake structures and pumping somewhat differently. Such pumping mechanisms are included in the proposed KLIS with small capacity barrages from where 2TMC water per day can be lifted. For example at Medaram tank which has less than 1TMC capacity, Sundilla with 2.16 TMC capacity and Annaram with a capacity of 6.22TMC with high discharge pumps 2 TMC per day delivery lift is proposed in the KLIP. Such technology can be applied at Tummidihatti, from which water can be lifted with 1 to 2 TMC per day depending upon the availability of water in the River Godavari. Alternatively a 10 TMC of reservoir can be built in Telangana territory and only a diversion channel at +148 RL that can carry 2 TMC can be considered at Tummidihatti. Such an innovative design can be developed. This method also discussed in one of the joint meetings by Maharashtra and Telangana officials. The chief Engineer, Maharashtra State stated *"The FRL of +152 m causing considerable submergence in MS. He opined that sill level at +144 m can be lowered considering average river bed level. He stated in Maharashtra there is a practice to keep sill level 0.5m above average bed level. This will reduce sill level and hence FRL. FRL shall be restricted just to create a required driving head for diverting the required discharge. As almost 97% utilization is possible through river diversion itself, storage capacity is of less significance. Thus, prima face, there is scope for reduction of FRL"*.(Minutes of the 1st meeting of Coordinating Committee of DR BR Ambedkar Pranahita Chevalla Sujala Sravanthi held in Hyderabad dt 21.01.2013).

There is a diverse view between the state government and CWC regarding the water

Table 2.17 Water availability and pumping at Tummidhatti

At Tummidihatti based on Ashti and Sirpur discharge data					
With Barrage 10 TMC(within territory of Telangana); Pumping 2.16 TMC/day; Initially starts at 5TMC; stop-restart at 3TMC					
Year	**Yearly Discharge**	**Pumping**	**Days Pumping**	**Flow into river**	**% water utilized**
1991 (Max)	2107	347	**164**	1760	16.56
2005 (Min)	336	174	**82**	162	51.78
1998 75% dep	805	237	**112**	568	29.44
Without Barrage					
1991 (Max)	2107	301	**142**	1806	14.28
2005 (Min)	336	66	**31**	270	19.64
1998 75% dep	805	142	**67**	663	17.64

availability at Tummidhatti. Both versions are given as follows.

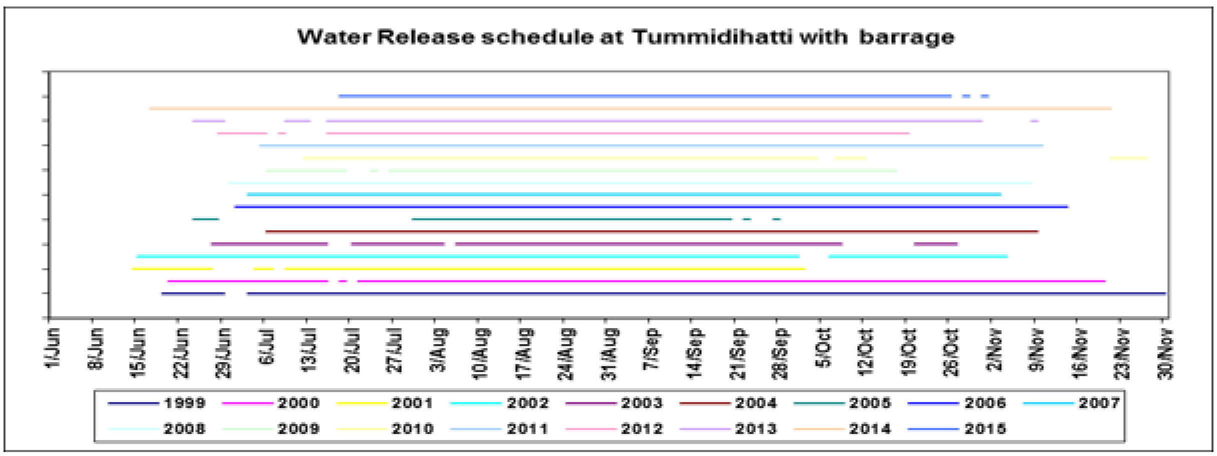
As per Website of Irrigation and CAD, Government of Telangana :In view of large extent of submergence in Maharashtra state due to the presumed Barrage FRL of (+)152.00m at Tummidihetti(V), the Government of Maharashtra has raised its concerns and sought for the reduction. After detailed Joint surveys and discussions, Maharashtra Government agreed to consider (+)148.00 m level at Tummidihetti involving a submergence of 494 acres which is the minimum possible. At this level, the divertible water would be only 44 TMC against 160 TMC required.

As per the Hydrology studies by CWC, availability of water at Tummidihetti was cleared for 165.38 TMC and out of which the divertible water would be 120 TMC in 90 days against 160 TMC required & proposed.

An attempt also has been done to calculate a possible lift from Tummidhatti without constructing the barriage. It has resulted that about 142 days water can be pumped @ 2TMC per day and barely 31 days during the draught year (Table 2.17). It is therefore necessary to construct the barriage for the optimium utiliztion of water after investing large sums of money for making the lift irrigattion infra structure.

However if one closely looks at the data, water discharge at 75% dependability is found to be 805 TMC during the year 1998. During this year at Tummidihatti 67 days pumping can be done 134 TMC can be extracted and utilizeed without constructing the barrage but small impounding and the technology to be used should be similar to that proposed in thhe KLIP at Sundilla, Annaram and Medaram tank where the capacity of the barrages are small.

Figure 2.10 Water release schedule @ 2.16TMC per day from Tummidihatti with a barrage for years 1999-2015



The detailed water release schedule also has been simulated for both with and without barrage and given in the figures 2.10 and 2.11 Detailed data is in the Annexure 4.

An exercise has been carried out to see whether 3TMC per day can be diverted from Tummidihatti. Theoretical calculations are carried out in such a scenario considering a small diversion from the river Pranahita downstream of Tummidihatti and constructing a storage of 10 TMC within in the territory of Telangana and lifting 3 TMC per day. Table 2.17A indicates it is possible to pump for 157 days in good rainfall year and 63 days in the draught year. At 755 dependable year it is possible to lift for 96 days amounting to divert about 288 TMC from Tummidihatti. This aspect has to be critically evaluated.

Figure 2.11 Water release schedule @ 2.16 TMC per day from Tummidihatti without a barrage for years 1999-2015

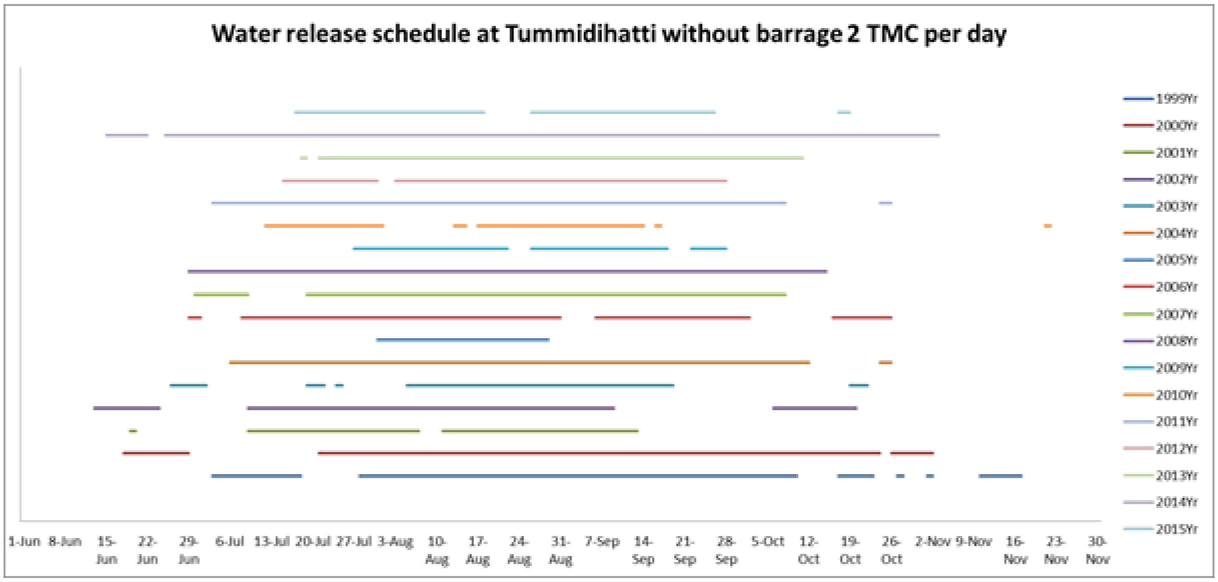


Table 2.17A. Water availability and pumping@3 TMC per day at Tummidihatti

At Tummidihatti based on Ashti and Sirpur discharge data					
With Barrage 10.2 TMC(within territory of Telangana); Pumping 3TMC/day; Initially starts at 4TMC; stop-restart at 3.5 TMC					
Year	**Yearly Discharge**	**Pumping**	**Days Pumping**	**Flow into river**	**% water utilized**
1991 (Max)	2107	471	**157**	1636	22.35
2005 (Min)	336	189	**63**	147	56.25
1998 75% dep	805	288	**96**	517	35.77

2.4.5 Simultaneous withdrawal of water at Tummidihatti, Medigadda and Downstream of Medigadda

Daily discharge data at Ashti and Sirpur have been computed for Tummidihatti which is a confluence of Pranahita and Penganga. Similarly the discharge data of Tekra, Mancheryal and Somanpalli have been computed for Medigadda and Kaleshwaram. Entire fifty years data has been analysed. A computer programme has been developed to simulate a) what would be the possible water pumping at three locations- at Tummidihatti, Medigadda and downstream of Medigadda with storage of 10 TMC, 20 TMC and 5 TMC respectively. These storages can be built by diverting (a) the main river into Telangana jurisdiction (b) pumping can commensurate to understand the pumping at all three locations and its impact on water availability at two downstream locations and (c) the water availability at three locations for the use of Telangana without any major impact upstream and downstream. The brief results are shown in the table 2.18 and the data of all the years is in Annexure 6.

The results indicated that

a) There is possibility to draw water 330 TMC to 162 TMC at Tummidihatti in good and draught year with average of 254 TMC. However, the averages

Table 2.18 Water availability and pumping at Tummidihatti, Medigadda and downstream of Medigadda with barrage for high, low, average and 75% dependable rainfall years (Rate of pumping 2 TMC/day)

	Year	Tummdihatti				Medigadda				Down stream Medigadda			
		inflow	**Pumping**	**Days**	**out flow**	**inflow**	**Pumping**	**Days**	**out flow**	**inflow**	**Pumping**	**Days**	**out flow**
Max	**1991**	**2058**	**330**	**165**	**1725**	**3177**	**332**	**166**	**2843**	**2843**	**130**	**130**	**2712**
Min	**2005**	**310**	**162**	**81**	**147**	**280**	**130**	**65**	**149**	**149**	**22**	**22**	**126**
Ave	**2013**	**1412**	**254**	**127**	**1155**	**1493**	**218**	**109**	**1273**	**1273**	**78**	**78**	**1194**
75% dep	**1998**	**655**	**232**	**116**	**421**	**591**	**186**	**93**	**402**	**402**	**43**	**43**	**358**

are only to give some idea, but in real world there are no averages, since daily discharges are actual not average of several years data.

b) Similarly, at Medigadda the availability is 280 TMC to 130 TMC at Medigadda. This is after pumping at Tummidihatti mentioned above. Without pumping at Tummidihatti the water availability is 364 TMC to 215 TMC for the same years. Therefore, the impact of upstream pumping on Medigadda seems to be less significant.

c) In addition to Tummidihatti and Medigadda, it is possible to draw another about 75 TMC just 15 to 20km below at 90-95 RL, which is about 10m lower than the Medigadda.

d) Total water availability through partial gravity (at Tummidihatti) and pumping at three locations will be around 400 TMC.

e) During high rainfall year withdrawal from Tummidhatti does not affect the inflow of Meddigadda because the total water pumped water is a small fraction of the total discharge.

However, during the draught year there is a significant impact on the withdrawal of water at Tummidhatti. But, total amount that can be pumped is much more than allocated water.

During the 75% dependable year optimum water can be diverted from the river and utilized the entire entitled water to Telangana.

However, how that pumped water be stored, distributed and what kind of infrastructure need to be created in order to use that water is another aspect. The computer simulations are only to get an indication of total water availability considering the similar daily discharge pattern of last fifteen years. Therefore it is concluded that Telangana state can draw between 200 TMC and 400 TMC without any issues with upstream state, Maharashtra and causing any impact at downstream to Andhra Pradesh state.

2.6 Conclusions about Water

Telangana state has been allocated 855 TMC of water as its share from Godavari river basin. Of that 370 TMC of water has been technically allocated to completed projects. Another 208 TMC of water is being allocated for ongoing projects. Of the remaining, 270 TMC, about 160 TMC has been allocated to Pranahita-Chevella project.

