Summary Report
On
Water Use Efficiency Studies
For 35 Irrigation Projects

Organized by
Performance Overview &
Management Improvement Organization
Central Water Commission
Government of India
February, 2016

Contents

PROLOGUE

Agriculture sector in India is the largest consumer of Water Resources and increasing water use efficiency (WUE) in this sector is need of the hour for enhancing per drop more crop as envisaged in the PMKSY. Further, that we are combating with pollution of our rivers and striving at in making them Aviral and Nirmal, this aspect naturally gains much prominence. The increase in water use efficiency in all sectors of water use by 20% by the year 2017 is also one of the five goals of National Water Mission.

CWC has been instrumental in assessment of the prevailing WUE of the Water Resources Projects since the Xth Plan. For Rs. 1.84 crores i.e. at an average cost of Rs. 5.25 lakh/study, 35 projects from 7 States have been studied so far, in a manner as outlined in the CWC Guideline for computing WUE of the Irrigation Projects, updated from time to time, last in Feb, 2014. The study reports with findings/corrective structural and non-structural measures have been transmitted to the concerned States for taking remedial steps for resurrecting the operative efficiencies of the studied projects.

January, 2010 summary report on 35 WUE studies gets updated herewith. The overall project efficiency ranged from 13 to 62 % with the group weighted average (on culturable command area basis) of around 36 %. Though the number of projects that could be studied so far is quite few to deduce with certainty nation-wide prevailing water use efficiency in water resources sector however, I sincerely hope that this brief report on WUE studies for 35 Major and Medium Irrigation Projects would serve as useful ready reckoner for in-house reference.

(BHAGAT SINGH)
CHIEF ENGINEER
POMIO, CWC

Abbreviation

CWC	Central Water Commission
POMIO	Performance Overview & management Improvement Organization
IPO	Irrigation Performance Directorate, CWC
EWU	Evaluation of Water Utilisation Directorate, CWC
WUE	Water Use Efficiency
WALMI	Water & land Management Institute
WALMTARI	Water & land Management Training & Research Institute
NERIWALM	North East Regional Institute for Water & Land Management
HIRMI	Haryana irrigation Research & Management Institute
IPRI	Irrigation Planning & Research Institute
IMTI	Irrigation Management & Training Institute
CAD	Command Area Development
CCA	Culturable Command Area
FRL	Full Reservoir Level
FSL	Full Supply Level
ETO	Reference Evapo-transpiration
GIR	Gross Irrigation Requirement
FIR	Field Irrigation Requirement
NIR	Net Irrigation Requirement
OFM's	Open Flume Modules
CNS Soils	Cohesive Non swelling Soils

SUMMARY

OF

WATER USE EFFICIENCY

STUDIES

ANDHRA PRADESH STATE

(1) BHAIRAVANITHIPPA PROJECT

1. Name of the project	:	BHAIRAVANITHIPPA PROJECT
2. River / Main River / Basin	:	Hagari (vedavathi) river.
3. Type of project (Major/Medium)	:	Medium irrigation project.
4. Type of structure (Dam/Barrage/Weir)	:	Dam (Reservoir)
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 14-32'-10" N (b) Longitude : 76-50'-30" E (ii) Village : Bhairavanithippa (iii) Mandal : Gummaghatta (iv) District : Ananthapur (v) State : Andhra Pradesh
6. Length / Period of data used for study		:10 Years
7. Culturable Command Area (C.C.A)	:	4856 Ha.
8. Ultimate irrigation potential	:	4856 Ha. Left flank : 3334 Ha Right flank : 1522 Ha Total : 4856 Ha
9. Potential Created (P.C)	:	4856 Ha.
10. Potential Utilized (P.U)	:	3083 Ha. (Highest in 1999-2000). utilization was never 100 % due to insufficient inflows)

11**. Major recommendations for overall improvement of efficiencies in the project:**

I. **Dam/Reservoir:**

a) Renovation of upstream revetment at head sluice of earthen dam.
b) The earthen bund is to be brought to standards by filling ruts.
c) Providing guide walls all along the bund where water is stagnated and rectification of toe drains.
d) Jungle clearance on the bund

II. **Delivery system:**

a) Arresting of silt by providing inlet and outlets at the places where natural stream crosses the canal.
b) Repairs and replacements to damaged shutters for canals and distributaries.
c) Re-sectioning of silted and scoured canals to the required standards for carrying out the designed discharges.
d) Improvements to the distributaries
e) Lining the canals and distributaries with necessary materials so as to improve canal efficiencies.
f) Repairs to the balancing tank to arrest the leakages in the weir.

III. **On farm application efficiency:**

a) In view of low rain fall, I.D crops like groundnut, cotton, sunflower, may be advised both in Kharif and Rabi season as per feasibility and need depending on availability of water instead of paddy in Rabi so that more areas could be brought under irrigation.

b) Suitable shutters need be provided for direct pipes and pipe out -lets and maintained. Water meters need be introduction of provided in the farm level operation system.

c) 'Warabandi' system or sprinkler irrigation system

d) Farmers are to be involved in irrigation water management effectively.

e) More water saving technologies like system of Rice intensification (SRI), aerobic rice cultivation etc, is better resorted to.

f) Recommended cropping pattern: - This are being low R.F region and erratic distribution of rainfall, it is highly desirable to encourage farmers to sow I.D crops in Kharif season instead of sowing in Rabi season.

12. Storage Efficiency:

The dam was designed for a gross storage of 74.20 Mm3.The inflow pattern in study period was very much unsteady in view of erratic rain fall in the catchment and insufficient inflows. The highest inflow of 326 Mm3 was received during 2000-01. Lowest inflow of 4.5 Mm3 was received during 1995-96. During last 10 years, inflows were insufficient for release during Kharif. The inflows received during Kharif were stored and released along with inflows received during Rabi. During 2003-04 & 2004-05 inflows were Nil.

13. Conveyance efficiency:

Canal conveyance efficiency studies have been conducted with current meter on 15-02-2008 on Right canal which runs for a length of 13.80 Kms. Weighted Average canal efficiency of Right main canal is 86.51 %. Canal conveyance efficiency studies could not be conducted on Left Main Canal since no water was released in Rabi season to the fields.

14. On farm application efficiency:

The principal crop cultivation under this project is paddy in Rabi season followed by ground nut I.D in Rabi with little paddy cultivation in Kharif. The main crop season is Rabi. The principal crop is paddy and the method of irrigation is continuous from field to field. On farm application efficiency has been evaluated for paddy cultivation under Right main canal which works out to 77.30 %. Overall efficiency of the project works out to 66.81 %. .

15. Drainage efficiency :

Twelve natural drains cross the left bank main canal and 13 natural drains cross the right flank main canal. The drainage in command area is absorbed by these drains.There are no cases of water logging and salinity in the area. .

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(2) GAJULADINNE (SANJEEVAIAH SAGAR PROJECT).

1. Name of the project: GAJULADINNE (SANJEEVAIAH SAGAR PROJECT).

2. River / Main River / Basin	:	Handri River (A tributary to Tunga Bhadra River)
3. Type of project (Major/Medium)	:	Medium irrigation project.
4. Type of structure (Dam/Barrage/Weir)	:	Dam (Reservoir)
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 15^{O}-41'-48" N (b) Longitude : 77^{O}-37'-20" E (ii) Village : Gajuladinne (iii) Mandal : Gonegandla (iv) District : Kurnool (v) State : Andhra Pradesh
6. Length / Period of data used for study		: 10 Years
7. Cultural Command Area (C.C.A)		: 10,310 ha(Out of Designed command area of 12,950)
8. Ultimate irrigation potential		: 10,310 ha.
9. Potential Created (P.C)		: From 10,246 ha in 1995-96 to 10,310 ha in 2004-05
10. Potential Utilized (P.U)		: Highest 6928 ha in 1995 -96

11**. Major recommendations for overall improvement of the project:**

I. **Dam/Reservoir efficiency:**

1. The rear side covered slopes of Earth dam where the hearting soils are exposed should be covered with gravel cover duly strengthening the bund, filling the rain gullies & scovers. The slipped revetment to the bund should be removed and reset.

2. The chutes and toe drains wherever damaged need reconstruction with masonry including plastering for effective drainage of rain water.

3. The leakages & cracks in the piers, Hoist plat form, Abutment returns need be plugged.

4. The rubber seals of gates require replacement and painting to gates is to be done as the same are rusted and scales formed. The concrete in the groves of spill way gates bulged causing lifting difficulty. Lifting equipment needs repairs and replacement. The generator also requires maintenance.

II. Delivery system / Conveyance efficiency:

i. The existing sluice gates of head sluices require replacement including reconstruction of damaged masonry structures. The approach channels on both sides are not to the required

profile as the same are silted up due to accumulation of earth and hence require re-sectioning and lining.

ii. There is no gauge well at the reservoir, one gauge well is to be constructed with gauge equipment for reading accurate gauge readings.

iii. The cross sections of both the canals running in contour is not to the standards since at some portion it is silted up and at some portion it is widened. It is desirable to remodel the canals and re-sectioning the same duly strengthening of banks and lining the same with suitable materials. The distributaries also require similar treatment.

iv. The existing O.T. sluices of distributaries needs reconstruction duly providing S. G. Shutters for proper regulation of water Reconstruction of new regulators in place of old and dilapidated regulators is also necessary.

v. Some cross drainage and cross masonry works are in dilapidated condition. These are to be reconstructed and strengthening of canal banks at vulnerable reaches is to be done.

vi. Gates may be provided at off taking points of minors to control water regulation so that drawing of more water by the head reach ryots can be avoided.

vii. 'V' notches, Broad crested weir, parshal flumes, cut throat flumes on the canal system may be provided to ensure control over water delivery and to increase operational efficiencies of the canal.

viii. The approaches to CM and CD works with formation of embankments need strengthening & repairs wherever required.

ix. The possibility of providing good communication system may be explored as the length of both the canals is more.

x. This being a low rain fall area, it is desirable that actual irrigation is confined to I.D crops in place of paddy as otherwise it would be difficult to meet the water requirement of all the command area. Also the possibility of adopting micro irrigation method or sprinkler irrigation or siri method for wet crops may be explored. Warabandi system may be introduced to make equitable distribution of water and to feed the water to tail and reaches.

III. On farm application efficiency:

The on farm application efficiency of Gajuladinne project right and left canals command area have been evaluated considering the Dry crops irrigated during 2003-04 and the canal in use there on and the efficiency is working out to 45.37 %. The overall project efficiency on farm application is working out to 25.75 % only which indicates that the function of canal system is not to the required level and needs improvements both structural as well as operational. The following is suggested for improving the project efficiency in addition to the suggestion under conveyance efficiency.

The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. To ensure effective water supplies to fields, suitable management techniques including installation of water measuring devices at field level need be provided. It is also necessary to

involve the farmer in irrigation management with latest techniques for optimum use of water. Shutters may also be provided to ensure regulated supplies to the farms I.D crops may be grown in Kharif or late Kharif season instead of Rabi season. Short duration I.D crops may be grown instead of long term crops.