This report, through extensive studies and computer programme confirmed that the water is there for pumping at Tummidihatti and Medigadda. The computer models using the daily discharge data at both these locations have been analysed using two parameters (a) that the pumping per would be 2 TMC, and (b) a minimum storage facility be created within Telangana territory without leading the submergence, particularly at Tummidihatti to avoid issues with Maharashtra.

From the data presented in the tables and release schedules indicate that

i. At Timmudihatti at the rate of 2 TMC pumping water is available between 82 days to 164 days in year, depending on the good monsoon and very bad monsoon year. There is possibility to draw water a minimum of 174 TMC at this location. Here first gravity can be used and then pumping to reach Yellampalli. That is part of the original scheme. So water availability at the Tummidihatti will be at least 174 TMC and could go to as high as 347 TMC. If water diversion is increased through increased canal diversion, without causing submergence, the capacity to draw water can be further increased.

ii. At Medigadda, with 20 TMC storage, the possibility to draw water @2.16 TMC per day based on computer model indicate that from minimum during the low monsoon year is 220 TMC and flood year 352 TMC.

iii. The advantage of shifting from Timmudihatti to Medigadda in terms of water availability seems to be only 40 to 50 TMC. However, the cost of drawing same quantity of water from both the location in terms of power consumption seem to be significant which has been discussed in later chapters.

This raises two major questions about the "re-engineered" version of the B.R.Ambedkar Pranahita-Chevella Sujala Sravanthi Project.

1. What are the specific reasons for shifting the intake site from Tummidihatti to Medigadda? This in spite a reported improved relations between two states and signing of the new co-operative agreements.
2. Even after shifting proposed site from Tummidhatti to Medigadda and building three barrages along the main River Godavari, another barrage with FRL +148 m is proposed at Tummidhatti limiting supply to Adilabad district. This is the part of agreement with Government of Maharashtra recently. All this will result in significant increase the investments. It appears, such "Reengineered" version actually lead to major capital expenditure involving three stages, each having at least 9 pumps and massive power requirement which has been discussed.
3. There seem to be strategic advantage of drawing water from Tummidihatti, since through gravity can be used. However, this requires further examination of water availability using the model instead.

Based on extensive analysis of daily discharge data our study clearly indicated that water is not the issue, but using it through gravity, pumping at the most cost effective way should be the prime consideration.

However, we are not here suggesting drawing water from Tummidihatti which will automatically solve all the other issues raised in this report and nor the issues are only related to shifting to Medigadda. But clearly it appears, there is no added advantage of both in terms of water availability in shifting the location. But certainly cost will be much higher. Even from drawing water from Tummidihatti need to be evaluated in terms of power consumption, capital costs etc.

Chapter: 3

Kaleshwaram Lift Irrigation Project: Pumping and Storages

3.0 Introduction

Proposed Kaleshwaram lift irrigation scheme is a revised and re-engineered project of the earlier proposed Dr.BR Ambedkar Sujala Sravanthi to be built at Tummidihatti in Adilabad district. At present this scheme has been renamed as Kaleshwaram lift irrigation scheme and is planned to build at Medigadda as described above. The details are shown in the line and schematic diagrams (Figure 3.1a and b) and discussed as under.

3.1 Stages of pumping

As mentioned earlier, this is a massive lift irrigation scheme involving several stages. First time in India such lift irrigation scheme is being planned. In order to understand the lift irrigation, based on the line diagram and sketchy information here and there, the following text has been drafted. This is to give an idea to reader about the stages involved and the complexity of this lift irrigation scheme.

If and when completed, this Kaleshwaram lift irrigation will be first of its kind of lifting water more than 500 meters and transporting 200 km distance and most of it being used for irrigation.

In order to reach water to Hyderabad, water is lifted from Medigadda and pumped in six stages. Scheme is described in six stages by the authors for convenience only. These stages are as follows.

- Stage I: From Medigadda to Yellampally
- Stage II: From Yellampally to Mid-Manair Reservoir
- Stage III: Mid Manair to Upper Manair
- Stage IV: From Mid-Manair to Mallannasagar
- Stage V: From Mallannasagar to Kondapochamma
- Stage VI: From Kondapochamma to Hyderabad/Shamirpet

In addition to these main stages, there are following stages:

- Stage I A
- Stage I B
- Stage I C
- Stage II A
- Stage II B
- Stage III A
- Stage III B
- Stage IV A
- Stage IV B.

In this report Stages V and VI are not discussed.

3.1.1 Stage I: From Medigadda to Yellampally

The Stage I is taking water from Medigadda to Yellampally a distance along the river 75 km. This stage I is essentially creating a reverse flow along the main Godavari river. The vertical lift from Medigadda (100 m RL) to Yellampally (148m RL) is 48 m lifting, but this involves three levels of lifts with about 27 pumps and three barrages on main Godavari River. This stage involves construction of three barrages and three levels lifts to provide water for pumping at approximately 2 TMC per day. The River Godavari becomes reservoir to pump water upstream.

3.1.2 Stage I A: Medigadda to Annaram

All the water for Kaleshwaram lift irrigation starts from Medigadda. Near Medigadda village (latitude 18°42’48” and longitude 80°04’37”) a barrage is proposed to impound the water for first stage of lifting water. The barrage is about 1632m across the river at 100m FRL, after confluence of Pranahita. The computer generated map indicates (Figure 2.2) that the total area submerged at 20 TMC storage capacity will be 15610acres and the water will be backed up to Kaleshwaram a distance 20 km from the proposed barrage.

The pumping speed will be at 656 cubic meters per second; this means in a day about 2 TMC of water is pumped by 9 pumps with a capacity of 50MW each.

The approximate pumping location has been indicated in the map. The water will be lifted 21m and poured into main Godavari, just before the proposed barrage at Sundilla.

Figure 3.1a Line diagram of Kaleshwaram Lift irrigation scheme

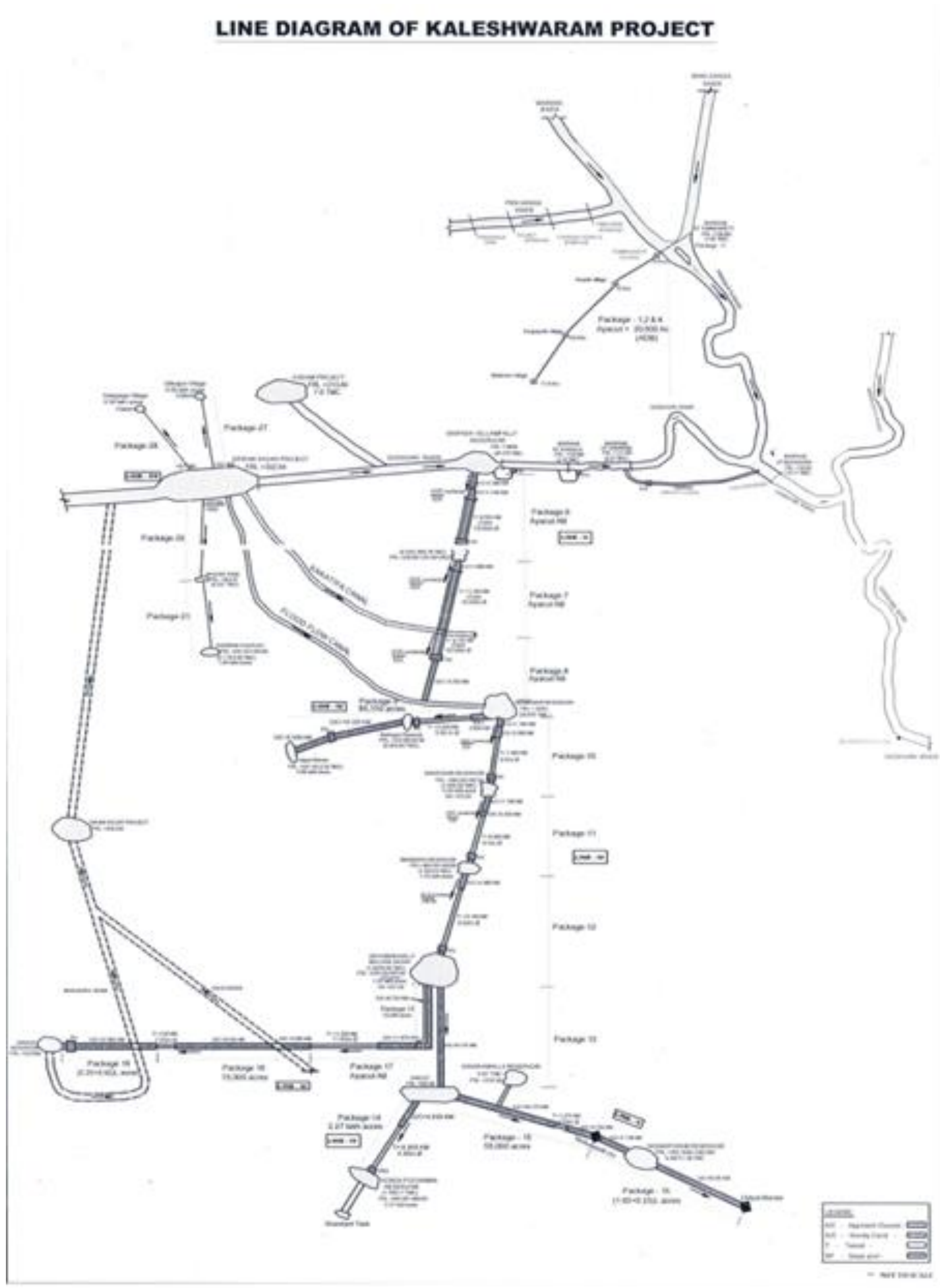
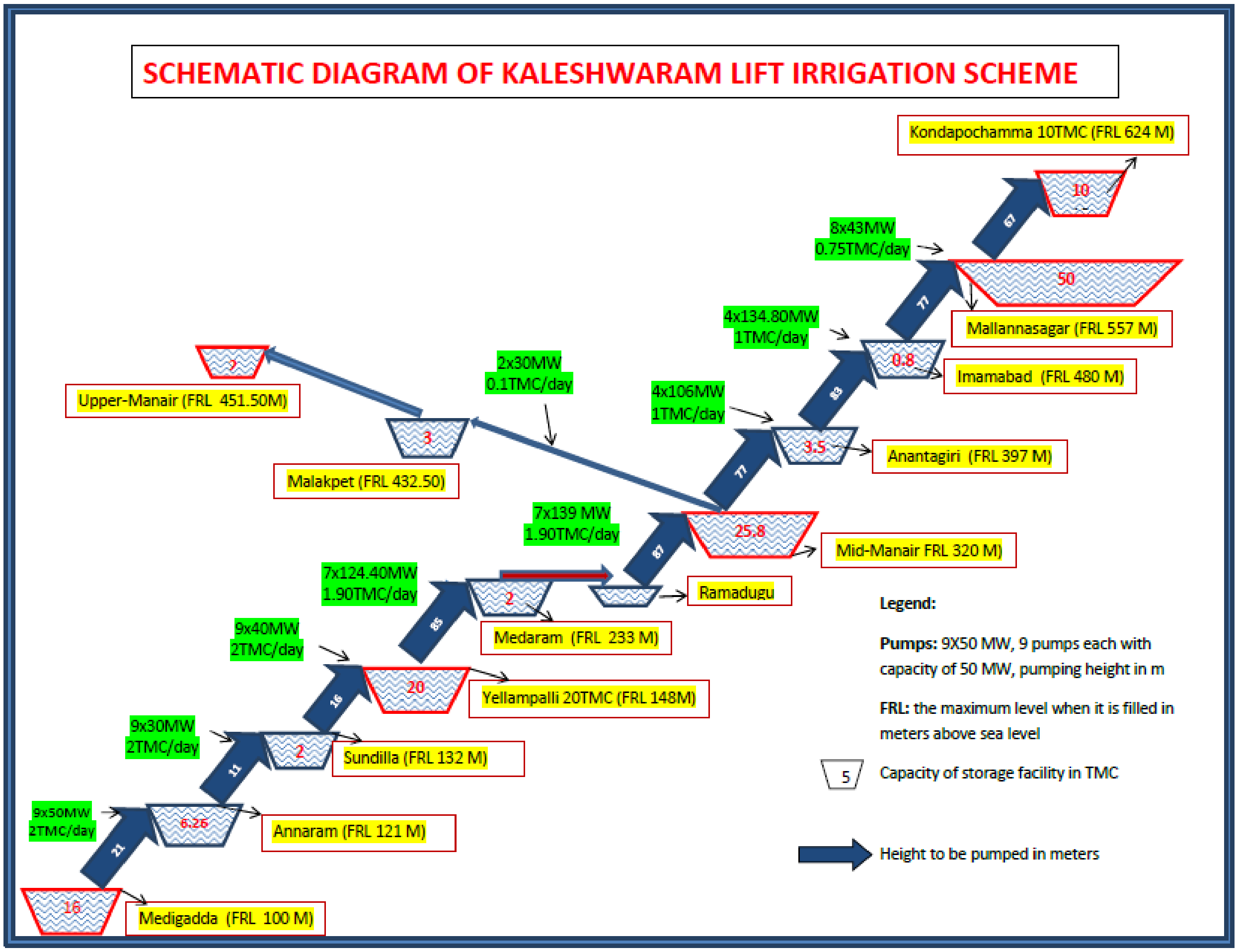


Figure 3.1b Schematic diagram of Kaleshwaram Lift Irrigation Scheme



3.1.3 Stage I-B: Annaram to Sundilla

From the water stored in the barrage at Annaram (FRL 121m) , on main Godavari will be lifted further 12 meters (FRL 132m) in order to reach another barrage at Sundilla The Sundilla barrage will be 1119m across the river Godavari. And another 9 pumps with a capacity of 30 MW each will be fitted to lift the same water to across the proposed bridge at Sundilla.