12. Storage Efficiency / Reservoir Efficiency:

a) Reservoir Filling Efficiency: The gross storage of the project is 148.68 M.m3 and the live storage is 121.21 M.m3 with a provision of 21.24 M.m3 to be stored from TBP, LLC system for supplementing LLC tail end ayacut.

b) Inflow pattern: The inflow pattern during 1995-96,97-98,1999-2000,2002-03,2003-04,2004-05 is not encouraging. For the remaining years inflows are sufficient to irrigate the command area developed to some extent. Though the inflows are less in 1995-96, maximum area of 6925 Ha was irrigated which may be due to carrying over of the previous year balance in the reservoir.

13. Conveyance efficiency:

(a) Main canals
(b) Branch canals
(c) Distributaries

The conveyance efficiency of both the right and left main canals have been conducted and the results are as detailed below.

a) Main Canal

1. Weighted average conveyance efficiency of Left Main Canal = 45.17 %
2. Weighted average conveyance efficiency of Right Main Canal = 68.35 %
3. Average conveyance efficiency of the canal system = 56.76 %

b) Branch Canals : No Branch Canals

c) Distributaries : Current meter data is main canals confined to only.

Conveyance Efficiency of Main Canals:

1. There may be pilforation at the head reaches by the interacted ryots who are tapping the water through unauthorized lifts and taking the water to the non command areas.
2. Most of the direct pipes sluices are being operated without shutters resulting in wastage of water. In some cases the sluices and shutters are usually tampered by ryots at head reach causing damages.
3. The existing sluice gates of OT's and Head regulators (both Left and Right canals) including the masonry structures are in damaged conditions and hence leaking.

   It is observed from the above that the conveyance losses are more at the head reaches of both the canals than at the tail reaches. Whereas the conveyance efficiencies are less at the head reach than at tail reaches.

14. Field application efficiencies for all major crops:

Under the project I.D cropping pattern like ground-nut, chillies, cotton, Sun flower and pulses is proposed during Rabi season. But actually, During Rabi season ground nut and sunflower are the two predominant crops followed by chilies and cotton. Paddy is also sown to large extent depending on the availability of water.

On farm application efficiencies for left and right canal command area has been evaluated considering the ayacut irrigated during the year 2003-04 and canal issues there on through the canal system for the command. The crops considered are the irrigated dry crops like Groundnut and Sunflower during Rabi season. The on farm application efficiency is working out to 45.37% and the overall project efficiency of Gajuladinne Project is working out to 25.75 %.

15. Drainage efficiency:

The quantum of water drainage efficiency is not realizable since the water releases plus rain water component in the command area put together less than the crop water requirement plus the ground water in the command area. Further there are no water logging problem in the command area of Gajuladinne Project but salinity and alkalinity problems exists which have occurred after the water logging problem receded leaving the salts of alkaline nature. An area of about 800 ha is assessed to be of such alkaline and saline areas. Efforts are to be taken up for mitigating the above problem by reclamation or by using gypsum at the project cost as the land owners are small farmers.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(3) GANDIPALEM PROJECT

1. Name of the project	:	GANDIPALEM PROJECT	
2. River / Main River / Basin	:	Pillaperu River / Manneru basin	
3. Type of project (Major/Medium)	:	Medium irrigation project	
4. Type of structure (Dam/Barrage/Weir)	:	Dam (Reservoir)	
5. Location – Latitude/Longitude Town / Dist / State (M.P. Dam)	:	i. (a) Latitude	: 14^0-59' N
		(b) Longitude	: 78^0-18' E
		ii Village	: Gandipalem
		iii Mandal	: Udayagiri
		iv District	: Nellore
		v State	: Andhra Pradesh
6. Length / Period of data used for study	:	11 Years	
		i. Dam filling data (Inflow)	: 1995-96 to 2005-06
		ii. With drawals	: 1995-96 to 2005-06
		iii. Irrigated areas	: 1996-97 to 2005-06
		iv Rainfall data	: 1995-96 to 2005-06
7. Cultural Command Area (C.C.A)	:	6478Ha.	
8. Ultimate irrigation potential	:	6478 Ha.	
9. Potential Created (P.C)	:	6478 Ha	
10. Potential Utilized (P.U)	:	Maximum utilized is 4155 Ha in 1998-99	

11. Major recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency: The present condition of Gandipalem reservoir is satisfactory. However certain improvements like construction of chutes in the rear side of bund is required to avoid stagnation of water in rear side. Repairs to weir, improvements to the approach road by laying CC etc, are required. The approach channels both left and right canals at head sluices are not functioning due to accumulation of earth in bed. These channels require re-sectioning and lining with suitable material. The shutters to regulators also require repairs and replacement as per necessity.

II. Delivery system / Conveyance efficiency:

i) To minimize the seepage losses improvements to both the canals is required and measures may be taken in lining the canals up to distributaries system level with suitable materials.

ii) Inspection paths along the distributaries may be provided to maintain the regulatory system effectively and to facilitate the ayacut-dars for carrying out agriculture activities.

iii) To ensure control over water delivery in the canal system, installations of measuring devices are necessary which will also ensure optimum use of water.

iv) Suitable communication system may be provided on the canal system.

v) Reconstruction or repairs to the existing old and deteriorated canal structures such as bridges, aqueducts, cross drainage works, off takes, and construction of additional structures like distribution boxes etc are required.

III. On farm application efficiency:

The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. To ensure effective optimum water supplies to fields, suitable management techniques including installation of water measuring devices and water meters at field level are necessary. It is highly desirable to involve fully the farmers in irrigation management with latest techniques for optimum use of water. Shutters may also be provided to ensure regulated supplies to the fields especially at direct pipe out lets, without wasting the water. Providing zones within the distributory system to feed the water to tail end reaches by introducing Warabandi system may be explored. The practice of irrigating wet crops may be discouraged and in its place I.D crops may be encouraged. Sprinkler irrigation system may be introduced as per feasibility. Farmers are to be involved in the use of irrigation water management to full extent with latest technology. System of Rice intensification (SRI), aerobic rice cultivation etc may be advised to be practiced.

Recommended cropping pattern : Rice being staple food and good market conditions exist for this crop. Cultivators prefer this crop to any other irrigated crop. Paddy is cultivated as Rabi crop here. In the Kharif season instead of raising Pluses or Oilseed crops as purely dry crops in Kharif, they could be cultivated under I.D conditions as it would improve the productivity.

12. Storage Efficiency:

The reservoir across the river Pillaperu at Gandipalem (V) is constructed to store a gross storage capacity of 53.24 M.Cum at FRL and live capacity of 45.88 M.Cum. in the study period of 11 years gross storage has touched only once in the year 2005. In rest of years the storage in the reservoir was below and sometimes far below the gross storage.

Inflow pattern: The inflow pattern from 1995-96 to 2005-06 is furnished (11 years) out of which 5 years are not encouraging. The highest inflow of 67.68 M.Cum, were received in the year 1996-97. However in almost all the years inflows are not sufficient to irrigate contemplated ayacut of 6475 ha.

13. Conveyance efficiency:

a) Main Canal:
   1. Right main canal
      a. The conveyance efficiency of Right main canal (Km 0.275 to 3.00) — 81.22 %
      b. Canal conveyance efficiency of right main canal (Km 3.00 to 5.26) — 83.58 %
      c. Canal conveyance efficiency of right main canal (Km 5.26 to 6.50) — 97.87 %
      d. Weighted average canal efficiency of RMC — 85.36 %
   2. Left main canal
      i. Canal conveyance efficiency of left main canal (Km 0.36 to 6.12) — 88.18 %
      ii. Canal conveyance efficiency of left main canal (Km 6.12 to 9.76) — 92.75 %
      iii. Weighted average canal efficiency of LMC — 80.36 %

b) Branch Canals — No Branch Canals

c) **Distributaries**
   1. Right main canal

Canal conveyance efficiency of Distributory D_3 of Right main canal — 86.44 %

2. Left main canal

Canal conveyance efficiency of No. 3 distributory of Left main canal — 80.36 %

I. Efficiency of Right main canal with distributory D_3 — 73.78 %

II. Efficiency of Left main canal with distributory No.3 — 72.20 %

14. On farm application efficiencies for major crops:

The principal crop for cultivation under this project is paddy in Rabi season to the extent of water available. I.D ground nut is also sown in Rabi season. The canals off taking from Right and Left flank are contour canals they are badly damaged and require repairs in all aspects. In paddy cultivation water would be supplied from field to field continuously. Therefore, on farm application efficiencies for the ayacut under L.F and R.F canals have been evaluated based on the available secondary data and other relevant primary data on canal systems.

Onfarm application efficiency = 38.40 %

Overall project efficiency = 28.03%

15. Drainage efficiency:

As the quantum of water released to the field is less than the crop water requirements calculated as per Modified pen man method which may be due to conjunctive use of water as the ground water potential. There is no problem of drainage in the project command. The terrain in the command area is having adequate slopes and well drained.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(4) GODAVARI DELTA SYSTEM (SIR ARTHUR COTTON BARRAGE)

1. Name of the Project :GODAVARI DELTA SYSTEM (SIR ARTHUR COTTON BARRAGE)
2. River / Main River /Basin : Godavari River
3. Type of Project (Major/Medium) :Major Irrigation project
4. Type of Structure (Dam/Barrage/Weir) :Barrage (S.A.C. Barrage)
5. Location:
   a) Latitude : 16^0 55 " N
   b) Longitude : 81^0.45 " E
   II. Village : Dowlaiswaram
   III. Mandal : Kadiam
   IV. District : East Godavari
   V. State : Andhra Pradesh

   The barrage is located 6 Km from Rajahmundry at Dowlaiswarm (V) in Kadiam Mandal, East Godavari .District Andhra Pradesh State
6. Length / Period of data used for study : 10 Years.
   1. Dam filling data (Inflows) : 1995-96 to 2004-05 (10 years)
   2. with drawls : 1995-96 to 2004-05 (10 years)
   3. Irrigated area : 1996-97 to 2004-05 (9 years)
   4. Rain fall data : 1995-96 to 2004-05 (10 years)
7. Culturable Command Area (C.C.A) : 410108 Ha
8. Ultimate irrigation potential : 410108 Ha
9. Potential created Kharif : 410108 Ha
   Rabi : 410108 Ha
10. Potential utilized during the years (1996-97 to 2004-05)

Kharif :Minimum 3,13,295 (in 2002-03)
:Maximum 4, 10,108 ha in all the years except 2001-02.
Rabi :Minimum 3, 13,295 (in 2002-03)
:Maximum 4, 10,108 ha in all the years except 2001-02.

11. Major recommendations for over all improvement of the project:

i) Dam / Reservoir EfficiencyBarrage Efficiency: The present gross storage capacity of barrage is 83MM^3 against the designed capacity of 113 MM^3 and the same is being maintained. The condition of the barrage in general is satisfactory. The following are the recommendations made with reference to barrage efficiency.

a. Regular maintenance of Dam, every year is to be done.
b. Strengthening of flood banks is to be carried out to suit for the maximum flood received during August 1986. The estimated cost is Rs. 549.32 Crores for strengthening the flood banks so as to protect the villages from in undation and submersion of fields during the floods.
c. To ensure safety of dam it is better not to allow public movement through vehicular traffic.

ii) Canal system / Delivery System Conveyance efficiency:

The distribution system of Godavari delta system is an age old one. The irrigation system needs improvement to carry out the designed discharges. The head sluice of Godavari Eastern Delta canal, Central Delta Canal and Godavari Western Delta Canals were only improved but the 135 years age old distributory system is to be improved. Hence the following measures need be taken.

a. Remodeling of canals to the designed capacity
b. Lining of branch canals and distributary system at least for the reaches passing through sandy soils.
c. Construction of additional regulators, repairs and reconstructions of age old locks etc.
d. Providing Gates to Sluices and construction of Masonry sluices in place of pipes embedded in earth.
e. Providing Telephone, Wireless along the canal banks of three delta canals.
f. Installation of measuring devices on canals and distributaries for ensuring optimum use of water for irrigation.
g. Inspection paths are to be provided wherever necessary.

The above measures are proposed to be implemented under modernization of age old Godavari Delta System with an estimated cost of Rs. 3060 Crores.

iii) On Farm application Efficiency:

The on farm application efficiency of Godavari Delta System command area under the canal system have been evaluated for the wet and I.D areas grown during the year 2004-05 and the results are as follows.

1.	On farm application efficiency for wet crops	41.74 %
2.	On farm application efficiency for I.D crops	66.56 %
3.	Average on farm efficiency	54.15 %
4.	Overall project efficiency	45.05 %

The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. But this is inevitable as the head system itself is barrage where water has to be delivered as it comes into the barrage. Paddy is the Major crop grown in the project command which requires more water. The following are suggested:

a. There are hundreds of irrigation pipes and sluices fixed in the earth without proper regulating shutters resulting in considerable wastage of water in distribution. Proper arrangements for fixing pipes in masonry (or) concrete and shutters are to be made to ensure regulated supply to the farmers.

b. The possibility of providing water meter at field level to be explored to supply water as per actual requirements.

c. Farmers are to be involved fully in water management with latest technologies for optimum use of water.

d. 'Warabandi' system or SRI method for paddy crops may be introduced for the equitable distribution of water and to feed tail end reaches effectively. The practice of irrigating wet crops may be discouraged at least during Rabi season and in its place short term I.D crops may be encouraged so that more areas could be irrigated with available water.

iv) Drainage efficiency:

The drainage congestion under Godavari Delta System arises only due to un precedent flood during rain season for which the existing drains are not designed to carry the extra water.

The deltaic area gets in undated easily due to heavy rains. The drains existing are functioning as irrigation source in addition to drainage system. The drainage congestion in the drains are at its worst when the local rains and the floods in the river are experienced simultaneously. The drains are also serving as irrigation sources. For the effective use of the drains as irrigation sources and to release the drainage congestion the following are suggested.

a. Drainage system is not designed to cope up with the extra ordinary conditions of floods it is necessary to revise the design criteria for drains and effect further improvements.

b. Some Major drains which Modification of drains are required so as to raise the water levels to suit for irrigating the command area.

c. The entire drainage system needs improvements such as removal of weed growth twice in every year.

d. Silt clearance, Strengthening of banks at vulnerable locations are required to be done.

e. As the present existing are perennial Clearing of vents of al the cross Masonry and cross drainage works well before the on set of rainy season.

f. and existing in the command can be utilized for supplementing the command area.

The modernization of Godavari Delta System Distribution system along with the drainage system has been taken up at a cost of Rs. 2047 Crores under various packages.

12 Storage Efficiency:

a. Reservoir / Barrage filling efficiency

The present gross storage capacity of the barrage is 83 M.cum against the designed capacity of 113 M.cum and the same is maintained. This is a diversion scheme and the canals are taking the discharges hence the barrage is able to maintain the driving head entailing FSD encroaching into free board. Therefore the barrage efficiency can be taken as 100%. The Barrage efficiency from the year 1995-96 to 2004-05 is presented in relevant chapter.

b. Inflows Pattern

As this is a Barrage scheme the inflows are diverted to the extent of requirements for the crops and the balance over and above the maximum storage spills over the barrage. Even the maximum storage can not be allowed to be retained in case of expected continuous inflows. The inflows are encouraging and the irrigation potential created is effectively utilized. The project (Barrage) has surplussed in all the years indicating the success of the Barrage. The inflow pattern from 1995-96 to 2004-05 is furnished in Format-I (PART-A).

13. Conveyance efficiency:

Field studies for evaluating conveyance efficiency have been carried out on Godavari Central Main canal from Km 3.20 to 6.50 and Km 6.50 to 12.10. Gannavaram canal from Km 16.95 to 31.08, Km 31.08 to 34.00 and Km 34.00 to 52.00 and Kadali canal from Km 0.95 to 6.50, by using current meter. The weighted average efficiency is working out to be 95.91 %, 84.01 % and 95.39 % respectively.The efficiency of Central canal system is working out to 76.86 %.

Similarly the field studies for evaluating conveyance efficiency have been carried out by using current meter method on Godavari Western Main Canal, V & W canal and Undi canal, Anakoderu canal from Km 0.00 to 9.88 from Km 25.85 to 50.38 and Km 0.00 to 11.92 and Singavaram Ava Channel from Km 0.00 to 1.40. The conveyance efficiencies are working out to 98.52 % for western main canal 96.30 % in respect of V & W canal and Undi canal 96.47 % for Anakoderu canal and 97.86 % on Singavaram Ava canal. The efficiency of Western main canal, V & W canal, Undi canal and Anakoderu canal is working out to 89.56 %.

The overall system efficiency in respect of Godavari Central and Godavari Western canal system works out to 76.86 % and 89.56 % and the combined efficiency works out to 83.21 %.

The conveyance losses seems to be more which may be due to the age old system of canals, poor maintenance in the system due to damaged shutters, non existence of sufficient berms and also disturbance of hydraulic gradient of the berms. The delivery system is unlined resulting in losses observed in specially in sandy soils. A number of Irrigation sluices are fixed in earth with out proper regulating arrangements resulting in considerable wastage of water in the distribution.

Due to in adequate number of cross regulators across the canals and channels command able levels could not be maintained resulting in much wastage of water specially during Rabi season. Some of the drainage works across the canals are not adequate and also the discharging capacity of the most of lock weirs is in adequate to meet the peak demand and there are leakages in the lock weirs resulting in losses. To regulate the required flows into the canals, there are no measuring devices.

14. On Farm application efficiencies for all Major Crops:

Designed Cropping Pattern

The general cropping pattern followed in the command area is paddy. Paddy is sown in 87% of the cultural command in both Kharif and Rabi, 3% is sown with sugarcane, 6% is sown with horticulture crops, 2% sown with I.D like ground nut and Banana and Aquaculture in 2% of area. Pulses like green gram black gram etc after harvesting paddy vegetables are also grown in small extents.

Observation of percolation losses is not possible in normal paddy fields where water would be supplied from field to field. The studies can be taken up only by special observation in open fields arranged for the purpose unlike the command area. The farmers are in the habit to maintain 3" to 4" depth of water in the fields, draining the fields frequently and letting in water again after every such drainage which results in water logging and losses of chemical nutrients.

The on farm application efficiency of Godavari delta system has been evaluated for wet and irrigated dry crops separately and the results are given below:

On farm application efficiency	54.15 %
Overall project efficiency	45.05 %

It is noticed that the entire three existing Delta distributory canals sections are condensed to U. shape and at some locations with raise in the bed level and hence not capable of carrying the designed discharge. The canals are to be improved to carry the Designed discharge. Also the CD and CM works, regulators, lock chambers, main off take head sluices constructed 135 years back require repairs and reconstruction. The shutters of the main 3 sluices, regulators, weirs etc are frequently tampered by the farmers. Heavy floods occurred during the months of September 2005, August, 2006 caused further damages to the canals systems.

15. Drainage efficiency:

a. Godavari Western Delta

The area irrigated in the Western Delta is mostly served by net work of Drainage sources. There are 22 Major drains, 56 Medium Drains and 559 Minor Drains in the Delta and serve the entire Ayacut of 214473 Ha (5,29,962 Acres). The inflows of the drain in the delta area is of three types. Some drains join in Kolleru Lake, which in turn is connected to the Sea by a narrow out let called Upputeru. The other drains join the sea through Upputeru or Vasista Godavari River.

b. Godavari Eastern & Central Delta

There are 11 Major Drains, 19 Medium & 117 Minor Drains and serve, the entire Ayacut of 111954 Ha. (2,76,528 Acres) and in the Godavari Central Delta there are 8 Major Drains, 25 Medium Drains and 145 Minor Drains to serve the entire Ayacut of 83760 Ha (2,06,887 Acres). The total quantum of water released to the field is less than the crop water requirement calculated as per Modified pen man method which indicates that there is no drainage problem in the command area. But actually problem is being encountered during the rainy season specially during floods. In usual course of time the drainage water from the drains is also being utilized for irrigation by cross bunding. The drainage system requires modernization and maintenance.

As the crop water requirement combined with Ground Water potential is more than the seepage plus evaporation losses, there is no drainage problem.

Participatory Irrigation Management

There are 16 Distributory Committees, 89 Water User Associations functioning under Eastern deltas and 9 Distributory Committees, 56 Water User Associations functioning under Central delta of East Godavari District. and 20 Distributaries committees, 131 Water User Associations functioning under Western delta of West Godavari District.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(5) KURNOOL -CUDDAPAH CANAL SYSTEM

1. Name of the project : Kurnool -Cuddapah Canal System
2. River / Main River / Basin : Tungabhadra River / Krishna River / Krishna Basin
3. Type of project (Major/Medium) : Major irrigation project
4. Type of structure (Dam/Barrage/Weir) : Sunkesula Barrage (Diversion structure)

5. Location – Latitude/Longitude Town / Dist / State (M.P. Dam) :
   i. (a) Latitude : 15^0-53' - 0" N
   (b) Longitude : 77^0-50' - 0" E
   ii. Village : Sunkesula
   iii. District : Kurnool
   iv. State : Andhra Pradesh

6. Length / Period of data used for study: 10 Years

   i. Dam filling data : (Inflow)
   ii. With drawals :

   Sunkesula anicut is a diversion structure and has no reservoir status.

   iii. Irrigated areas : 1996-97 to 2005-06
   iv. Rainfall data : 1995-96 to 2004-05

7. Gross Command Area : 1, 94,508 Hectares.
8. Cultural Command Area (C.C.A) : 1, 46,220 Hectares.
9. Potential Created (Localized Area): 1, 07,499 Hectares.
10. Potential Utilized : 65,465 Ha (Paddy)
    34,321 Ha (I, D) Maximum in the year 2005-06.