3.1.4 Stage I-C. From Sundilla to Yellampalli

From Sundilla (FRL 132), the water will be lifted with same number of pumps and with capacity 40MW each to pump into the existing Yellampalli (FRL 148 m) barrage. The vertical height of lifting water would be 17 meters.

To sum up the Stage I pumping, there will be at least 27 pumps with another three or four stand by at three locations-Medigadda, Annaram, Sundilla. The water will be pumped backwards on Godavari River at the rate of approximately, 656 Cumecs, which is 2 TMC per day. Though this is only 48 meters actual height and 75 km straight line distance, there are three levels are planned. Actual pumping might be around 113 M considering designs and head losses.

3.1.5 Technical questions related to this stage I

In earlier plan this project known as Pranahita-Chevella, the intake point was at

Tummidihatti further north of Medigadda near Maharashtra boarder. Since the Maharashtra Government has not agreed for a barrage of 152 FRL which might cause submergence of many villages in Maharashtra, Telangana Government has moved the intake point to Medigadda. This stage raises several technical and practical questions some of them are mentioned below.

- This stage involves three barrages, 27 to 30 pumps and massive expenditure on electricity just to transport water to Yellampally. This could have been reduced significantly either re-visiting the original location at Tummidihatti.
- Close examination of water discharges at Tummidihatti indicated that it was possible to draw water from there to Yellampalli without any submergence or the same level of submergence agreed by Maharashtra Government. This may be closely examined through independent experts, both in terms of costs, long term implications.
- There is general consensus, though informal, that this three level pumping and three barrages may be unnecessary and extremely expensive. Additional costs of pumping due to shifting of intake point from Tummidihatti to Medigadda is around Rs 1250 crore every year. Details are given in Chapter V.

3.2 Stage II: From Yellampally barrage to Mid-Manair Reservoir

This stage involves the same water (at 624 cumecs, 1.90 TMC per day) which has been pumped into Yellampally barrage further transport to Mid-Manair reservoir. This stage involves two levels of pumping, first from Yellampally to Medaram(about 13km) and then transporting from Medaram to Ramadugu through twin tunnel system and Pumping water at Ramadugu to discharge water into Flood Flow Canal of SRSP. From this point the water reaches the Mid-Manair reservoir through FFC. The rate of pumping at this stage II is 624 cu.m per second, this almost the same as at Medigadda, which means if pumping is done for 24 hours the volume of water will be about 1.90 TMC. This is rate of pumping specified all the way upto Mid-Manair at both the levels of Stage II. Yellampally FRL is 148 m and the Mid-Manair FRL is 318. This stage involves about 170 m. of lifting, but might be around 250 considering the designs and head losses etc.

The Mid Manair dam in Boinapally mandal of Karimnagar is under construction. The dam started overflowing in September 2016 rains and the embankment was washed away leading to flooding in the region. On 25th of September more than 1000 people living in six nearby villages have been evacuated due to floods caused by breach of Embankments. This reservoir will hold 25 TMC of water and facilitate further transfer of 1TMC per day to Mallannasagar in Third stage of pumping.

3.2.1 Stage II A: Yellampally to Medaram Tank

The water from Yellampalli (FRL 148 m) will be first pumped to first Medaram reservoir (FRL 233 m) involving pumping of about 85 meters. There is an existing tank, which will be converted into reservoir to convey the water further up. In order to reach water to Medaram tank, pumping need to be done to lift water 120 m considering the head losses and pumping designs etc, and then transport through tunnels to a distance of 12 Km. In rest of the distance, two parallel tunnels with 10 meter diameter are being dug to transport water from Yellampalli to Medaram.

3.2.2 Stage II B: From Medaram to Flood flow canal

From Medaram, water will be transported to Ramadugu Pump house through twin tunnels and water will be pumped at Ramadugu and discharged into FFC, the water will reach to Mid-Manair through FFC. Stage II, Level 2 will involve 85meters of lift (233 to318) and then transport of water 24 km until it reaches flood flow canal.

3.2.3 Mid-Manair reservoir

Mid-Manair reservoir is being built on Manair River and the foundation stone was laid by Late PV. Narashimha Rao in 1991. The main purpose then envisaged was to store flood water from SRSP. The 130 km flood flow canal with a deliver 624 cumecs or (about 2 TMC per day) was planned to reach Lower Manair at Karimnagar town. In between the Mid-Manair dam is supposed to be holding about 25 TMC of water and irrigating 100,000 ac, through two canals, right (21 km) and left (60 Km). This reservoir, then supply water to lower Manair which has its own capacity of 24 TMC of water.

The Mid-Manair dam with 400 m length and 45 meters height from river level is expected to store 25 TMC of water. The idea of connecting the Kaleshwaram lift irrigation canal with this reservoir seem to be based on two reasons a) the flood flow will not be coming enough to fill the reservoir and then supply to Lower Manair dam b) the Kaleshwaram lift irrigation will provide enough water during every year to fill the dam and supply further to Mallannasagar.

3.2.4 Some of the technical questions on Stage II

1. The Medaram reservoir capacity is about 2 TMC, whether it can support pumping at the rate of 624 cumecs (1.90 TMC/day). This needs to be examined.
2. In the original Pranahita-Chevella scheme, another lift was contemplated between Medaram and Ramadugu and release of about 32 TMC of water into Kakatiya canal leading to Lower Manair Dam. Now this level is deleted in the re-engineered scheme. In the revised scheme the same quantum of water is proposed to be taken upto Mid-Manair Dam and release the same into Lower Manair Dam from Mid-Manair. This clearly entails additional pumping costs, around Rs 180 crore, for lifting 35 TMC over 50 meters. Reasons for such decision are not clear.
3. It is proposed to draw 32 TMC of water from SRSP foreshore to irrigate about 270000 acres of land in Adilabad and Nizamabad districts, and in lieu of this drop 32 TMC of water at Mid-Manair Dam to reach Lower Manair Dam. When SRSP is already facing acute shortage of water, irrigating 270000 Acre of additional area as proposed above is not possible.

Stage III: Mid-Manair to Upper Manair, this lift off takes from Mid Manair reservoir with a discharge of 24 cumecs at FRL 318 m for irrigating a total area of 80,000 acres. It involves a gravity canal of 32.50 Km and tunnel of 11.65 Km length.

Stage III-A: Proposed at Malakpet (V), Konaraopet (M), Karimnagar (D) with two numbers of pumps each with a capacity of 15 MW with total power of 30 MW required.

Stage III-B: Proposed at Singasamudram (V), Gambhiraopet (M), and Karimnagar (D) with two numbers of pumps each with a capacity of 2 MW with a total power of 4 MW required.

3.3 Stage IV: Mid-Manair to Mallannasagar

Mid-Manair FRL is 318 m. This means when reservoir is full with 25.8 TMC of water the water level will be at 318 m. from mean seal level. Already up to this stage, water has been lifted from 100 m RL to 318 meter RL, which is vertical lift of 218 meter. At this stage about 2 TMC of water will have to be pumped for nearly by five levels of pumping transporting through three barrages, two large tunnels and flood flow canal to reach approximately 170 km distance from the source at Medigadda.

From Mid-Manair, water need to be pumped further 240 meters involving three levels of pumping and storing to reach Mallannasagar. The FRL of Mallannasagar is supposed to be at 557 meters. The distance between Mid-Manair and Mallannasagar is about 50 km.

3.3.1 Stage IV-A: From Mid-Manair to Ananthagiri Reservoir

From Mid-Manair, water will be further lifted at the rate of 321 cubic meters per second to Ananthagiri reservoir. At this rate of pumping, in 24 hours the volume of water pumped will be about 1TMC. The distance between two points is about 12 km and the lift involves about 80meters. The Ananthagiri FRL is 397 m. 4 pumps of 106 MW each are proposed to be installed here to lift the water at 321 cumecs. Ananthagiri reservoir is designed to have 3.2 TMC of water at any given time. The reservoir will be receiving water at 321 cubic meters per second (cumecs) and pumping out at 301 cumecs. The remaining 20 Cumecs, which is about 0.06 TMC of water per day is used at this stage.

3.3.2 Stage IV-B: From Ananthagir reservoir to Imamabad Reservoir

The distance between Ananthagiri reservoir to Imamabad is about 12 Km. Imamabad FRL when it is full will be 480 meters. Therefore, water need to be pumped 80 meters height from Ananthagiri to Imamabad. 4 pumps of 134.80MW each are proposed to be installed here with discharge of 301 cumecs each. Imamabad will be receiving water at 301 Cumecs (0.92 TMC per day) and will be pumping out at 248 cumecs (0.76 TMC per day). That means about 53 cumecs (0.16 TMC per day) of water is being used at this level.

3.3.3 Stage IV-C: From Imamabad to Mallannasagar reservoir

From Imamabad the next place water will be pumped is the controversial, Mallannasagar. Imamabad's FRL is 480 m and Mallannasagar FRL is 557 m, which is nearly 80 meters, which is same as Ananthagiri to Imamabad. Water will be pumped at 248 cumecs (0.75TMC per day) to reach Mallannasagar. The distance is about 22 km with vertical height of 80 meters. 8 pumps of 43 MW each are proposed to be installed here with a total discharge of 248.50 cumecs.

3.4 Mallannasagar reservoir

As mentioned earlier, the Mallannasagar reservoir is part of the Kaleshwaram lift irrigation project. This is the same as earlier project known as Pranahita-Chevella during AP forced on Telangana region. However, Kaleshwaram Lift Irrigation Project is though conceptually same, but several modifications, changes were have been made by the present Telangana Government. One of the major modifications is Mallannasagar. Earlier, this reservoir had only 1.5 TMC of water storage, now this has been made to 50 TMC. May be for these major changes and associated displacement, this specific part of the project has become focus and center of controversy. Actually, the other changes, though even much bigger in terms of technical, cost wise, have not been focus of discussion.

Figure 3.2 GIS software generated Mallannasagar reservoir

Location for the reservoir has been selected to close to Komeravelli Mallanna Temple, in Medak district. The Temple is famous and there is annual Jatra takes place between Sankaranti (second week of January) through Ugadi. During this period large number of devotes come to visit the place. Also during the Mahashivaratri, another auspicious period pilgrim comes to visit Temple.

The Reservoir is supposed to store 50 TMC of water (1,500 million cu.m) (About 50 times Hussainsagar capacity) during the monsoon period and then release for the irrigation. The water to Mallannasagar reservoir is pumped from Medigadda. Before reaching Mallannasagar reservoir, water is pumped in three stages. So water lifted at Medigadda will go through three stages and 9 levels and through tunnels, gravity, four surface storages and then reach the reservoir.

Mallannasagar reservoir with 50 TMC capacity is being proposed. The submergence area is calculated and shown in the table 3.1 and shown in figure 3.2. The total area of the reservoir is reported to be around 21,000 ac in which 21 villages involving 3,112 houses. Mallannasagar will be major reservoir, if built, will be larger than the Mid Manair and almost close to SRSP (this is 90 TMC, but many times water will not exceed 30 TMC). The Bund of the Mallannasagar will exceed 40 meters which is massive for an “Earthen” dam.

The proposed reservoir has been simulated based on the elevation and contours. Initially the project area has been plotted on the google earth and found out number villages that would be submerged, identified the locations, topo-sheet numbers and other geographic coordinates. Relevant SRTM and DEM details have been downloaded from the public domain. The downloaded data has been processed in ArcGIS environment. Contours with 5 meters interval have been generated. A complete topographic map has been simulated, corrected and verified with Survey of India topo-sheets. Validation has been done after plotting on the Google earth. The entire area has been gridded and identified the number of villages and tandas in Thogata and Kondapaka mandals that are likely to submerge.

Area and volume of the computer generated Mallannasagar reservoir for various changing parameters are given in the table 3.1.