11. Major recommendations for overall improvement of the project:

1. Dam / Reservoir efficiency :

The existing age old Sunkesula anicut was replaced by a new barrage as a part of K.C.Canal modernization under J.B.I.C loan assistance at a cost of 1017 Crores and the work was completed in the year 2005.

The main purpose of construction of new barrage at Sunkesula is to divert Tungabhadra waters to K.C.Canal. As such, the barrage has no reservoir status as it is purely a diversion structure.

The barrage constructed recently is functioning satisfactorily.

2. Delivery system / Conveyance efficiency:

Though the modernization of K.C.Canal was completed in 2005 covering major deficiencies in pre-modernization, some improvements are still to be taken up including improvements in canal conveyance efficiency.

Major Recommendations:

(i) Regular maintenance of canal system with adequate watch and ward to avoid damages to the structures and illegal tapping of water.

(ii) Installation of measuring devices on canal system to assess actual water availability in various reaches of canal.

(iii) Introduction of VHF communication along the canal as the length of canal is more than 300 Kms.

3. **On farm application efficiency:**

Evaluation of on farm application efficiencies reveals that the average on farm application efficiency works out to 70.485 % and the overall project efficiency works out to 43.87 %. Therefore, it is desirable improve on farm efficiency and overall efficiency of the project.

Major Recommendations:

(i) Effective water regulation to the entire ayacut by regular maintenance of D.P. Sluices with adequate watch and ward to safeguard against illegal tapping of water and damage to structures.

(ii) Regular maintenance of field channels.

(iii) Proving water meters at field level to ensure supply of water as per field requirements.

(iv) Full involvement of farmers in irrigation water management adopting latest techniques to ensure sustainable water management.

(v) Recommended Cropping Pattern: There is deviation in cropping patter. As per designed cropping pattern 5249 ha of ayacut was proposed for Sugarcane. But Sugarcane is not sown in the ayacut. Due to non availability of water Rabi cultivation is also meager. Paddy cultivation is predominant in Kharif in all these years. So, I.D crops in the Kharif season should be encouraged in place of wet cultivation.

4. **Drainage Efficiency :**

The command area of K.C.Canal system is having natural drainage system leading to main rivers like Tungabhadra, Kundu, Vakkileru and Pennar Rivers. As such no recommendations are made.

12. Storage Efficiency:

Sunkesula anicut was constructed in place of old Sunkesula anicut as a part of K.C.Canal Modernization in the year 2005. The aim of the barrage is to divert Tungabhadra waters to K.C.Canal with meager storage capacity. It does not have reservoir status. As such, the aspects of storage efficiency are not covered.

13. Conveyance efficiency:

Canal conveyance efficiency studies have been conducted with current meter in the reach from Km 0.00 to 120.19 canal conveyance efficiencies are furnished below.

	Reach	**Efficiency**
1. K.C. Canal (Above 150 c/s)	Km 0.3 o 13.50	83.02 %
2. K. C. Canal (Above 150 c/s)	Km 13.50 to 91.00	58.70 %
3. Weighted average canal conveyance efficiency		62.25 %

14. On-farm application efficiency:

Kharif is the main crop season in the command. Paddy is the principal wet crop sown in the command of K.C.Canal System. On farm application efficiencies have been evaluated on K.C.Canal system for wet and dry crops separately.

On farm application efficiency works out to 45.15 %

Overall efficiency of the project works out to 28.10 %.

15. Drainage efficiency:

The command area of K.C.Canal is having natural drainage system draining in to main rivers like Tungabhadra, Kundu, Vakkileru and Pennar Rivers. No field assessment of quantum of excess water from the command area could be made to evaluate drainage efficiency.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(6) KRISHNA DELTA SYSTEM (PRAKASAM BARRAGE)

1. Name of the Project : KRISHNA DELTA SYSTEM (PRAKASAM BARRAGE)

2. River / Main River / Basin : Krishna

3. Type of project (Major/Medium) : Major Irrigation Project

4. Type of structure (Dam/Barrage/Weir) : Barrage (Prakasam Barrage)

5. Location – Latitude/ Town / Dist / State : (i) a) Latitude : 16^0 – 30' N
b) Longitude : 80^0 – 37' E
ii. District :Krishna & Guntur
iii. State : Andhra Pradesh

6. Length / Period of data used for study :10 Years

I. Dam filling data : 1995-96 to 2005-06 (11 Years)
II. Canal With drawals : 1996-97 to 2005-06 (10 Years)
III. Irrigated area : 1996-97 to 2005-06 (10 Years)
IV. Rainfall data : 1995-96 to 2004-05 (10 Years)

7. Culturable command Area :5.29 L ha (13.07 L. acres).

8. Ultimate irrigation potential : 5.29 L. ha.

9. Potential Created :5.29 L. ha.

10. Potential utilized Khariff :4.74 to 5.18 L.ha.

Rabi :0.56 to 2.05 L.ha.

(Depending upon water availability.)

0.03 lakh ha of ayacut has come under urbanization.

11. Major recommendations for over all improvement of the project:

I. Dam / Reservoir efficiency :

The barrage condition in general is satisfactory. The F.R.L. of barrage is + 57.05 ft. During unprecedented floods of 7-10-1903, the observed M.F.L. was + 70.55 ft in front of anicut and on the rear side the M.F.L. was + 68.00 ft. The maximum flood discharge arrived at was 11, 90,000 cusecs. (33,700 Cumecs). Suitable flood banks were already formed to meet any such contingency of unprecedented floods. Also, at present, Double Lane Roads on both flood banks are proposed to be formed. The Vijayawada Thermal Power Station is getting water from the barrage by gravity.

II. Delivery system / Conveyance efficiency :

All the canals in Krishna Delta System are in a satisfactory condition to deliver the designed discharges at present. But, there are no proper regulating arrangements for the pipes. Weed growth is in abundance in all the canals preventing the flow of water. (Natchu, Toodu, Junger, water Hyacinth, etc.).

The following items are to be attended to:

1. Repairs and replacements to the old and damaged shutters of Main canals and distributaries.
2. C.C. lining is necessary in vulnerable reaches to avoid seepage and where they run in sandy Zones.
3. Measuring devices are to be constructed in masonry and concrete to regulate the discharges into majors and minors.
4. Proper communication system has to be developed for effective patrolling and controlling of misuse of water.
5. All the Direct Pipes are to be fixed in masonry walls duly deciding the size of the pipes based on requirements in the fields.
6. The lock system which is in dilapidated condition has to be replaced by new one including repairs and replacements of CM & CD works wherever necessary.
7. The breaches caused to the system by Cyclones have to be permanently closed and modernization of the canals is required to be done.

The above aspects have been considered in the Krishna delta modernization programme at an estimated cost of Rs. 3500 Crores. The work is already commenced in packages by end of crop closure in 2008.

III. On farm application efficiency:

The on farm application efficiency for Delta command works out to 46.18 % and the overall delta system efficiency works at to 40.36%. To improve the efficiency of the system, modernization is necessary. In this connection, Krishna Delta modernization works have been taken up at a cost of Rs 3500 Crores to cover the overall improvement of the system. However, the following recommendations are made:

1. Direct pipe sluices are operated for supply of water to fields without any shutters resulting in wastage of water. Masonry walls are to be constructed and shutters are to be fixed to ensure regulated supplies to the farmers.
2. The possibility of providing water meters at field level has to be explored to supply water as per actual requirements.
3. Lining to the bed and sides of distributory system may be proposed especially for channels running in sand mixed soils of porous nature as the seepage losses are observed to be high. The banks may also be strengthened.
4. Farmers are involved in water management using latest techniques for optimum use of water, and encouraging latest Cultivation methods with optimum use of water. Efforts are to be made for full involvement of farmers in irrigation management.
5. Conjunctive use of water may be advised as the ground water potential is available. High yielding varieties of crops may be raised specially in Rabi season. Black gram during Rabi season in the paddy fallows is an established practice to an extent of about 2.5 Lakh Ha in the command. The possibility of increasing the area under Black gram is recommended.
6. Measuring devices are to be provided for each and every distributary, either major or minor.

Recommended Cropping Pattern: The crops sown depend upon the soils, climate conditions, irrigation facilities, food habits, market facilities, price fluctuation and other factors. Paddy is the most favoured crop by the cultivators as rice is the staple food, besides good musket conditions. There cannot be any deviation from the existing cropping pattern in

view of soils and agro climatic condition prevailing except to go in for crops like pulses and vegetables in Rabi season. The possibilities of increasing the area in Rabi season for pulses and vegetables may be explored.

12. Storage Efficiency:

a) Reservoir filling efficiency: As this is a barrage, the Live Storage capacity is meagre which is 64.90 $Mm.^{3.}$ The filling efficiency is 100% as seen from the inflow data and spillage for the last 10 years.

b) Inflow Pattern: As this is a Barrage scheme, the inflows are diverted to canals to the extent of requirements for the crops and the balance over & above the maximum storage spills over the barrage. The inflows during the year 2002-03, 2003-04 and 2004-05 are discouraging and in the remaining years the inflows were sufficient to irrigate the contemplated areas under the project.

13. Conveyance efficiency:

a) Main Canals: **Efficiency**

I. Krishna Eastern Delta:

1. Ryve's canal taking off from 1.60 of Main Canal 94.30 %

II. Krishna Western Delta: 93.94 %

b) Branch Canals: No Branch Canals

c) Distributaries :

I. Canal conveyance efficiency of Krishna Eastern Delta= 87.10 %

II. Canal conveyance efficiency of Krishna Western Delta= 87.70 %

14. On-Farm application efficiencies:

The principal crop cultivated under this project is paddy in Kharif season. Paddy is also grown in Rabi. Sugar cane is also grown in certain areas. On farm application efficiencies for Eastern delta system and as well as Western delta system have been evaluated is 46.17 and

Canal conveyance efficiency 87.40 %

Overall project efficiency 40.36 %

15. Drainage efficiency:

The irrigated area in the Krishna Delta System is served by a number of major, medium, and minor drains to remove surplus water that, gets accumulated especially during the Kharif season when the area is subjected to incidence of heavy and wide spread rainfall In the year 1964 the Government of India constituted Mithra Committee to go into the details of drainage problems in Krishna and Godavari Deltas. The committee submitted a report on the drainage system and suggested certain measures to improve the drainage in the deltas. Repairs and improvements have been carried out to most of the major and medium drains under CERP funded by World Bank. The seepage water from fields gets collected in the minor drains or medium drains and gets discharged through them.

The drainage efficiency has been worked out considering the water releases during 2004-05 and effective rainfall in the command, crop water requirement as per modified pen man method and ground water potential in the command area. It is observed that the crop water requirement during the year 2004-05 being more than water releases and the effective rainfall and hence did not result in any drainage problem. Incidentally this year happens to be a drought year. But in practice drainage problem is being encountered in the delta system specially in the tail end command. The existing drains are presently not serving up to the

desired extent due to the presence of thick weed growth and Julie flora trees as it is an age old system. At times of heavy floods due to cyclones, the drainage system is getting heavily damaged and the crops are also getting submerged. It is essential to improve the drainage system to accommodate the increased flood discharges being released during heavy floods. The drainage system needs modernization after detailed investigation and study.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(7) NARAYANAPURAM PROJECT

1. Name of the project	:	NARAYANAPURAM PROJECT
2. River / Main River / Basin	:	Nagavali River
3. Type of project (Major/Medium)	:	Medium
4. Type of structure (Dam/Barrage/Weir)	:	Barrage (Anicut)
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 18^{o}-23'-0'' E (b) Longitude : 83^{o}-48'-0'' N (ii) 28 km from Srikakulam town. (iii) Dist : Srikakulam (iv) State : Andhra Pradesh
6. Length / Period of data used for study	:	10 Years
7. Cultural Command Area (C.C.A)	:	15,855 Ha
8. Ultimate irrigation potential	:	16,620 Ha
		Left flank : 8,325 Ha
		Right flank : 7,530 Ha
		Left flank High level canal : 765 Ha
		Total : 16,620 Ha
9. Potential Created	:	15,855.52 Ha
10. Potential Utilized	:	15,855.52 Ha

11. Main recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency: The Narayanapuram anicut scheme is a diversion scheme constructed long back in the year 1963.

1. The existing gates have become old and need replacement.
2. Generator facilities are to be provided to operate gates during emergency or power failure.
3. As seen from the inflow pattern and spillage data of the scheme, there is no shortage of water and the anicut is functioning with out any scarcity of water to irrigate the planned ayacut.

II. Delivery system / Conveyance efficiency:

a. In order to ensure proper control over water delivery and reduce operational losses it is necessary to provide screw gearing shutters to all regulators.

b. Total canal system has become old. There is need to reconstruct old structures in dilapidated condition including regulators.

c. To ensure control over water delivery in the canal system, installation of measuring devises is necessary.

III. On farm application efficiency : The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. To ensure effective optimum water supplies to fields, suitable management techniques including installation of water measuring devises are necessary. It is highly desirable to involve fully the farmers in irrigation management.

Recommended cropping pattern: Paddy is the principal crop sown in Kharif Sugarcane, is also sown in 10 % of command area. Cultivators should be encouraged to sown some I.D crops also in command area along with Paddy and Sugarcane.

12. Storage Efficiency:

a) The anicut is a diversion scheme with meager storage.
b) Inflow pattern:- The inflow pattern is from 1996-97 to 2005-06 is encouraging and reached 1281 Mcum in the year 2005-06. The inflow during the crop period are diverted for irrigation and rest of the water spills over the anicut.
c) Dam efficiency is not applicable as its is a diversion scheme.

13. Conveyance efficiency:

Canal conveyance studies have been conducted on right canal as well as distributory using current meter.

Weighted Average canal efficiency of Right canal with distributory = 46.57 %

Conveyance efficiency studies for left canal were not conducted as it is an age old inundation channel and not constructed as a canal as such. Besides this, drain water is also joining the canal in the mid stream making it difficult to measure the conveyance losses. Further, straight reaches are not available for conducting the studies in a systematic manner.

14. Field application efficiency:

The principal crop for cultivation under this project is paddy in Kharif season. The on farm application efficiency has been evaluated for the Right canal ayacut and works out to 31.18 %. The overall efficiency of the project is 14.52 %.

15. Drainage efficiency:

The drainage efficiency for the project is evaluated. There is no drainage problem in the command.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(8) SRISAILAM (NEELAM SANJEEVA REDDY SAGAR) PROJECT / SRBC

1. Name of the project	:	SRISAILAM (NEELAM SANJEEVA REDDY SAGAR) PROJECT / SRBC
2. River / Main River / Basin	:	River Krishna
3. Type of project (Major/Medium)	:	Major irrigation project (Multipurpose Project)
4. Type of structure (Dam/Barrage/Weir)	:	Dam
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a)Latitude : 16^0- 5' N (b) Longitude : 78^0-54' E (ii) Village : Srisailam (iii) Mandal : Srisailam (iv) District : Kurnool (v) State : Andhra Pradesh
6. Length / Period of data used for study	:	10 Years
7. Cultural Command Area (C.C.A)	:	77,000 ha.
8. Ultimate irrigation potential	:	77,000 ha.
9. Potential Created (P.C)	:	59,900 ha
10. Potential Utilized (P.U)	:	26,300 ha

11. Main recommendations for overall improvement of the project:

I. Dam/Reservoir filling efficiency:

The Srisailam dam has achieved maximum storage (full storage) during the years 1996-97 to 2001-02 i.e. 6 years, out of 11 years study period. The storage attained is 80 to 90 % during 1995-96 and 2005-06 (2 years) and 70 to 80 % in 2004-05. Only in two years the dam efficiency is below 50 % and meager. i.e. in the years 2002-03 and 2003-04 (being drought years). Siltation problem is noticed as per the hydrographic surveys conducted during 1998-99. The reservoir is mainly meant for the production of hydroelectric power generation. The condition of the reservoir in general is satisfactory. The siltation problem has to be studied in depth and necessary expert opinion to be obtained, for solving this problem. Further the balancing reservoir which are supposed to supply water to SRBC system are not yet completed (i.e. Sri Narasimha Raya Sagar and Owk reservoir Stage-II) and water to the irrigation is drawn through a bye pass canal by laying pressure pipes.

II. Canal Conveyance efficiency:

The delivery system of the SRBC is partially completed. The canal system is provided only upto 16 Blocks (except certain portion) out of 21 Blocks proposed. Further, in certain reaches the distributory system along with micro level system is yet to be done. The same are in progress and expected to be completed in 2009. The potential utilization is slowly improving. The water is not let out during Rabi season of 2007-08

This is an ongoing scheme. The delivery system i.e. the main canal of SRBC is partially completed (completed upto 141 Km against 199 Km). The distributory system along with micro level system is not yet completed fully, and hence the efficiencies could not be taken up and recommendations could not be done. Lining is proposed for the channels with a carrying

capacity of more than 1 cusec or 0.0283 cumecs at the time of formulation of proposals itself and is being carried out accordingly. However conveyance efficiency of 50 % is considered for the purpose of evaluating on farm application efficiency.

III. On farm application efficiency:

Major crops actually being irrigated to the extent of ayacut developed is paddy with little I.D crops. On farm application efficiency have been evaluated considering the water available at pipe out let and water utilized on field. The conveyance system upto field level of the SRBC project is still in progress and is expected to be completed by 2009. the head works such as balancing reservoirs at owk (Stage II) and Sri Nara Simha Raya Sagar Project are still in progress.

In this connection it is to be stated that the partial ayacut being developed is for irrigating paddy crops against the proposal of irrigated dry crops. It is better to go in for irrigated dry crops both in Kharif and Rabi seasons since more areas can be irrigated without any gap ayacut. Better water management Techniques will solve the problem to a greater extent. The on farm application efficiency will also get increased with dry crop irrigation preferably cash crops like cotton, chillies etc instead of paddy. More areas could be brought under irrigation with I.D crops than paddy areas requiring more water requirement for the same area.

12. Storage Efficiency:

a) Reservoir filling efficiency :

The dam has achieved maximum storage (above 90 %) during the years 1996-97 to 2001-02. The gross storage of Srisailam Dam is 308.06 TMC or 8724.25 M.cum. Though there was spill over of water in the years 2001-02, 2004-05 and 2005-06, the maximum storage level could not be achieved as the gross storage capacity has reduced to 264 TMC or 7476.50 M.cum due to siltage, as per the siltage studies conducted during the year 1998-99.

b) Inflow Pattern:

The inflow pattern from 1995-96 to 2005-06 i.e. for 11 years is gathered. The annual inflow varies over a wide range of values ranging from a minimum of 157.05 TMC or 4447.65 M. cum during 2003-04 to a maximum of 1887 TMC or 53439.84 M. cum during 1998-99. As far as monthly inflows are concerned, a maximum inflow of 945.94 TMC or 26789 M. cum was received in August, 2005.

13. Conveyance efficiency:

The Srisailam Right Bank Canal System and its distributory system is partially completed upto Km 141 only. (i.e. upto Block No. XVI). The remaining work is in progress and the same is proposed to be completed by 2009. The Head works like construction of Gorakallu Balancing Reservoir (Narasimha Raya Sagar project) and Owk Reservoir Stage II are in progress. Water is being drawn to the command without en-routing the above projects through a number of pressure pipe resting on piers connecting the up stream and down stream of SRBC.An extent of 26,300 ha has been developed so far. The main canal, Distributory system and Micro level system are yet to be completed for irrigating the contemplated ayacut of 77,000 ha. Water is not released during Rabi season of 2007-08 and hence the conveyance efficiencies could not be conducted. More over the system is not fully executed. However the seepage losses are considered at the rate of 1.80 cumecs per Million Square meter of wetted perimeter of lined canal at the time of formulation proposals it self. Hence lining is proposed for the channels with a carrying discharges of more than 1 cusec or 0.0283 cumecs and being

carried out accordingly. For the purpose of evaluating the on farm application efficiency, the canal conveyance efficiency considered is 50 %.

14. Field application efficiencies for all major crops:

The major crops grown in the command area of SRBC command is only paddy with little I.D crops. The potential created under the SRBC is only 59,900 ha and the potential utilized is 26,300 ha. The water for wet crops is usually supplied continuously from field to field. On farm application efficiency for the major crops grown i.e. paddy crops in the command area of SRBC have been evaluated considering the quantum of water available at pipe out lets and on field at the command.

On farm application efficiency is working out to	33.94 %
Over all project efficiency is working	17 %

15. Drainage efficiency:

The drainage efficiency for the command area of SRBC has been evaluated and it is noticed that there is no drainage problem in the command area of the project. The project command is not fully developed since the canals and distributory system along with micro level system are partially completed. However, the command is having adequate slopes as such there will not be any drainage problem.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(9) SOMASILA PROJECT

1. Name of the project	:	SOMASILA PROJECT
2. River / Main River / Basin	:	Pennar River
3. Type of project (Major/Medium)	:	Major irrigation project
4. Type of structure (Dam/Barrage/Weir)	:	Dam
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 14^0-29'-15'' N (b) Longitude : 79^0-18'-25'' E (ii) Village : Somasila (V) (iii) Mandal : Ananthasagaram (iv) District : Nellore (v) State : Andhra Pradesh
6. Length / Period of data used for study		:11 Years
7. Culturable Command Area (C.C.A):		
Under Pennar Delta System stabilization		2.75 Lakh Acres.
New I.D creation under Somasila Project		0.95 Lakh Acres.
Kanpur Canal feeding to separate medium irrigation scheme		0.44 Lakh Acres
Total		4.14 Lakh Acres
8. Ultimate irrigation potential	:	54,656 Ha
9. Potential Created (P.C)	:	54,650 Ha
10. Potential Utilized (P.U)	:	22,663 Ha

11. Major recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency: The Somasila Reservoir Project scheme is an ongoing scheme. The maximum storage so far made is only 51 TMcft or 1.444 T.Mcum against the full reservoir capacity of 2.21 T.Mcum since the land acquisition for building the remaining capacity is in progress. However, for safety of dam it is better to keep dam site away from public movement through vehicular traffic of any sort.