Table 3.1 GIS software generated Mallannasagar reservoir for various changing parameters

Contour Range (m)	Area (m^2)	Area (Acres)	Area (Ha)	Cumulative Area (Acres)	Cumulative Area (Ha)	Volume (M^3)	Volume (MCM)	Volume (TMC)	Cumulative Volume (TMC)
505 - 510	76,986	19.0	7.7	19.0	7.7	384,930	0.4	0.01	0.01
510 - 515	1,119,744	276.7	112.0	295.7	119.7	5,983,650	6.0	0.21	0.22
515 - 520	2,737,394	676.4	273.7	972.1	393.4	19,670,620	19.7	0.69	0.92
520 - 525	7,109,382	1,756.8	710.9	2,728.9	1,104.4	55,217,530	55.2	1.95	2.87
525 - 530	9,382,546	2,318.5	938.3	5,047.4	2,042.6	102,130,260	102.1	3.61	6.48
530 - 535	9,459,724	2,337.5	946.0	7,384.9	2,988.6	149,428,880	149.4	5.28	11.75
535 - 540	9,981,428	2,466.5	998.1	9,851.4	3,986.7	199,336,020	199.3	7.04	18.79
540 - 545	9,896,002	2,445.4	989.6	12,296.7	4,976.3	248,816,030	248.8	8.79	27.58
545 - 550	9,969,226	2,463.4	996.9	14,760.2	5,973.2	298,662,160	298.7	10.55	38.13
550 - 555	**7,532,052**	**1,861.2**	**753.2**	**16,621.4**	**6,726.4**	**336,322,420**	**336.3**	**11.88**	**50.00**
555 - 560	6,802,323	1,680.9	680.2	18,302.3	7,406.7	370,334,035	370.3	13.08	63.08
560 - 565	280,386	69.3	28.0	18,371.6	7,434.7	371,735,965	371.7	13.13	76.21
565 - 570	219,207	54.2	21.9	18,425.7	7,456.6	372,832,000	372.8	13.17	89.38
570 - 575	108,322	26.8	10.8	18,452.5	7,467.5	373,373,610	373.4	13.19	102.56
575 - 580	27,403	6.8	2.7	18,459.3	7,470.2	373,510,625	373.5	13.19	115.75
580 - 585	15,982	3.9	1.6	18,463.2	7,471.8	373,590,535	373.6	13.19	128.95
585 - 590	14,578	3.6	1.5	18,466.8	7,473.3	373,663,425	373.7	13.20	142.14
590 - 595	10,094	2.5	1.0	18,469.3	7,474.3	373,713,895	373.7	13.20	155.34
595 - 600	1,373	0.3	0.1	18,469.7	7,474.4	373,720,760	373.7	13.20	168.54

Conversion:	1TMC = 28316846.592 m^3
	1 Acre = 4046.86 m^2

The total distance water will be travelled to would be around 200 Km and the aerial distance between Medigadda and Mallannasagar would be about 125 km.

Medigadda FRL is at 100 m RL and Mallannasagar FRL is 557 m, the vertical height would be 457 m, but actually pumping might involve at least 800 meters when all losses and design margins are added.

Based on extensive GIS analysis following observations have been made on Mallannasagar Reservoir:

- Total area of submergence for storing 50 TMC is 18,460 acres.
- This involves the submergence of 21 villages in 2 mandals of Medak district.
- The northeastern side of the Mallannasagar is high land area covered with hillocks.
- A retaining wall of approximately 40m height need to be constructed which can hold the water pressure exerted in due course.
- Small retaining wall has to be constructed in the northeastern

portion to isolate for decreasing the area of submergence the other side of hillocks.

3.4.1 Results of the GIS study of Mallannasagar

- Reservoir area has the lowest contour of 505 m. When water is filled to FRL 557 m, the water will be 43 meters.
- Area between each 5 meter contour has been measured using the DEM. (Table 3.1 gives the values in ha and ac of area in each 5 contour). Almost 95% of the area is between 520 m to 560 m.
- The total area based on the dam location given would be 7,474 ha (18,460 ac).
- The maximum height (at the lowest point) of the dam in order to fill up to 565 m would be 55 meters.
- The water storage capacity of each five meter water column has been given in the table.
- When water is stored up-to 565 m, it would reach 76 TMC.
- At the Sill level 527, the dead storage would be around 3-4 TMC.
- At the stated FRL of 557, it would store of 55 TMC with dead storage of 5 TMC.

3.4.2 Some technical and other concerns of Stage IV pumping

3.4.2.1 Where is water for storage at Mallannasagar?

From Mallannasagar and above, the KLIP proposes to irrigate 5.64 lakh acres under Mallannasagar and 2.40 Lakh Acres under Kondapochamma reservoir and supply about 30 TMC of water to Hyderabad drinking needs and about 26 TMC of water for industry and drinking water needs to villages enroute.

Thus the total water that needs to be handled at Mallannasagar reservoir would be (Assuming 1 TMC would irrigate about 9000 acre):

	Used for	Acre in Lakhs	Water in TMC
Mallannasagar & surroundings	Agriculture	5.64	63
Mallannasagar to Kondapochamma	Agriculture	2.4	27
Hyderabad	Drinking	-	30
Hyderabad	Industry	-	26
Total			146

All the above water has to reach Mallannasagar from Stage IV of lifting from Mid-Manair Dam through Imamabad pumping station.

Assuming 120 days of pumping under KLIP, maximum water that can be pumped from Imamabad, whose pumping capacity is 0.75 TMC per day, to Mallannasagar is: 120x0.75= 90 TMC.

This water barely meets the requirements of irrigation proposed, about 90 TMC, from Mallannasagar onwards. There is hardly any water left for 56 TMC meant for other uses. Even if one considers 150days of pumping, only 22.5 TMC of additional water is available falling short of requirement of other uses. Hence there is hardly any possibility of water reaching Mallannasagar reservoir over and above the proposed requirements under KLIP.

Even if someone manages to find additional water by some means, we should not forget additional storage now proposed to be created above Mallannasagar, like Gandhamalla, Baswapur, Kondapochamma etc, to the tune of 77 TMC, excluding 50 TMC capacity now proposed under Mallannasagar. Apart from this, water is proposed to be supplied to Singur reservoir (28 TMC) and Nizamsagar reservoir (17 TMC) from Mallannasagar. Even if one undertakes pumping round the clock for 365 days, presuming such water is available in

Godavari, not a single drop of water will be left at Mallannasagar for the purpose of storage.

Thus creation of such large storage to the tune of 50 TMC needs re-examination. In our view, a storage upto 5 TMC meets all the requirements proposed under KLIP:

- Normal dam is always across the river, but in this case it is parallel to the stream which would create high hydraulic gradient at the downstream creating water logging and artesian conditions.
- Major lineament is noticed parallel to the proposed Main bund of Mallannasagar. With 40m-60m water column will rejuvenate the entire structure into creating perennial flow that would result in scouring phenomenon from the reservoir.
- It can create reservoir induced seismicity similar to Koyna reservoir near Satara district, thereby possibility for a massive earth quake.
- The rehabilitation costs may be too high.
- The dam may not be at proper place, knowing the topography, it is better to revisit the location, even if dam need to be build.

Chapter: 4

Proposed Irrigation by Kaleshwaram Lift Irrigation Project, KLIP

4.0 Introduction

Kaleshwaram Lift Irrigation Project is proposing to provide about 160 TMC of water for irrigation at various distribution points. Assuming that this water is available after completion of the KLIP, the estimated area to be irrigated is around 18 lack ac. This is very large area. Before discussing the possibility of irrigating 18 lack ac by KLIP, a brief review has been presented below on the current situation of the irrigation through three sources such as canals, bore wells and other wells, tanks. KLIP will be adding to Canal irrigation.

4.1 Current status of Irrigation in Telangana: A brief review

Statistics about irrigated area is mystery, particularly during the regimes in AP. However, based on recent publication of statistics by Telangana Government here are some basic figures and analysis. This will give broad understanding of the irrigation in the state of Telangana in the context of Kaleshearam Lift irrigation project.

Statistics on Area of irrigation are given in hectares (in order to convert broadly one can use 2.47 ac is one ha) and also give as gross and net. The gross area has to be always more than net area. Area irrigated more than once is counted in the gross area. For example if net area is 10 ha, of that 5 ha is irrigated more than once in particular agriculture year, so gross area of irrigation in that year will be 15 ha.

The gross area during the last five years fluctuated between 52.6 lakh acres (21.3 lakh ha. (2008-09) to 78 lakh acre (31.6 lakh ha (2013-14). During the same period, then net area fluctuated from 36.8 lakh acres (14.9 lakh ha) to 56.5 lakh acres (22.9 lakh ha). During the same five years, the fluctuations could be -22% to +42% over previous year. So are under irrigation is highly fluctuating, both gross and net area.

There is almost 10 lakh ha of difference between gross and net during the period, except during 2009-2010, a low rain fall year. During that year difference is about 6 lakh ha.

Most interesting observations about the fluctuations of area under irrigation is on Canal irrigation, this is where the most of Government spending has gone in and this is most expensive in terms of creating each ha of irrigation.

During the same five year period (2008-09 to 2013-14), the net area of canal irrigation fluctuated from 3.25 lack ha. 2011-12) to just 0.90 lack ha (2012-13) the very next year. For the same years, the gross area irrigated is from 1.2 lakh ha to 4.7 lakh ha. Year to year fluctuations are highest for area under canal irrigation.

Interestingly the tube well irrigation is most stable, regardless of the fluctuations in canal irrigation. During the same five year period, the net area under tube well irrigation fluctuated from 12.6 lakh ha. (2009-10) to 17.1 lakh ha. (2013-14) and Gross from 18.4 lakh ha. to 23.3 lakh ha.

Area irrigated by Tanks, seem to be relatively stable, except for 2009-10, this may be due to acute shortage or rainfall.

Based on five years data presented on irrigation, the following observations are noted.

- **Well irrigation**: The well irrigation is the prime source of irrigation in Telangana. Area under well irrigation in Telangana could be as high as 85% to 66%. For example, during 2013-14, gross area under irrigation was 31.6

lakh ha, of that 23.3 lakh ha, 74% is by the wells. The figures are almost the same for other years as well. It is also same for net area. So three ha out of four ha irrigated in Telangana are by the well irrigation. Except for providing irrigation, the infrastructure for well irrigation is entirely from farmers.

- **Canal irrigation** is just 7% to 15% of the total Gross irrigated area. Canal irrigation is highly fluctuating and it appears the canal irrigation is the most un-reliable mode of irrigation.
- **Tank irrigation**: The tank irrigation while is somewhat stable, around 2 lack ha net area and 3 lack ha for gross, but it could go as low as 0.56 lakh (2009-10) during low rain fall year. The fluctuations of the canal and tank irrigation are coinciding, though there is an impact on well irrigation during year as well, the impact is not as wide as for canal and tank irrigation. For example during 2009-10, the tank irrigation dropped to 0.56 lakh ha from 2.3 lack ha the previous year, for the same year, the canal irrigation dropped to 1.37 lakh ha from 2.73 lack ha. But for the well irrigation it dropped to 12.6 lakh ha from 13.1 lakh ha, a drop of 8%. Whereas for Canal it was 48% and for tank irrigation it was 76%. This clearly indicates that the well irrigation might not be hit by low rain fall from the previous year as much as canal and tank. However, more data need to be analyzed to see if tube well irrigation can sustain long term low rain fall spanning to few years.
- **Government investments in Irrigation**: It is important to note that, all the expenditure of major irrigation for last several decades could provide just 3.25 lakh ha (2011-12 this is the maximum year in last five years canal irrigation). This is just 16% of the net irrigated area in that particular year. This is also the case for the gross irrigated area as well. Highest ever reported gross irrigated area in Telangana was 5 lakh ha during 2010-11. This is just 16.6% of the total gross area irrigated, 29.98 lakh ha, during that particular year.

4.2 KLIP: promised irrigation

KLIP main objective is to provide irrigation to 18,19,550 ac, which is about 700,000 ha. As on 2013-14 the net canal irrigated area is just 3.25 lakh ha. This is in all

Table 4.1 Command area under irrigation in KLIP

Link	Description	Command area (acre)
Barrage	Ayacut under Annaram and Sundilla	30,000
Link II	Yellampally Midmanair P6-8	0
Link III	MidManair to Upper Manair P9	80,000
Link IV	Mid Maanir to Mallanna sagar P10 - 14	5,95,754
Link V	Mallannasagar to Chityala P 15 and 16	2,43,500
Link VI	Mallannasagar to Cherial P17-19 &23-26 *	2,80,296
Link VII	SRSP foreshore to Nizamsaga Canal and Nirmal-Mudhole P 20-22, 27&28 **	5,90,000
	Total	**18,19,550**
	Total cost of project Rs 90, 000 crores	
	Water for Agriculture 80%	
	Cost per ac ~ 38 lakhs	
	* no data on P 23-26	** no data on P 27&28

the districts of Telangana, including water utilized from Krishna basin. It is important emphasize here that, in entire Telangana, ever since Governments have started investing in canal irrigation, including Nizam's time and post-independence could create just 3.25 lakh ha or (8 lakh ac) of net irrigated area. One single project Kaleshwaram Lift irrigation project wants to create irrigation for 700,000 ha. KLIP (Table 4.1 and 4.2).

- Is this 18,19,550 is net area to be irrigated or includes the stabilization, If this includes stabilization, then what the proportion.
- The breakup of each district seems to be really far stretched. For example, currently Nizamabad district has total area of net irrigated (2013-14) is about 4 lakh ha, of that about 35,381 acres was net irrigated by canals. KLIP want to increase another 454,500 ac, which is 180,000 ha, this is about 5 times more than existing canal irrigated area. Similarly the increase for Nalgonda will be more than 130% on existing canal irrigated area (table 4.2).

Table 4.2 District wise command area under irrigation in KLIP proposed net KLIP area, probable production and Revenue

Area under Irrigation present and In future units					
Districts	**Total**	**GW**	**Canals**	**Proposed KLIP**	**% increase under canal**
RR	182	176	1	50	4,351
MED	465	413	7	731	10,444
NIZ	574	448	87	455	520
ADL	251	173	26	100	389
KRM	1,374	1159	137	201	148
WAR	854	652	29	21	71
NAL	751	513	200	262	131
Data in Thousand Acres (rounded off) ***Source: Statistical year book 2015***					

The KLIP propose to provide irrigation in seven districts. The table gives the proposed area to be irrigated by KLIP and the net area irrigated now in each of the district. The increase will be several thousand folds. Such an increase by canal irrigation, with a single project, with 160 TMC of water seems to be far stretch.

The proposed are to be irrigated by KLIP need to provide the following clarifications in order to create confidence in the figures.

- Is this area proposed to irrigate, 18,19,550 ac (or about 7 lakh ha) is realistic?

The area to be irrigated by KLIP seems to be highly impossible. Such spectacular increase with a single project seem to somewhat un-realistic and impractical. However, more specific information on where the irrigation is going to be and how the no 18,19,550 ac figure has been arrived is required to have credibility on the proposed project.

Chapter 5

KLIP: Power requirement for pumping

5.0 Introduction

Before getting into the details and the discussion about the electricity requirement, three things need to be reiterated very clearly.

5.1.1 Telangana needs to use Godavari water

The state is entitled to use 855 TMC of Water from Godavari basin. After all the completed and ongoing projects, still Telangana state can use 277 TMC of water. Godavari water can only be used through lift irrigation, combination flood flows and filling of tanks etc. There is complete agreement about it, no one is disputing or questioning about pumping water from Godavari River. That is fact and the geography dictates it. Even after formation of Telangana state, Godavari continues to flow as it was and that will not change.

5.1.2 Lift irrigation means electricity

So in order to use Godavari water, electricity has to be used. No one is disputing that aspect.

5.1.3 Effective methods, cost effective means

The entire debate is about how to lift, from where, how effective etc. More these are debated, more views are considered the more effective method will emerge. The efficient use of electricity, efficient pumping and cost effective technology, maintenance of the systems need to be debated in order to take transparent and cost effective decisions. This is the discussion and the following information should be viewed in that context.

5.2 Estimating the electricity requirement

Electricity is key component of Kaleshwaram Lift irrigation. Not the water, which is there, but the electricity and its costs will determine the effectiveness of this project. Electricity requirement for the Kaleshwaram Lift Irrigation Scheme (KLIP) is estimated based on the pumping capacities proposed at various pumping stations and ayacut proposed to be irrigated at various water distribution points along the lift scheme. No official information is available in public domain on pumping capacities and discharge particulars and hence information published in various newspapers and data shared by some officials during the course of discussions on the scheme is used in the estimation of electricity requirement for KLIP.

5.2.1 Following step by step procedure is used to estimate the electricity requirement for KLIP

Step-1: Estimate the electricity requirement for lifting 1 TMC of water from Medigadda (starting point) to each of the water distribution points and sown in the schematic diagram.

Step-2: Calculate electricity requirement to irrigate 1 Acre at each water distribution point. For this, it is assumed that 1 TMC of water would irrigate about 9,000 acres. This figure is based on generally accepted norm that 1 TMC of water would irrigate about 6,000 acres for paddy and 10000 Acres for ID crops. Of the total proposed irrigated area under KLIP, paddy and ID crops are assumed to be grown in the ratio 20:80.

Step-3: Total electricity requirement under KLIP = electricity required to irrigate 1 Acre at each water distribution point x Ayacut proposed under each water distribution point.

Figure 3.1b Schematic diagram of Kaleshwaram Lift Irrigation Scheme

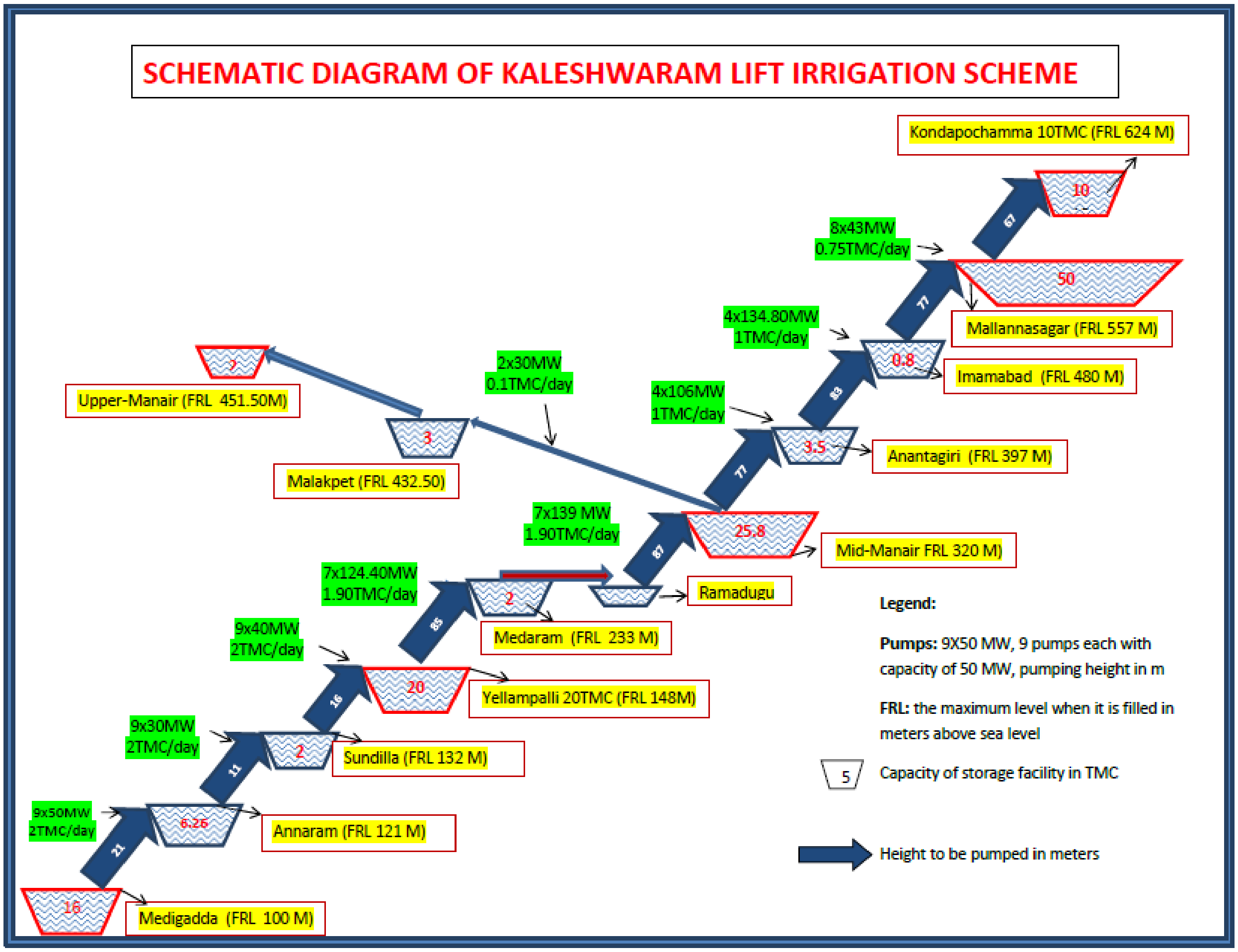


Table 5.1 Pumping Capacities at Each Pumping Station under KLIP

Sl. No.	Pumping Station From	To	No. of Pumps	Motor Rating (MW)	Total Capacity (MW)	Pump Capacity (Cumecs)	Total Discharge (Cumecs)	Discharge (TMC/Day)	Energy Required (mu/TMC)	Cumulative Energy (mu/TMC)
1	Medigadda	Annaram	9	50.0	450.0	73.0	656.0	2.0	5.4	5.4
2	Annaram	Sundilla	9	30.0	270.0	73.0	656.0	2.0	3.2	8.6
3	Sundilla	Yellampally	9	40.0	360.0	73.0	656.0	2.0	4.3	13.0
4	Yellampally	Medaram	7	124.4	874.8		624.0	1.9	11.1	24.0
5	Medaram	Ramadugu		Through Tunnels						24.0
6	Ramadugu	Mid Manair	7	139.0	977.0		624.0	1.9	12.3	36.4
7	Midmanair	Anantagiri	4	106.0	424.0		321.0	1.0	10.4	46.7
8	Anantagiri	Imamabad	4	134.8	543.2		301.0	1.0	13.3	60.0
9	Imamabad	Mallanna Sagar	8	43.0	344.0		248.5	0.8	11.0	71.0
10	Mallanna Sagar	Konda Pochamma							9.1	80.1
11	Mid Manair	Upper Manair	2	30.0	60.0	15.0	30.0	0.1	16.0	52.4
	Total		59		4,303.0					

5.2.2 Information gaps

- Pumping capacities are available only upto Mallannasagar reservoir. Details of pumping from Mallannasagar to Kondapochamma reservoir are not available. Hence, electricity requirement for lifting 1TMC of water from Mallannasagar to Kondapochamma reservoir is estimated from electricity requirement for lifting water from Mid-Manair reservoir to Mallannasagar reservoir duly adjusting for the difference in pumping Head.
- Ayacut under Mid-manair reservoir is not available in the maps. But it is reported in newspapers that 35 TMC of water would be released from Mid-manair reservoir for irrigation purposes. This information is used to estimate the ayacut under Mid-manair reservoir presuming 1 TMC would irrigate 9000 Acres.
- Available line diagram of KLIP indicate about 2.84 lakh acres of new ayacut in Adilabad and Nizamabad districts from water pumped from foreshores of SRSP. However, no information is available on both pumping capacities and lifting heads at the SRSP project to the proposed ayacut in Adilabad and Nizamabad districts. Hence electricity requirement for this ayacut could not be estimated.
- All waters that are pumped will not reach the fields. Significant portion of water would be lost in the transit on account of evaporation, seepage and leakages. It is difficult to assess the exact quantum of these losses in KLIP, but it could be very high in view of arid and parched conditions subsisting in Telangana, long stretches of open and unlined canals, large storage facilities with vast surface areas created under KLIP, expected long storage periods in reservoirs etc. Hence, electricity requirement for KLIP is estimated for different loss levels ranging from 0% to 40% with 10% increments.

In all, out of 18.19 lakh acres irrigation proposed under KLIP, electricity requirement could be estimated for 13.69 lakh Acres for which pumping details are available. This data in turn is extrapolated to arrive at the electricity requirement for the entire scheme details in Table 5.1.

5.3 Electricity Requirement and Costs for KLIP:

Electricity required for KLIP for one crop is estimated to be 12349 mu at 0% loss level and this goes up to 20582 mu at 40% loss level. Corresponding cost of supply of this electricity would be Rs 7903 cr and Rs 13172 cr, with current level of electricity tariff applicable for Lift Irrigation Schemes for FY 2016-17, i.e.Rs 6.40/unit.

Average cost of supplying electricity for each acre under KLIP would vary from Rs 43449 for 0% loss level to Rs 72416 for 40% loss level (Table 5.2).

5.3.1 Cost of electricity at Mallannasagar

The storage capacity of Mallannasagar in the re-engineered design is increased to 50 TMC from 1.5 TMC in the original scheme. Thus additional storage means huge additional investments, additional seepage and evaporation losses. It is interesting to see the electricity requirement for lifting 1 TMC of water upto Mallannasagar from Medigadda reservoir and the cost of irrigating 1 Acre under Mallannasagar.

Electricity requirement for lifting 1 TMC of water up to Mallannasagar would be 71 mu at 0%loss level and 118.30 mu at 40% loss level. Corresponding cost of electricity for irrigating 1 Acre of land for one crop under Mallannasagar would be Rs 50,489 and Rs 84,148 respectively.

5.3.2 Electricity Requirement at Yellampalli and Mid-Manair

Electricity requirement for lifting 1 TMC of water upto Yellampalli is 24 mu and Mid-Manair is 36.4 mu for 0%loss level and respective requirement is 40 mu and 60.7 mu for 40% loss level. Corresponding cost of electricity for irrigating 1 Acre of land for one crop under Yellampalli and Mid-Manair would be INR 17067, 25,884 at 0% loss level and INR 28,444, INR 43,141 at 40% loss level, respectively.

It may be noted that as these two sources are relatively closer to the intake point, loss levels are expected to be also low.