II. Delivery system / Conveyance efficiency:

1. To minimize the seepage losses measure may be taken in lining the canal upto distributory system level with suitable materials.

2. Inspection paths along the distributaries may be provided to maintain the regulatory system effectively and to facilitate the ayacut-dars for carrying out agriculture activities.

3. To ensure control over water delivery in the canal system, installation of measuring devices is necessary which will also ensures optimum use of water.

d) Suitable communication system may be provided in the canal system.

e) Providing zones within the distributory system to feed the water to tail end reaches by introducing Warabandi system. The practice of irrigating I.D crops may be encouraged in place of wet crops so as to bring more areas into irrigation as the requirement of water for wet areas is more than that of I.D

III. On farm application efficiency: The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. To ensure effective optimum water supplies to fields, suitable management techniques including installation of water measuring devices at field level are necessary. It is highly desirable to involve fully the farmers in irrigation management with latest techniques for optimum use of water. Shutters may also be provided to ensure regulated supplies to the farms. The possibility of providing water meters at field level for supply of water as per actual requirement may be explored. It is better to irrigate I.D crops in both Kharif and Rabi seasons instead of wet crops that too short duration crops like Bajra, Ragi, Pulses, Sunflower etc., so that more areas could be brought under irrigation and there may not be any tail end problems. This may also yield for improving the onfarm application efficiency.

12. Storage Efficiency:

a) **Reservoir filling Efficiency:**

At present the maximum storage so far made is 1438.97 $M.m^3$ against the ultimate storage capacity of 2210.10 $M.m^3$. The dam storage efficiency varies from a minimum of 22.96 % in the year 2002-2003 to a maximum of 72.16 % in the year 2005-2006.

b) **Inflow pattern:** The inflow pattern from 1996-97, 1997-98, 1998-99, 2000-01, 2001-02, 2005-06 (i.e. 6 years) is encouraging and the maximum inflow being 9888 Mcum in the year 1996-97. The inflow for the remaining 5 years are not encouraging. The inflows during the crop period are diverted for irrigation and rest of the water spills over. The inflow pattern from 1995-96 to 2005-06 is furnished in Format – I (PART-A).

13. Conveyance efficiency:

a) Main canals

1. The weighted average efficiency of North feeder canal = 85.27 %
2. The weighted average efficiency of South feeder canal = 50.45 %
3. The weighted average efficiency of South and North feeder canals = 67.86 %

b) Branch canals No Branch canals

c) Distributaries

1. The efficiency of Distributory 7 R of North feeder canal = 96.11 %
2. The weighted average efficiency of distributory 26 L of South feeder canal=60.73 %.

14. Field application efficiencies for all major crops:

The principal crop for cultivation under this project is paddy in Kharif season (from October to January) with 10% I.D against the I.D proposals contemplated.

On farm application efficiency	31.84 %
Overall project efficiency	18 %

15. Drainage efficiency:

The terrain in the command area is having adequate slope to drain the excess water to nearest valleys and rivers. As such, there is no drainage problem. Further, the quantum of surface drainage is not realizable as the water releases are less than the crop water requirements.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(10) TUNGABHADRA HIGH LEVEL CANAL (TBL – HLC) Stage – I.

1. Name of the project	:	TUNGABHADRA HIGH LEVEL CANAL (TBL – HLC) Stage – I. from A.P border @ Km 105.437.
2. River / Main River / Basin	:	Tungabhadra River / Krishna River / Krishna Basin
3. Type of project (Major/Medium)	:	Major irrigation project TBHLC (Stage – 1)
4. Type of structure (Dam/Barrage/Weir)	:	Tungabhadra Project and Mid Pennar balancing Reservoir.
5. Location – Latitude/Longitude Town / Dist / State (M.P. Dam)	:	i. (a) Latitude : 14^0-52' - 30" N (b) Longitude : 77^0-24' - 30" E ii Village : Penkacharla iii District : Ananthapur iv State : Andhra Pradesh
TBP – HLMC (A.P area)	:	From Km 105.437 to 189.68 (84.25 Kms)
6. Length / Period of data used for study	:	10 Years
7. Cultural Command Area (C.C.A)	:	65,153 Hectares.
8. Ultimate irrigation potential	:	65,153 Hectares.
9. Potential Created (P.C)	:	45,800 Hectares.
10. Potential Utilized (P.U)	:	56,766 Hectares. (Maximum utilization in the year 1998-99)

11. Main recommendations for overall improvement of the project:

1. **Dam / Reservoir :**

A. Tungabhadra Reservoir

a. The present condition of the reservoir is satisfactory.

b. As its is an old reservoir, maintenance works including improvements are to be taken up regularly by Tungabhadra Board.

c. 1993 Hydrological surveys reveal that the dead capacity has been totally silted up. It is necessary to take up de-silting operations to recover lost capacity to the extent possible.

B. Mid Pennar Reservoir (MPR)

a. The Mid pennar Reservoir was constructed 4 decades back. However, the general condition of the reservoir is satisfactory. The reservoir components need modernization.

b. The seepage losses are to the extent of 19%. Possibility of reducing seepage losses should be explored.

2. Canal conveyance efficiency:

Canal conveyance studies have been conducted on TBP-HL Canal from A.P. border in the reach from Km 104.537 to Km 189.68 using current meter.

Similarly, canal conveyance studies have also been conducted on Mid Pennar South Canal from Km 0.00 to 96.70 using current meter.

The efficiencies are furnished below.

I.	High level main canal from A.P border (Km 107.70 to 172.08)	88.82 %
II.	Mid Pennar South Canal Weighted average canal efficiency of Mid Pennar South Canal from Km 3.19 to 84.20	72.78 %

III. Canal Conveyance Efficiency of High level main canal with Mid Pennar South canal 80.8%

A. High level main canal (HLMC)

The High level main canal was constructed 50 years back. A committee of experts inspected the reach from A.P border in May, 2005 and suggested immediate measures, short term measures and long term measures. Remedial measures include widening of canal, strengthening of banks, treatment of canal in deep cut reaches etc. Modernization of HLMC has been taken up at a cost of 463.50 Crores.

B. Mid Pennar South canal and North canal systems

The canal systems under Mid Pennar Reservoir (MPR) were constructed more than 4 decades back and require modernization.

i. Modernization to M.P south canal from Km 0.00 to 84.00 by providing C.C. lining to bed and sides has been taken up.

ii. Modernization to M.P south canal by widening and lining including improvements to existing structures and construction of new structures from Km 40.00 to 80.00. The work is being carried out in suitable packages. The cost of Modernization of M.P. South canal to be executed in various packages is 124 Crores.

iii. Improvements to M.P North canal have been taken up at a cost of 89 Crores along with Mid Pennar Dam works and other works.

3. On farm application efficiency:

The canal distribution system constructed 4 decades back has become old and needs modernization. The following are the recommendations for improving on farm application efficiency.

a) Modernization to canal distribution system up to field level.
b) Suitable regulatory arrangements to off take and D.P sluices are essentially required to avoid wastage of water and un-authorized use of water.
c) Fixing of water meters @ field level to ensure release of water as per requirements.
d) 'Warabandi' system for wet crops is desirable for equitable distribution of water and to feed water to tailend reaches effectively.
e) It is highly desirable to involve farmers fully in irrigation management.

Recommended Cropping Pattern: The main crop season is Kharif. Paddy is main crop sown under irrigated wet, Ground nut, Sunflower, Chillies, Cotton, Jawar are also sown in Kharif only Ground nut is sown in Rabi.It is recommended to encourage crops like Ground nut, Jawar, Chillies and Sunflower reducing paddy in late Kharif season as the area is located in low rainfall region.

4. Drainage Efficiency:

There is no drainage system for the project. As there is no problem, no additional drainage proposals are necessary.

12. Storage Efficiency:

A. Tungabhadra Reservoir

i. Tungabhadra Reservoir was designed for a gross capacity of 3157.497 M.cum. As seen from the working tables, the dam efficiency varies from 62.82% to 100% in a period of 10 years.

ii. **Inflow pattern:** The inflow pattern from the year 1997-98 to 2000-01 are very encouraging when compared to other years.

iii. **Water spillage:** The surplus history of the project shows that the reservoir spilled in 6 years out of 10 years.

B. Mid Pennar Reservoir

i. The Mid Pennar Reservoir was designed for a gross capacity of 146.40 M.cum and Live storage capacity of 135.07 M.cum.

ii. The dam filling efficiency varies from 33.34% to 100%

iii. **Inflow pattern:** As seen from inflow pattern of river flows, at Mid Pennar Reservoir, Yearly inflows are not so encouraging. No spillage during any year.

13. Conveyance efficiency:

Canal conveyance studies have been conducted on TBPHL Main canal form A.P border in the reach from Km 104.70 to Km 189.68 using Current Meter. Conveyance studies were also conducted on Mid Pennar South Canal in a length of 96.00 Kms using Current Meter.

The conveyance efficiency of TBPHLC (main canal) works out to 88.82%. Similarly weighted average conveyance efficiency of Mid Pennar south canal works out to 72.78%. The canal conveyance efficiency of High level canal including M.P south canal works out to 80.8%.

14. Field Application Efficiencies for all major crops:

The main crop season is Kharif. Paddy is the main crop sown under irrigated wet. Ground nut, Sunflower, Chillies, Cotton, Jawar etc are also sown in Kharif. Depending upon the availability of water, ID crops like Ground nut are also sown in Rabi season. On farm application efficiency have been evaluated for wet crops and I.D crops separately sown in the command.

On farm application efficiencies for wet crop is working out to be 75.8 %
On farm application efficiencies for I.D crops is working out to be 68.57%
Overall project efficiency works out to 58.32 %

15. Drainage efficiency:

There is no existing drainage system for the project command. There are adequate slopes in the command area and well defined streams in the boundaries of command area to drain off excess water from the command area.

No water logging, salinity or alkalinity areas are noticed.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(11) TUNGABHADRA PROJECT LOW LEVEL CANAL (TBP-LLC)

1. Name of the project	:	TUNGABHADRA PROJECT LOW LEVEL CANAL (TBP-LLC)
2. River / Main River / Basin	:	Tungabhadra River / Krishna River / Krishna Basin
3. Type of project (Major/Medium)	:	Major irrigation project
4. Type of structure (Dam/Barrage/Weir)	:	Tungabhadra Project Low Level Canal taking off from Tungabhadra Project @ Km 250.58 (A.P Border)
5. Location – Latitude/Longitude Town / Dist / State	:	i. (a) Latitude : 15^0-41' N (b) Longitude : 77^0- 9' E ii. Village : Holagunda iii. Mandal : Holagunda. iv. District : Bellary v. State : Karnataka
TBP – LLC (A.P area)	:	From Km 250.58 to 324.00 (73.42 Kms)
TBP – LLC (Length)	:	324 Kms
Kurnool Branch Canal (Extension)	:	48 Kms
6. Length / Period of data used for study:		10 Years
7. (a) Gross Command Area	:	78,864 Ha (1,94,794 Acres)
(b) Cultural Command Area (C.C.A):		61,163 Ha (1, 51,157 Acres)
8. Ultimate irrigation potential	:	–
9. Potential Created (P.C)	:	61,163 Ha (1, 51,157 Acres)
10. Potential Utilized (P.U)	:	37,745 Ha (Maximum in 1995-96)

11. Main recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency:

a) The present condition of Tungabhadra Reservoir is satisfactory.
b) As it is an old reservoir, maintenance works including improvements are to be taken up regularly by Tungabhadra Board.
c) 1993 Hydrological surveys reveal that the dead storage capacity has been totally silted up. It is necessary to take up de-silting operations to recover lost capacity to the extent possible.

II. Delivery system / Conveyance efficiency:

a) The canal is delivering only 350 to 385 cusecs or 9.91 to 10.90 cumecs against the designed discharge of 725 cusecs or 20.53 cumecs at Andhra Pradesh border i.e. at km 250.58. In view of the difficulty in getting the water to tail end reaches, existing regulating arrangements need improvements to minimize operational losses. As the system has been functioning for more than 4 decades, the delivery system needs modernization.
b) The existing structures have become old and some of them are in dilapidated condition. There is need to reconstruct old structures including regulators.
c) Suitable CC lining to canal system in vulnerable and banking reaches is necessary.

d) Installation of measuring devices on canals and distributaries is necessary to ensure control over delivery in the canal system.

III. On farm application efficiency:

The average on farm efficiency of TB LLC system works out to 44.80 %. The overall efficiency of the project works out to 32.33 %. The following improvements are suggested to improve the efficiency.

a) Overall improvement of distribution network covering field channels is necessary as the system was constructed long back.
b) Effective Water regulation has to be resorted to, by providing shutters to all OT sluices and D.P. sluices including replacement of old and dilapidated sluices.
c) The possibility of providing water meters at field level should be explored to supply water as per actual requirements.
d) Farmers are to be involved fully in water management with latest techniques for optimum use of water.
e) **Recommended Cropping Pattern:** 90 % of the area in Kharif is sown under paddy. It is desirable to encourage I.D crops like Sunflower Ground nut, Chillies etc in Kharif. In some years no Rabi crops are sown suitable I.D crops can also be proposed subject to the availability of water in Rabi season.

IV. Drainage Efficiency:

There is no drainage system for the project. No drainage problems are faced. As such, no improvements are suggested.

12. Storage Efficiency:

a) The Tungabhadra Reservoir was designed for a gross capacity of 3157.497 M.cum. As seen from the working tables, the dam efficiency varies from 62.82 % to 100% in a period of 10 years.
b) **Inflow Pattern:** The inflow pattern from the year 1997-98 to 2000-01 are very encouraging when compared to other years.
c) **Water Spillage:** The surplus history of the project shows that the reservoir spilled in 6 years out of 10 years.

13. Conveyance efficiency:

The Tungabhadra Project Low Level Canal takes off from Tungabhadra Dam and runs for a length of 73 Kms from A.P. border. Canal conveyance efficiencies have been conducted @ Km 273.18, @ Km 282.20 and @ Km 324.00 and efficiencies are presented below.

	Reach	**Efficiency**
1. Low Level Canal	Km 273.18 to 292.20	98.3 %
2. Low Level Canal	Km 292.20 to 324.00	56.36 %

3. Weighted Average canal efficiency of Low Level Canal system 72.13 %

14. On farm application efficiency:

The Principal crop for cultivation under this project is paddy in Kharif season. The other I.D crops sown in Rabi season are groundnut and chilies. The Tungabhadra Project Low Level Canal has got an existing net work of distribution system functioning for more than four decades.

The system has become old. Due to poor maintenance of water regulation system, most of the D.Ps are not functioning with shutters. There are no measuring devices to assess the water

released to the fields. On farm efficiency for Low Level Canal command area have been evaluated for paddy Kharif and the results are shown in the following table.

On farm application efficiency works out to 44.80%

Overall efficiency of the project works out to 32.33 %.

15. Drainage efficiency:

There is no existing drainage system for the project. There are adequate slopes in the command area to drain off excess water. Hence, there is no drainage problem.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(12) Vamsadhara Project (Stage – I)

1. Name of the project : Vamsadhara Project (Stage – I)
2. River / Main River / Basin : Vamsadhara River
3. Type of project (Major/Medium) : Major irrigation project
4. Type of structure (Dam/Barrage/Weir) : Barrage (Gotta barrage)
5. Location – Latitude/Longitude Town / Dist / State : (i) (a) Latitude : 18^{o}-12'-0'' E
   (b) Longitude: 83^{o}-48'-0'' N

The barrage is located at 0.805 kms south west of Gotta Village, Heeramandalam mandal
(ii) 50 km from Srikakulam town.
iii) Dist : Srikakulam
(iv) State : Andhra Pradesh

6. Length / Period of data used for study : 11 Years
7. Cultural Command Area (C.C.A) : 59,987 Ha (1, 48,230 acres)
8. Ultimate irrigation potential : 59,987 Ha (1, 48,230 acres)
9. Potential Created Stage- I : 59,987 Ha
   Phase I Stage-II : 82,087 Ha.
10. Potential Utilized : 82,087 Ha (by the year 2006)

11. Main recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency:

i) The F.R.L of Gotta barrage is +38.10m, with free board margin of 3.35m. During unprecedented floods of 1980, the observed M.F.L to an extent of 6 lakh cusecs encroached 1 metre in to free board margin. Necessary proposals are being framed to extend the spillway bays to let out additional maximum flood. The proposals should be implemented immediately to safe guard the barrage.

ii) In view of the encroachment of flood water, there is need to safe guard the flood banks by strengthening them suitably.

II. Delivery system / Conveyance efficiency:

Canal conveyance efficiency studies on unlined distributary 48R of main canal have been conducted using current meter The canal is delivering only 1800 cusecs against the designed discharge of 2,400 cusecs. In view of the difficulty in diverting water to tail end reaches, existing regulating arrangement need improvements to minimize operational losses.

a) Repairs and replacements to the old and damaged shutters in main canals & distributaries are essential.
b) Suitable Cement Concrete lining in vulnerable and bed filling reaches is necessary.
c) Introducing of Very High Frequency communication system on the canal runs for a length of 107.00 kms.
d) Installation of measuring devises on canal and distributaries for ensuring optimum use of water to irrigation.

III. On farm application efficiency:

The principal crop for cultivation under the project is paddy in Kharif season. Direct pipe sluices are operated for supply of water to field without any shutters resulting in wastage of water. Shutters

are to be fixed to ensure regulated supplies to the farmers.The possibility of providing water meters at field level to be explored to supply water as per actual requirements.Farmers are to be involved fully in water management with latest techniques for optimum use of water.

Recommended cropping pattern: The entire command area of Vamsadhara Project s sown with paddy crop only which is as per original designed cropping pattern. Because of good rains and favourable conditions the entire command is sown with paddy crop only. It is desirable to encourage farmers to cultivate I.D crops along with paddy in Kharif season in stead of total paddy cultivation.

12. Storage Efficiency:

(a) Reservoir filling efficiency: As this is a barrage, the storage capacity is meager which 17.33 M.cum is. The filling efficiency is 100% as seen from the inflow data and spillage for the last 10 years.

(b) Inflow pattern: As this is an anicut scheme, the inflows are diverted to the extent of requirements for the crops and the balance over & above the maximum storage spills over the barrage.

13. Conveyance efficiency:

Conveyance efficiency of 48R of L.M.C (Above 150 c/s) is 90.50 %

14. Field application efficiencies for all major crops:

The principal crop for cultivation under this project is paddy in Kharif season.

On farm application efficiency	58.47 %
Overall project efficiency	52.91 %

15. Drainage efficiency:

1. There is no drainage problem in the command area of the project.
2. There are no cases of water logging and salinity in the area.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(13) YELERU PROJECT

1. Name of the project	:	YELERU PROJECT
2. River / Main River / Basin	:	Yeleru
3. Type of project (Major/Medium)	:	Major irrigation project
4. Type of structure (Dam/Barrage/Weir)	:	Dam
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 17-18'-0'' E (b) Longitude: 82-5'-30'' N

The entire dam is located near Yeleswaram village opposite to 9.20 km stone of Yeleswaram – Addateegala road in East Godavari District, in the State of Andhra Pradesh.

6. Length / Period of data used for study	:	10 Years
7. Cultural Command Area (C.C.A)	:	27,240 ha (67614Ac)
8. Ultimate irrigation potential	:	58,280 ha (After the completion of Stage-II of the project)
9. Potential Created (PC)	:	27,240 ha
10. Potential Utilized (PU)	:	27,240 ha (100%)

11. Major recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency:

The condition of the reservoir in general is satisfactory. However the following dam safety measures are suggested for proper maintenance of the reservoir.

1. Yeleru project is a reservoir Project. All the gaps of earthen dam are proposed to be connected to all weather roads for proper approach to the dam.
2. It is recommended to install permanent power supply lines for operation of spill way & canal gates.
3. An independent departmental wireless system connecting the dam office to the dam administration like Dist. Collector of Kakinada & S.E., Kakinada etc is necessary.

II. Canal Conveyance efficiency:

The entire existing ayacut under Yeleru Reservoir Project is being irrigated since long time through an age old open head channels system consisting of 113 Nos on left side and 112 Nos on right side of the river. Now also the required water is supplied on turn basis to the ayacut from Direct-cum-Reservoir (DCR) sluices located in the gaps of the dam. The ayacut is being irrigated by laying big temporary cross bunds across the river to a height of 1 m to 1.50 m and drawing the water on 6 days turn basis as per "Kanchi Ramanna Panthulu" Diary to ayacut by gravity through open head channels. The present canal net work system has formed to its regime. This is a typical system deferent from regular canal system where no hydrological standards are in practice. Once the canal net work is completed and tagged on to Yeleru Reservoir Project then the contemplated ayacut and Irrigation Potential can be reckoned. The system is able to irrigate on an average of 33,778 ha (Both Kharif and Rabi) by utilizing the canal with drawl of 264.60 M.cum (on an average) against the ultimate irrigation potential of 58,280 ha (After completion of Stage-II of the project). The following are the proposals under canal system.

1. The ayacut under the Yeleru River under the old system irrigated though 225 open head channels is proposed to be modified to 75 distributaries.
2. Improvement to rivulets on the upstream side of the bed regulators are proposed to be taken up by constructing off take sluices, drops etc. to irrigate an ayacut of 7432 ha

3. The left side and right side main canals are proposed to be improved, by providing regulators, drops and off take sluices.
4. Improvements to the existing river banks is proposed to be taken up from km 2.98 to 10.805 km up to Kandrakota Village.
5. Remodelling of Yeleru river below Kandrakota (V) namely irrigation canal by providing cross regulators, off take sluices on both sides is proposed

III. On farm application efficiency:

There is no specific distribution system with controlling arrangements for letting out the water to the command area of Yeleru Reservoir Project. The ryots are following the same olden days practice of drawing the water on turn basis at 6 days interval through the open head channels by raising full supply levels with cross bunding the river. However the following recommendations are made.