5.4 Cost of Electricity for well irrigation

For FY 2016-17, about 11,535 mu of electricity is proposed to be supplied to around 20 Lakh open wells and bore wells in Telangana. Electricity is supplied free or at nominal cost to agricultural consumers. Cost of supplying electricity to these wells is recovered by the electricity distribution companies in three ways- tariffs, subsidies from the government and cross subsidies contributed by other consumers by way of payment of higher tariffs. Estimating cost of supply to Agriculture (wells) is a complicated exercise. It depends on several factors such as cost of power procurement, losses upto Low Tension level, timing of supply of electricity, coincidence of agriculture demand with peak demand, load factor etc. It varies from Rs 5.00/unit to INR 8.00/unit. Assuming cost-to-serve to irrigation wells as INR 7.00/unit,

Table 5.2 Average cost of supplying electricity for each acre under KLIP

Loss level %	Station	Yellampalli	Mid Manair	Anantagiri	Imamabad	Mallanna Sagar	Konda Pochamma	Upper Manair	Total	Extrapolation to Total Ayacut under KLIS
	Ayacut (Acres)	30,000	315,000	30,000	110,000	564,000	240,000	80000	1,369,000	1,819,000
0	Electricity per TMC (mu)	24	36	47	60	71	80	52		
	TotalElectricity(mu)	80	1,274	156	733	4,449	2,136	466	9,294	12,349
	Cost (Rs.Cr)	51	815	100	469	2,848	1,367	298	5,948	7,903
	Cost/Acre (Rs)	17,067	25,884	33,209	42,667	50,489	56,960	37262	43,449	43,449
10	Electricity per TMC (mu)	27	40	52	67	79	89	58		
	Total Electricity (mu)	89	1,416	173	815	4,944	2,373	518	10,327	13,721
	Cost (Rs.Cr)	57	906	111	522	3,164	1,519	331	6,609	8,782
	Cost/Acre (Rs)	18,963	28,760	36,899	47,407	56,099	63,289	41402	48,277	48,277
20	Electricity per TMC (mu)	30	46	58	75	89	100	66		
	Total Electricity (mu)	100	1,593	195	917	5,562	2,670	582	11,618	15,436
	Cost (Rs.Cr)	64	1,019	125	587	3,560	1,709	373	7,435	9,879
	Cost/Acre (Rs)	21,333	32,356	41,511	53,333	63,111	71,200	46578	54,312	54,312
30	Electricity per TMC (mu)	34	52	67	86	101	114	75		
	Total Electricity (mu)	114	1,820	222	1,048	6,356	3,051	665	13,277	17,642
	Cost (Rs.Cr)	73	1,165	142	671	4,068	1,953	426	8,497	11,291
	Cost/Acre (Rs)	24,381	36,978	47,441	60,952	72,127	81,371	53232	62,071	62,071
40	Electricity per TMC (mu)	40	61	78	100	118	134	87		
	Total Electricity (mu)	133	2,123	259	1,222	7,416	3,560	776	15,490	20,582
	Cost (Rs.Cr)	85	1,359	166	782	4,746	2,278	497	9,914	13,172
	Cost/Acre (Rs)	28,444	43,141	55,348	71,111	84,148	94,933	62104	72,416	72,416

total cost of supply to agriculture comes to Rs 8075 crores. For the FY 2016-17, about Rs 86 crores is realized through tariffs, proposed Government subsidy is INR 3,305 crore and balance is expected to be met from cross subsidies from other categories of consumers. About 55 Lakh Acres are irrigated under these wells. Thus cost of electricity for well irrigation is about INR 14,680/Acre. As already discussed, overall cost of pumping under KLIP varies from INR 43,449/Acre to INR 72,416/Acre at different loss levels.

This leads to some interesting conclusions:

- Average electricity costs under KLIP are almost 3 to 5 times to those of well irrigation.
- Costs of pumping under KLIP are almost comparable to those of well irrigation up to Yellampalli (1.1 to 2.0 times). But Ayacut proposed upto Yellampalli is only 30,000 acres (1.6%) of the total Ayacut proposed under KLIP.
- Pumping costs under KLIP upto Mid-Manair varies from 1.75 to 3.00times compared to well irrigation costs.
- Cost of irrigation under KLIP increases significantly after Mid-Manair reservoir. Irrigation cost at Mallannasagar is almost 3.5 to 6 times and for Kondapochamma it is 4.0 to 6.5 times in comparison with well irrigation costs.
- For KLIP, cost of irrigation under Mallannasagar is almost double as compared to irrigation costs at Mid-manair. This difference could be even higher as loss levels at Mallannasagar would be much higher due to longer transportation required in unlined canals and higher surface area of reservoirs.

5.5 Is there any possibility of accessing cheaper power?

It is now clear that success of any lift irrigation scheme largely depends on accessing cheaper power. Is there any possibility of getting cheaper power for the KLIP? This let us examine.

In the past two years cost of power in the market has come down drastically from over Rs 6/unit to around Rs 4/unit. Currently in the power exchanges the daily rates for electricity have fallen below Rs 2/unit. Though prices in power exchanges are applicable only for shorter periods upto 1 week, they indicate the trend of falling prices of electricity all over the country. Even the Prime Minister of India during his recent visit to Telangana has claimed falling prices of electricity as one of his Governments major achievements. Today through open competitive bidding one can access cheaper power at around INR 4/unit for longer periods upto 25 years.

In such a scenario, one may be tempted to presume cost of pumping to come down drastically for lift irrigation schemes taken up by the Telangana Government. But unfortunately, this may not be possible. Government of Telangana has taken up several power projects, namely Bhadradri Thermal Power Project (4x270 MW), Yadadri Thermal Power Project (5x800MW) and entered into long term Power Purchase Agreement with Chhattisgarh for supply 2000 MW, keeping in view the future growth in demand for power in Telangana state, especially from Lift Irrigation Schemes. Considering capital costs and other variable costs (fuel etc.), cost of power purchase from these projects is not likely to be less than Rs 5.50/unit and when it reaches end consumer considering Transmission and Distribution losses and other network expenditure, the cost of supply of electricity from these new projects is likely to exceed INR 6.50/Unit. Capital cost of Marwa power plant in Chhattisgarh, with which Telangana power companies signed long term Power Purchase Agreement, is around INR 9 Cr/MW, one of the highest capital costs recorded for any power plants so far. Due to time and cost overruns ultimate cost of power from these projects may be even higher. Even after two years, both BTPS and YTPS have failed to take off as environmental clearances have not yet been given by MoEF.

As Telangana distribution companies are already tied up with buying expensive power on long term basis, possibility of accessing cheaper power is remote even though cheaper power is available in the open market.

What about using cheaper hydel power generated to meet the power requirements of Lift Irrigation schemes? Some people started arguing that Lift Irrigation Schemes operate during monsoon period when hydel generation is available. So it is argued that this cheaper power can be used to meet the power demand from Lift Irrigation Schemes. Unfortunately this is not possible for the following reasons:

- Tariff for Lift Irrigation schemes is worked out taking into consideration Hydel generation also. Hence, this is already factored into the tariff.
- If Hydel projects are exclusively allocated to Lift Irrigation Projects, then it results in increase in tariff for other consumers or ends up as additional burden on State Governments in the form of subsidy.
- Total power requirement for all the lift irrigation schemes, existing, ongoing and contemplated, is over 10000 MW. For two major LISs alone, namely KLIP and Palamooru and Rangareddy LIS, power requirement is around 9000 MW. However, installed capacity of Hydro power projects in Telangana is only 2500 MW and average power generated from these plants in the last 10 years is only 400 MW. Thus hydro plants cannot meet more than 5% of the energy requirement of the LISs.

Lift Irrigation schemes require continuous pumping, 24hours a day for a period of four months or so. But hydel projects are used to meet the peak hour demand, mainly from morning 6am to 9am and evening 6pm to 9pm. Also Hydro projects are operated keeping in view the demands of drinking water and irrigation requirement protocols. Nagarjunasagar plant with 810MW capacity can be operated only during floods.. Thus there are serious limitations on use of hydro projects to meet the power requirements of LISs. Hence continuous operation of hydel plants to meet power requirements of LISs is not practically possible, economically viable and financially justified.

Hence, given the above scenarios, possibility of reducing power costs for the LISs may not be possible. Any effort to reduce power costs require serious review of power policy adopted by the Government of Telangana.

5.6 Tummidihatti Vs Medigadda

The Government of Telangana has shifted the location of intake point of Dr Pranahita-Chevella Lift Irrigation Scheme from Tummidihatti to Medigadda. Lack of adequate divertible water at Tummidihatti is cited as the main reason for shifting the location from Tummidihatti to Medigadda. However our studies have indicated that ~300TMC of water is available at Tummidihatti of which 177 TMC of water can be diverted by installing pumps with capacity same as that now proposed to be installed at Medigadda (details are discussed in chapter 2). By increasing the pumping capacity, we can further increase the quantity of water diverted. Height of barrage at Tummidihatti has very little impact on quantity of water that could be diverted. Enough water can be drawn from Tummidihatti even at FRL of + 148.0 M by diverting waters from the barrage through innovative designs and constructing a reservoir with a capacity, say 10 TMC, within the territory of Telangana, without submerging the lands in Maharashtra. Even CWC has indicated that about 165 TMC of water is available at Tummidihatti after accounting for the share of upper riparian states. Thus it is clear that significant quantity of waters can be diverted from Tummidihatti.

It is also important to note that, even in the re-engineered scheme, Government of Telangana proposes to construct a barrage at Tummidihatti also, but limit the supplies from Tummidihatti to the Ayacut of Adilabad district only. Thus there is no involvement of additional expenditure towards construction of barrage for diverting waters to Yellampalli. It is also learnt that significant investments have already been pumped into Dr. BR Ambedkars Pranahita Chevella Scheme for tunnels and other structures for diverting waters from Tummidihatti to Yellampally.

With these issues in the background, and with the understanding that significant waters can be diverted from Tummidihatti, now it becomes very important to analyse the impact of shifting location of intake from Tummidihatti to Medigadda in terms of electricity costs. Pumping capacities and discharge particulars at Tummidihatti are taken from Pranahita Chevella Detailed Project Report. Both under the original scheme and re-engineered scheme, water will be delivered from intake point to Yellampalli. Hence electricity costs are estimated for lifting water from Tummidihatti and Medigadda to Yellampalli reservoir under old and new schemes.

It can be seen in table 5.3 that for lifting the same quantity of water (180 TMC) from Medigadda as compared to Tummidihatti, an additional cost of Rs 1253 crores every year is to be incurred towards electricity supply. This is in addition to the additional investments required for construction of barrages and pumping stations at Medigadda, Annaram and Sundilla.

It is very important to utilize all the waters that can be diverted from

Table 5.3 Power required to pump 180 TMC of water

From	To	Power (MW)	Discharge (Cumecs)	Power (mu)
Tummidhatti (+148m)	Yellampalli (+148m)	154	583	374
Medigadda (+100m)	Yellampalli (+148m)	1080	656	2333
Power difference				1959
Cost difference is Rs. 1253 crores per year				

Tummidihatti and design the Kaleswaram scheme for balance requirements, if any, duly conducting benefit-cost analysis, to minimize the overall costs.

5.7 Impact of deletion of pumping station at Rangampet(v), Choppadandi (M), Karimnagar (D)

In the original Pranahita-Chevella scheme, a lift was proposed at Rangampet village, Choppadandi mandal in Karimnagar District with three numbers of pumps each with capacity of 50 MW with total power of 150 MW required. It was proposed to drop a quantum of 32 TMC of water in Kakatiya canal of SRSP project leading to Lower-Manair Dam, in the enroute link between Yellampally to Mid-Manair. This is done to compensate drawal of about 32 TMC from SRSP to provide irrigation facilities in Adilabad (7TMC) and Nizamabad (25TMC) Districts under the Pranahita-Chevella Scheme.

Now, in the re-engineered scheme of KLIP, the pumping station at Rangampet village is deleted and now it is proposed to take all these water up to Mid-Manair Dam and release 35 TMC, into Lower Manair Dam through river course.

Reasons for such change are not clear, but re-engineered scheme requires additional pumping to a height of about 40 meters resulting in additional pumping costs. Additional energy requirement for lifting 1TMC of water from Rangampet to Mid-Manair Dam is about 8 mu and thus for lifting 35 TMC about 280 mu required. Additional cost of pumping at INR 6.40/unit is Rs 180 crores. This cost would be even higher if water losses from Rangampet to

Mid-Manair and from Mid-Manair to Lower-Manair Dam are taken into account. Even cost of infrastructure has increased as tunnel sizes had to be increased to carry additional discharge from Rangampet to Mid-Manair.

5.8 Who will pay for Fixed Costs of Power Projects?

One important issue that is often forgotten while estimating the electricity requirement for large Lift Irrigation Schemes is stranded costs of electricity when LISs are not pumping water. These LISs operate only for 3 to 4 months, that too depending on availability of water. For rest of the year these projects remain idle, and power projects taken up for these LISs have to either sell their energy to third parties or remain shut down. Total power requirement for all the Lift Irrigation Schemes in Telangana-existing, ongoing and contemplated projects, is over 10000 MW. Current demand for power in Telangana is around 7000 MW to 8000 MW. Out of this about 2000 to 3000 MW demand is from Agriculture sector from bore wells and open wells. Balance demand is mainly from Industrial and Domestic sectors. Thus the power projects capacity now proposed to be created for LISs is more than double the demand from all other sectors excluding Agriculture sector. These power plants are mainly base load plants which run round the clock for entire year. Then it becomes a big challenge where this power will be utilized after the demand from LISs comes to naught for balance 8 months in a year.

Is it possible to sell this power in the market? Surplus power conditions prevail throughout the country, for variety of reasons, and huge power capacity additions are already planned at national level. Power from Telangana projects being expensive compared to market price, it may be very difficult to find any takers. Even if 50% of this capacity remains idle, the consequences will be colossal.

States like Maharashtra, Karnataka, Gujarat, Punjab and several others States are already facing this “surplus power problem” and are forced to pay huge fixed charges, running into thousands of crores, to the power generators for the power that is not used by them. Even Telangana state Generating company (TSGENCO) has registered its lowest ever Plant Load Factor (PLF) in the year 2016 due to frequent backing down of its generating units due to lack of demand.

Lift Irrigation Projects pose even bigger challenge as their use is only seasonal. Thus careful power planning assumes greater significance.

5.9 Conclusions on electricity requirement for KLIP

1. Average cost of supplying electricity for each acre under KLIP would vary from Rs 43449 for 0% loss level to Rs 72416 for 40% loss level. For irrigating one Acre for one crop under Mallannasagar, electricity costs would vary from INR 50,489 to INR 84,148.
2. Average electricity costs under KLIP are almost 3 to 5 times to those of well irrigation.
3. As Telangana Power Distribution companies have already tied up with buying expensive power on long term basis, possibility of accessing cheaper power is remote, even though cheaper power is available in the open market.
4. For lifting the same quantity of water (180 TMC) from Medigadda as compared to Tummidihatti, an additional cost of INR 1,253 crores every year is to be incurred towards electricity supply. This is in addition to the additional investments required for construction of barrages and pumping stations at Medigadda, Annaram and Sundilla.
5. In the re-engineered scheme of KLIP, pumping station at Rangampet village,

Karimnagar is deleted. This would result in additional pumping costs to the tune of INR 180 cr/year.

6. In all the estimates on electricity requirement for Lift Irrigation Schemes, stranded costs of power projects on account of non-operation of pumps for most part of the year are not considered. These costs significantly increase overall system costs.

7. Review of overall power policy for supply of electricity to Lift Irrigation Schemes is the need of the hour.

Chapter 6

Benefit and Cost ratio of Kaleshwaram Lift Irrigation project

6.0 Introduction

Before we look into the benefits to cost (BC) ratio it is important to mention few basics. The public money, for irrigation and other major projects are expected lead to benefits at least more than the cost of the project. It is elementary. There are specific guidelines on how much the BC ratio should for irrigation projects.. Estimation of benefits may not be only in terms of money but also in terms of social good, which is again possible to quantify.

However, in recent times, very few projects achieved the stipulated BC ratio. These are the following reasons / explanations

- Very rarely the projects are completed within the initial estimate. Many projects exceed costs several folds than initial estimate.
- BC ratios are done only on first cost estimates and later spending will not be taken into consideration.
- The benefits are often over emphasized with other considerations such as food security, rural employment and or siting spending on other sectors such as roads etc.
- Projects have been built at most of the places where costs are low. The projects are expensive, complicated and the benefits are rather difficult. So there is inherently the new projects are fitting into BC ratio.
- Some of the irrigation projects are for "stabilisation" of already irrigated area. This means, there is irrigation by some other project, but water is not reaching, so there is need for another project.

The list goes on and on it is the case in every state. The most important aspect of irrigation projects, both its designs and implementation is about spending money for other considerations which are stated or otherwise. At the end, after spending such massive money, there will always be some water and some farmers get some benefit. Whether or not such benefits are comparable to the costs incurred is an ongoing debate. Therefore, one has to look at the overall project and its overall benefits to the state, not just benefits to some farmers who are getting water.

There are following difficulties in understanding the costs of the Kaleshwaram lift irrigation project.

1. This is not a new project. Lot of money has been already spent on these projects, with different name as Pranahita-Chevella project. So first one need to start the costs which are already incurred for earlier project.
2. It is not clear, what part of the project is "re-engineered" what part has been retained. The package numbers, which are now popularly known for segments of the project, given to contractor, seem to be the same as earlier project. So there is a need for establishing, what is the cost of "re-engineered" part of costs of retained part.
3. The KLIP is being presented as bits pieces. For example Mallannasagar dam, is actually the part of the KLIP, but seems to be presented as separate project with its own costs and entity. So it is essential to know what the costs of this project, including the costs of R&R package, which might be quite significant.

4. The costs of this project are not officially known since there is no DPR. Still several contracts are being awarded, even the new segments, which are part of "re-engineered" are being awarded to the contractor.

6.1 Estimating the costs of KLIP

Based on several bits and pieces of information available on the "Packages" and the information once in a while mentioned in the newspapers, the approximate costs of this project have been compiled.

KLIP, as presented in the latest line diagram, if implemented, will certainly cost close to INR 90,000 crores. But this is the lower end of the estimate. Since many of these costs escalate, this figure could go anywhere between INR 150,000 to INR 180,000 cores.

These costs do not include the canals which need to be laid for distributing the water for irrigation. They are not even part of the current discussion.

6.2 Costs and benefits

It is provided in table 6.1

6.2.1 Capital costs

Distributing the costs, proportionately, the share of costs for irrigation would be 80%. In other words the irrigation component would approximately cost INR 71,600 crores to INR 150,000crores.

The capital costs to provide irrigation for each acre under KLIP will range from INR 4 lakhs to INR 8.25 lakhs. But certainly the cost is not below INR 4 lakhs.

Just for comparative purpose, the value of lands which are going to be submerged at Mallannasagar is about INR 6 lakhs an acre. So the capital costs to irrigate on acre of land may be as much as total current value of land. The details are given in table 6.1

6.2.2 Total overall costs

Total cost of cultivation under KLIP would range from INR 1,00,000 to INR 1,80,000 per acre.

6.2.3 Are these costs reasonable?

This report is not about showing costs higher and benefits lower. The intention is not to say the project is not viable or expensive. Government of Telangana and people of Telangana need to know clearly the following facts.

- What would be the total cost of this project, including the money spent earlier on different name?
- What would be the current estimate to complete the KLIP as presented today, as on 20th November 2016.
- What would be the likely costs when it is completed?
- What is actual area KLIP will additionally irrigate and where exactly that area lies
- What would be water in TMC used for stabilization and for new irrigation, so that the costs can be computed for new irrigation and stabilization?
- What is the water allocated to drinking and industry when it is completed
- According to the Government of Telangana, what is the cost of providing water for irrigation under KLIP, including capital and operational
- Specifically what would be the cost of electricity, to provide water for irrigation at various stages of the KLIP?

6.3 Benefits of the KLIP

The KLIP's main objective is to provide irrigation for 18 lakh acres. The other objectives include water for drinking and water for Industry. For the purpose of this report, only benefits of water for irrigation have been computed. In order to estimate the benefits of this project the following assumptions have been made.

6.3.1 Estimate 1: Farmers using water to grow paddy

- The KLIP will fully irrigate 18 lakh acres (or approximately 700,000 ha)
- Farmers will grow with it Paddy, this the maximum value creation crop
- That the farmers will produce 3.2 t/ha, which is the state's average yield.
- That the average price per ton of paddy is INR 11,000 (last year average price was INR 1,100 quintal)

Table 6.1 Cost of water utilization and benefits that are likely to be from KLIP Project

A.	Water Requirements:	**TMC**
	Total Quantity of Water Diverted:	225
B.	**Water Utilization for Drinking and Industrial Requirement:**	
	Drinking Water Requirement to Hyderabad:	30
	Industrial Requirement:	16
C.	**Water Utilization for Irrigation Requirement:**	
	Irrigation Requirement:	169
	Drinking Water to Enroute villages:	10
	Total:	179
	Cost Particulars:	INR In crores
	Total cost of the Scheme PCSS:	90,000
	Proportionate Cost of the Project as Irrigation Project:	71,600
	Total Cost of KLIP:	71,600

	Capital cost INR in Crores	**Minimum**	**Maximum**
		71600	150000
		Benefit Cost Ratio:	
I.	Annual Benefit:	4000	4000
	Annual Cost (Recurring)		
i.	Interest on Capital @ 10% of total cost:	7160	15000
ii.	Depreciation of the project @ 1% of the cost of the project for 100 years of life	716	1500
iii.	Annual Operation and Maintenance charges @ Rs 2000 per hactare of CCA	147.3	147.3
iv.	Depreciation of the pumping system @ 8.33% of the estimated cost of the pumping system	1988.1	3313.5
v	Depreciation of the raising mains (pipelines) @ 3.33% of the estimated cost of the raising mains system assuming life of the system as 30 years	33.3	55.5
vi	Annual power requirement cost	7832	13054
vii	Annual costs	17876.7	33070

The total production will be around 2.25 million tons. (*Note* that current state production of paddy is 5.5 million tons).

The total value @ 11,000 ton would be INR 24,640 million or INR 2,464 crores.

6.3.2 Estimate 2: Growing basket of crops

Assumptions:

- That KLIP will provide irrigation to 18 lack acres (about 700,000 ha).
- Water will be used to grow basket of crops as is done today

14 crops are selected and same proportion will be grown with KLIP water (Table 6.2)

6.3.3 Estimate 3: Growing Groundnuts

Let us assume all the farmers go for groundnuts and also all the farmers produce the current state's average yield of 1,691 kg/ha.

The total groundnuts production of 18.19 lakh acres will be 1.2 million tons (note the groundnuts production of the Telangana state in 2013-14 is 355,000 tons). The Price of groundnuts last year was INR 34,000 per ton. The total value of 1.2 million tons of groundnuts would be Rs.4,080 crores.

6.3.4 Estimate 4. Growing Chillis

The state average production is 3.5 tonns per ha. Average price last year-Rs.70,000 ton. Therefore total value generated from the ayacut area would be around– Rs.17,000 crores.

This means increasing 10 times the area of chillis and ten times the production of last year, which might have difficulty in marketing.

Whatever might be the crops, whatever might be the prices, it is highly unlikely that the total value generated after expenses for cultivation will not exceed more than Rs.5000 crores.

6.4 What are the Alternatives?

Any critical analysis of Government irrigation projects is drawing very hostile reaction from Government and also some concerned citizens. Not that all the concerned citizens who are critical of those who criticize the irrigation projects are having some motives. They simply want to know what the alternatives are, if so and so project is not good enough, if that is what the conclusion of the critical analysis. That is valid question.

Before deciding on investing on any specific irrigation project, there is a process. That process is part of the Governments guidelines on formulating the irrigation project. Such guidelines clearly specify that, project formulation has several stages form pre-feasibility studies to Detailed Project Reports, known as DPR's. During that process, at every stage, state Government

Table 6.2 Present irrigated area in Telangana, Proposed KLIP, net area, Probable production and Revenue

Present irrigated area, KLIP net area and Probable Production Revenue						
	Present Ac	**%**	**KLIP irrigation Ac**	**Production Kg/ac**	**Cost per q**	**Amount in lakh INR**
Rice	49,63,168	44	7,93,354	1,334	1,460	154,546
Turmaric	2,69,270	2	43,042	300	5,318	6,867
Maize	18,59,344	16	2,97,213	1,896	1,256	70,776
Redgram	6,51,176	6	1,04,089	214	3,946	8,810
Pulses	13,91,100	12	2,22,365	339	4,000	30,128
Chillies	1,95,052	2	31,179	1,434	7,018	31,382
Sugarcane	79,837	1	12,762	4,309	2,345	12,894
Groundnut	5,19,131	5	82,982	684	3,442	19,546
oil seeds	14,54,900	13	2,32,563	606	3,500	49,312
	1,13,82,978					384,261
						About 4000 cr.

with their vast machinery, mandate need to "justify" that, a particular project has been selected because that is the best option available at that given point of time. Most important aspect is that during that process, certain other alternatives have also been considered and compared. Such process of considering alternatives is part of the decision making process so that public money is spent on best and most suitable project. So, every project which has been finalized theoretically should and must have had some alternatives to consider, which were not "suitable" for various reasons.

Coming back to Kaleshwaram lift irrigation project (KLIP), Government must have considered other options as well before deciding on this project. There is peculiar a situation here, there are no reports on KLIP itself. There is no project report, there is no DPR and there are no publicly available documents suggesting that this project is the best option.

Suggesting alternatives is not the work of those who are critical of the Government irrigation projects. Sadly, some critics also seem to be having alternatives in their back packets. In order to do critical analysis of a project, one need not provide alternatives.

This report is about providing some factual and critical analysis of the KLIP. So providing alternatives is not pre-requisite for civil society or any individual to be critical of the Government irrigation project.

Therefore, this report is not suggesting any specific "alternatives" to the KLIP. That is not the objective of this report. However, a frame work can be suggested to arrive at the better and suitable alternatives. That would be the follow up of this report.

Chapter 7
Kaleshwaram Lift Irrigation Project: Social and ecological issues

Introduction 7.0

KLIP has many components, many stages of pumping, pump houses, canals, tunnels, dams, deepening and widening of existing reservoirs, constructing new reservoirs etc. Each one of this component is much bigger than many individual irrigation projects. As per the guidelines and norms, there has to be a social and ecological impact of KLIP, as whole and for each individual component. Many times the cumulative impact of such large project is much larger than the sum of individual components.

Mallannasagar reservoir, a component of the KLIP, has raised many social issues in last six months. Public agitation is still going on resisting the takeover lands from farmers. Actually, Mallannasagar reservoir related social issues are the main reason for KLIP coming into focus. Mallannasagar project, which involves a dam for storing 50 TMC of water certainly the largest and most demanding component of farmers lands. But other components too require land including forest lands, farmers' lands and ecological impact. Virtually, there is no report whatsoever on the impact KLIP or Mallannasagar on social and ecological impact

7.1 Social costs of Mallannasagar

- Mallannasagar itself requires more than 20,000 ac of land and will displace people in 19 villages and tandas.
- 19 villages are going to be effected by the project of that 13 villages will be submerged.
- It is not clear how many people are going to be effected, but the total no of people living in these 14 villages.
- Many people who live in village do not have land, but their livelihoods are depended on the existence of the village and village economy. It is possible to compute the loss to such people in terms of loss of opportunities due to the project.

This report did not go into depth of the social and ecological issues of KLIP or its individual components for the following reasons.

- There are many organizations and individuals who worked about this issue and produced reports containing lot of details about the Mallannasagar. Such reports are available in the public domain.
- Generating information on social issues will require lot of resources and time.
- This report is in way complimentary to social issues than duplicating the efforts of other individuals and groups who documented the issues and published it earlier.

7.2 Social issues of KILP as whole

There is no data on the KLIP about the land it requires and its impact. Our estimate indicates that at least about 100,000 ac of land is required for KLIP. Some of it is forest land and some of it private lands. While computing the costs of KLIP, one need to take the following aspects into consideration

- Total costs of R&R package
- The loss of revenue, particularly the loss of productivity of the lands which are going to be submerged

- Loss of jobs and opportunities for those who are displaced

Such costs need to be added to the cost of the project that is what guidelines stipulate.

7.3 Social issues and the project

In India, there is long history of movements and struggles related to displacement of people due to large dams and irrigation projects. Many times arguments to oppose certain irrigation projects are based on social issues.

We suggest the merit or otherwise of an irrigation project need to be judged based on its overall costs and benefits to society rather than the R&R alone. It is important to raise the human issues particularly displacement, loss of revenue and loss of opportunities for the people who are loosing homes, lands and ancestral places. Though is important, but not the sole criteria. We can visualize the following four categories of the irrigation projects.

1. **Project is good and R&R is bad**: A irrigation project could be very good, interims of its need, benefits to society at large, but might seriously doing the harm to some people who are loosing lands and houses. ***It is possible to design and implement good R&R policy and good ecosystem restoration. Project is desirable, but needs good R&R package.***
2. **Project is bad and good R&R package**: A irrigation project could be very bad, interims of its need, cost economics, damage to ecosystem etc., but might come out with excellent R&R package benefiting people who are loosing lands. This is rare, but possible. ***Though R&R package may be good, displaced people may be happy, but still such irrigation projects are not desirable in the interest of people at large. So fighting for R&R package is not an end but it should lead to better projects***.
3. **Project is good and R&R is good**: An irrigation project may be very good for the state and farmers with proven benefits over costs. The project also has good R&R component and addressed all the known ecological issues. ***This is the most desirable state. Such projects should act as model to other irrigation projects***.
4. **The Project is bad and R&R is bad as well**: It is possible that an irrigation project is bad for society, ecosystems and also bad for displaced people. In such case, ***fighting for better R&R package, and getting one will not make project better for society at large.***

Therefore, those who are raising about R&R issues and ecological issue need to be aware of the category of the project they are dealing with. Fighting for R&R is not an end in itself. Ideally, all irrigation projects should fall in category 3 mentioned above. It is possible that projects should be good for the farmers, good for the displaced people. The objective of any irrigation project should be to take care of all three components such as economy, ecology and people, not just one at the expense of others.

7.4 Where does KLIP and Mallannasagar stand

It appears as on today (26th Oct 2016) , the KLIP and its component, Mallannasagar seem to be falling in category 4. Which means the KLIP itself is not going to benefit state of Telangana, it is not going to provide intended benefits but seem to lead to massive social issues, displacement and possibly ecological degradation. The stated benefits seem to far less than the costs. The information on the project is not able to prove that, it will benefit farmers and it will benefit state. It appears the cost of this project, as we understand now, might far exceed the benefits. So, economically this project may not be good for Telangana, until and unless it is proved otherwise. In addition to that the KLIP and its components such as Mallannasagar seem to be leading to massive displacement, and social unrest. So, first one need to examine, with data, that if at all KLIP can be modified to category 3. Then one can suggest and demand for better R&R package.

Ideally, the KLIP need to provide enough data and evidence that this project can be modified to category 3 mentioned above. As first step civil society should focus on if the project itself. Government of Telangana should also come out with data that the project itself is good for state as whole. After that it is possible to negotiate and come to some consensus with farmers and civil society about the R&R package. Those who are "opposing" the project need to have clarity on two things (a) are they interested in getting good R&R package irrespective of the overall benefits of the project to the state or (b) they are opposing the project since its overall benefits to Telangana are questionable, so by raising R&R issues somehow they can stop the project. This clarity is required for those who are opposing the project.

This report clearly indicates that KLIP as on today falls in the category 4 project. In order to make it better, first Government has to come out data that, the overall project is beneficial to state and then its R&R package is also good enough within the established legal framework. Right now both – benefits and the R&R package are questionable.

It is possible to provide better R&R policy and package, much better one which might be agreeable to all the people who are loosing lands and livelihoods. In addition to that the overall benefits also need to be clear. Then only KLIP should be taken up

7.5 Ecological issues

This report has not undertaken any specific study on ecological impact of this project. That is big exercise; in any case Government of Telangana should do in order to get the environmental clearance. At the time of public hearings, if at all that ever takes place, one could raise those issues.

7.6 Environmental issues

Construction of large storage to the tune of 50 TMC needs reexamination. Because normal dam is always across the river, but in this case it is parallel to the stream which would create high hydraulic gradient at the downstream creating water logging and artesian conditions. Major lineament is noticed parallel to the proposed Main bund of Mallannasagar. 40m-60m water column will rejuvenate the entire fracture creating perennial flow that would result in scouring phenomenon from the reservoir.

It can create reservoir induced seismicity similar to Koyna reservoir in Satara district, thereby possibility for a massive earth quake.

Chapter 8
Conclusion

Kaleshwaram Lift irrigation Project, KLIP, is a massive project. This is the first time in India such multistage lift irrigation project of this scale and complexity is being contemplated. The projects components involving several stages of pumping, storing, lifting to 800 meters of height, transporting 350 km and using water for irrigation never happened in India or in anywhere in the world. Telangana Government should do everything possible to understand its complexity, costs and the likely impacts. Such large scale irrigation projects will have major implications lasting several decades.

Telangana farmers and people have seen the outcome of grand projects such as Jalayagnam. Any public spending of this level will have both positive and negative implications to the society at large. Before awarding contracts, all possible dimensions need to be studied and understood. Earlier Governments have done project in haphazard way with no significant positive results but spending massive financial resources. Some of those projects also damaged livelihoods of thousands of people. Telangana farmers have seen many bad projects; lot of money has been wasted in the name of irrigation. That shouldn't happen now in Telangana state.

While, everyone recognises and appreciates the efforts to bring water for irrigation, but such half-baked, haphazardly designed, without proper documents, DPR has potential to do lot more harm than good, as was the case earlier. Particularly KLIP involves at least 9 levels of pumping before reaching farmers at the end. Synchronisation of systems is a very difficult aspect in India, not just for irrigation systems but in general. Understanding of how several systems work together might help the process of implementation. Since there is no credible project report, let alone Detailed Project Report, it is difficult to know even basic facts such as losses due to multistage pumping due to transport, evaporation and seepage. Experts think that achieving 85% efficiency at every stage itself may be daunting task. So at every stage loosing 5% of pumped water may actually lead to less than 50% delivery at 9 stages pumping, not considering evaporation, seepage etc. This project as it is appears being rushed in hurry avoiding debate, discussion and dialogue.

This report is an effort to raise some critical questions about the project so that some of these questions are debated, discussion and dialogue might come out with some answers. If Government is presents convincing data that this project is in the larger interest of Telangana state that would facilitate greater cooperation and support for all sections for the project. Right now there are more concerns about the implications of project than its impact in improving the lives of farmers.

This report with extensive data gathering and analysis, concluded that there is water at proposed sites. So water is not the issue at all, but clarity is needed on how that water is pumped efficiently and transported to reach the destinations in very cost effective way.

There is water for pumping at Medigadda and if required, more water can also be drawn from Tummidihatti and downstream of Medigadda. Water is not an issue and also submergence in Maharashtra also may be not a big issue. There is possibility to draw water from Tummidihatti, without leading to submergence than agreed in Maharashtra. For this to happen, certain innovative measures need to be taken in creating storing facility, pumping within Telangana with canals, sump houses and some diversion of river from Telangana side.

A detailed study might be able to provide better solutions to use water from Tummidihatti. This might reduce costs significantly. However that aspect has not been closely examined by this report. Pumping schedules for both with barrage and without barrage have been developed and included in the report.

Medigadda is certainly has water for proposed project and a detailed pumping schedule has been developed as part of preparing this report.

The cost of project seems to be a great concern. Particularly pumping water from Mid-Manair and upwards need to be closely examined once again. May be this project need to be viewed as phase one and phase two. From Tummidihatti and or Medigadda to Mid-Manair has one phase. The cost of the water delivered to various uses might certainly be reduced significantly in this section. After completing the phase on, depending on the experiences and lessons, the next section of upward pumping may be examined. That is one option need to be examined.

Completing KLIP as whole will certainly pose several challenges some of might be very difficult to solve. KLIP will pose greater challenge for Telangana Government in (a) mobilizing the resources required, (b) completing in time, (c) integrating the components particularly above Mid-Manair, (d) resolving the social issues related to Mallannasagar, (e) synchronizing the systems to function as one unit, and (f) delivering the water for various uses etc.

Overall, KLIP as presented is certainly going to be great burden on state of Telangana.

What should be the cost of providing water for irrigation? The answer to this question will depend on what is acceptable? It is a public policy decision. May be one will say, water should be provided for irrigation, regardless of the cost. At least is in the interest of state and public to know what it costs to irrigate an acre through KLIP. It appears there is no credible information even to know the cost of this project let alone benefits. As on today, Government of Telangana certainly does not have a, document to justify such large public spending. Government of Telangana has responsibility to provide that information to public. Lack of understanding is not justification for spending money.

Way forward

1. **Independent expert review**: Constitute an expert committee of top most experts outside of Telangana to review this project in its entirety. Those experts may be given a three month time period to come out with report. Specific TOR might include (a) the economic viability of this project, (b) the time lines to compete are reasonable, (c) will this project benefit state as whole, (d) is it possible to mobilize required financial resources to complete the project in the light of all other commitments made by Government of Telangana, (e) Does this project has best system of implementation, including the contractors and their capabilities, and (f) are there any changes major or minor can be made to further improve the project etc.
2. **Withhold the process of awarding contracts**: Until the review process is completed, Government Telangana should not award the contract, particularly the first stage one from Medigadda to Yellampally. This need to be stopped in order to know the experts view. If committee concludes that this project is in the best interest of farmers, people and state at large, surely no one can raise any voice on contracts, then the implementation will become smooth.
3. **Stop land acquisition**: Until the review process is completed, stop forcing people to sell the lands for this project, particularly Mallannasagar reservoir. Stop all the cohesive actions on farmers

and local people to take the lands for this project. This is only until review report is out, that might not take more than three months. If committee report is in favor of the project in general and Mallannasagar in particular, surely farmers will come forward for giving lands. That would increase the credibility of project also silence if any one raising opposition to Mallannasagar.

4. **Publish all the relevant documents on web**: There is secrecy surrounding this large project. Release all the documents including all the “packages” for which contracts are issued and contracts which are in the process.

5. **Detailed Project Report**: It is mandatory for any Government to have a DPR before spending any public money. So place the DPR in the public domain for discussion.

6. **Dialogue**: Government of Telangana may start a credible and genuine dialogue on its entire water related project. This is not as ritual, but as genuine process so that independent experts can contribute to the process.

Through a constructive and participatory process, it is possible to discuss and resolve the issues. Kaleshwaram Lift Irrigation Project certainly needs an open and public debate. Hope this report assists in that direction of public debate.

***