1. It is desirable to involve the farmers in irrigation management to ensure equitable distribution of water to farmers.
2. The possibility of providing water meters at field level is to be explored.

The modernization proposals Yeleru Irrigation and Drainage System duly including the following scopes are in progress at a cost of Rs 147.70 Crores.

1. Improvements to Yeleru Reservoir Project as per the suggestions of Dam safety organization.
2. Improvements to existing canal system for a length of 73.99 Km.
3. Improvements to existing Drainage system for a length of 69.70 Km
4. Bed regulators wherever necessary, proposed to maintain designed Full Supply Levels in canal sections.

12. Storage Efficiency / Reservoir efficiency:

a) Reservoir Filing Efficiency : The reservoir across the river Yeleru at Yeleswaram (V) is constructed to store a gross storage capacity of 24.11 TMC or 682.80 M.cum to stabilize an existing ayacut of 44240 ha (including 17000 ha proposed under Samalkot extension canal i.e. Pithapuram branch canal), providing 5 TMC or 141.60 M.cum water to Visakhapatnam Steel Plant and flood control. The dam efficiency is 100% in (5) five years (in the years 1996-97, 1997-98, 1999-2000, 2000-01 and 2001-02) and during 1995-96 it is about 90 %. During 1998-99 and 2002-03 it is in between 70 to 80 % and during 2004-05 it is below 70 %. The inflows during 2003-04, are not encouraging.

b) Inflow pattern: The inflow pattern from 1995-96 to 2004-05 except in 2002-03 is encouraging and reached maximum storage of 583.6 Mm3 in the year 1999 after with drawals and spill over.

13. Conveyance efficiency:

The canal net work is not yet formed but irrigation is being continued under the Yeleru River System. The existing ayacut under Yeleru Project is being irrigated. Since long time through on age old open head channel system consisting of 113 Nos on left side and 112 Nos on Right side of the river. The water is being drawn on turn basis @ 6 days interval from good olden days. After the formation of the project, siltation is arrested at the dam and the river course downstream is free from siltation resulting in higher level of ayacut than the river course. Therefore cross bunds to a height of 1m to 1.50m are being formed across the river to raise the water levels to draw water to the ayacut by gravity. Water is supplied on turn basis to the ayacut from Direct-cum-Reservoir (DCR) sluices located in the gaps of the dam now also on turn basis. As per practice 50 % of canal conveyance efficiency is assumed.

14. Field application efficiency for all major crops:

The principal crop (80%) for cultivation under this project is paddy in Kharif season only utilizing water on turn system at 6 days interval. In about 20% of the area sugarcane is grown. There is no proper regulating arrangements existing and no specific distribution system with controlling arrangements existing and hence the on farm application studies could not be conducted. However the on farm application efficiency has been evaluated based on the performance of the system considering the command areas irrigated during 2004-05 and the canal with drawals for the wet crop cultivation as the major crop grown is paddy. It is suggested for exploring the possibility of adopting micro irrigation method or sprinkler irrigation or SIRI method for paddy cultivation for the command.

On farm application efficiency is working out to	28.42 %
Over all project efficiency is working out to	14.21%.

15. Drainage efficiency:

The terrain in the command is having adequate slopes and is well drained. The problem comes only during the floods, which effects in undation of the command. It is proposed to improve the existing drainage system for the project command naturally formed before the formation of the reservoir which was instrumental in irrigating command area by open head channels without any regulating arrangements. The following conclusions are however drawn.

1. There is no drainage problem in the command area of the project.
2. There are no cases of water logging and salinity in the project area.

16. Final Report of WUE study of the project sent to Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

ANDHRA PRADESH & TELENGANA STATE

(14) NAGARJUNA SAGAR PROJECT

1. Name of the project	:	NAGARJUNA SAGAR PROJECT
2. River / Main River / Basin	:	Krishna River.
3. Type of project (Major/Medium)	:	Major irrigation project Multipurpose Project
4. Type of structure (Dam/Barrage/Weir)	:	Dam
5. Location – Latitude/Longitude Town / Dist / State	:	i) (a) Latitude : 16^0 34' 24" N (b) Longitude: 79^0 18' 47" E The project site is situated near the historic and ancient town Nandi Konda in Nalgonda District. (ii) Village : Nandikonda (iii) Mandal : Peddavoora (iv) District : Nalgonda (v) State : Andhra Pradesh & Telangana
6. Length / Period of data used for study	:	10 Years
7. Cultural Command Area (C.C.A)	:	8.99 Lakh Ha (22.28 L. Acres)
8. Ultimate irrigation potential	:	8.96 Lakh Ha. (21.43 L. Acres)
9. Potential Created (P.C)	:	8.89 Lakh Ha (21.96 L. Acres)
10. Potential Utilized (P.U) during the Years 1995 to 2004-05	:	Wet 0.30 to 5.40 Lakh Ha. I.D 0.80 to 6.53 Lakh Ha.

11. Main recommendations for overall improvement of the project:

I. Dam / Reservoir filling efficiency:

The dam condition in general is satisfactory certain problems referred to the expert committee by the Govt. of Andhra Pradesh as stated below, needs further investigation for suggesting suitable remedial measures for the Dam Safety. The dam safety cell also suggested certain measures as indicated below.

1. Cavity at chain age 142.50 on the upstream slope of right earth dam.
2. The seepage on downstream face of non over flow dam in Block No.76.
3. The damages to the spill way slope and bucket
4. The condition of the road way on spill way piers requires resurfacing.
5. Precise instruments required for observing and taking dam safety measures.
6. The defects in the left canal regulators, the diversion canal gates and the Right canal head regulator gates.
7. The defects in operation of radial arm.
8. Providing more 'v' notches for observing seepage losses.
9. Sedimentation (siltation) into the reservoir.

All the above defects observed needs rectification and suitable measures need be taken up. Constant monitoring measures in observing the sedimentation studies may be taken up so that in case of any alarming situation necessary remedial measures can be taken up.

II. Delivery system / Conveyance efficiency:

Improvements to both the main canals and its Distributory system are required to minimize the seepage losses. The following suggestions are made.

1. Lining with suitable material over the existing side revetments (wherever slipped and disturbed) in certain reaches of main canals and in unlined portion of Distributaries. The canal section needs re-sectioning so a to drawn the required designed discharge for the Main canals, Branch canal and Distributaries etc.
2. The existing regulating arrangements need improvements. Repairs and replacement to the damaged. Shutters of main canal and distributaries are required to ensure effective water delivery and arrest wastage of water through leakages.
3. Improvements and repairs to structures (C.M and C.D works) of Distributaries and Main canal system wherever necessary including reconstruction as per necessity. Measuring devices like 'v' notches, Broad crested weirs, Partial flumes, and-throat flumes, Gauges etc on the canal distributory system up to field channel are required to be provided to increase operational efficiencies and also to measure seepage losses.
4. Strengthening and stabilization of banks is to be done where the canal banks are slipped and at places where it is not to the required section.

The entire canal system needs modernization since the canal conveyance efficiencies and the project overall efficiency is found to be far less. The requirements for improving the canal system efficiencies are covered in the modernization proposals of Nagarjuna Sagar Project at a cost of about Rs. 4,400 Crores and the work is taken up.The overall Project Irrigation Efficiencies of Nagarjuna Sagar Project works out to 21.80 %.

In this connection, it is to be mentioned here that as per the information available on onfarm application efficiency throughout the world is varying from 11 to 60 % and the overall Project Irrigation Efficiency is about 22 %. Viewing with this back ground the overall projects efficiency cannot be said to be very poor although from the point view of deprivation of irrigation facilities to farmers who are legitimately due. The picture is rather dismal with the improved water management and a reduction in seepage losses.

It could be possible to obtain a Project Irrigation Efficiency of 60-70 % for paddy. The Project Irrigation Management on this project is only 22% i.e. 78% water (on an average) could not be utilized effectively for many reasons. Reduction of seepage losses would require lining of canals and distributaries. By improving the canal system it could be possible to bridge the gap to certain extent and the balance by adopting the suitable cropping pattern and by adopting improved method of irrigation practices, so that the overall project efficiency could be achieved.

III. On farm application efficiency: The present practice of supply of water on continuous basis involves lack of uniform supply and wastage.

The on farm application efficiency of Nagarjuna Sagar Project command area under the canal system have been evaluated for the wet and dry crops grown during the year 2004-05 and the results are as follows.

1. On farm application efficiency for wet crops 33.10 %
2. On farm application for Dry crops 44.76 %
3. Average on farm application efficiency 38.93 %
4. Overall project efficiency= 21.78 % or 21.80 %.

As seen the project efficiency is found to be less. To improve the on farm application efficiency the following are suggested.

1. Suitable shutters are to be provided for operation of direct pipe sluices and to all the sluices and to be maintained regularly with watch and ward avoiding damages.
2. The possibility of providing water meters at field level for supply of water as per actual requirements is to be explored.
3. Conjunctive use of water may be advised as the ground water potential is available.
4. To ensure sustainable water management in conservation of water and equitable distribution to farmers, it is highly desirable to involve the farmers fully in irrigation management
5. Warabandi system or sprinkler irrigation system or SRI method paddy cultivation may be introduced for equitable distribution of water and to feed tail end ayacut effectively.
6. It is recommended to grow crops like pulses, vegetables and I.D crop like ground nut, Maize sunflower etc and short term crops instead of paddy during Rabi season as the I.D crops require less water than the paddy crops so that more areas could be brought under irrigation without tail end problem.

12. Storage Efficiency:

a) Dam / Reservoir filling efficiency:

Nagarjuna Sagar Project constructed on Krishna River near Nandikonda Village, Peddavoora mandal, Nalgonda district is a pride project of Andhra Pradesh, to store 408.240 TMC or 11561.35 M.cum for irrigating an ayacut of 21.43 Lakh Acres or 8.673 Lakh ha under Right and Left Canals.

Besides there are 57 Nos of Lift irrigation schemes to irrigate an ayacut of 0.42 Lakh ha (1.04 Lakh acres) and 82 Nos of Supplementation Schemes to irrigate an ayacut of 0.68 Lakh ha (1.69Lakh acres). In consonance with the National water policy, the Dam also serves drinking water requirements of surrounding villages of the command area. It also generates 960 M.W of electricity through its 3 power houses Viz, Main Power house, Right Bank canal power house and Left Bank canal power house.

The Dam / Reservoir efficiency is worked out and furnished in the following table for the years 1995-96 to 2004-05. Dam efficiency 100 % in good inflow years of 1996-97 and 1998-99. The efficiency was moderate during 1997-98, 1999-00 and 2001-02. The dam efficiency is nil during 2002-03 and 2003-04 and in the other 3 years i.e. during 1995-96, 2000-01 and 2004-05 the inflows are meager.

The project is getting silted up at the rate of more than that anticipated and hence needs special studies and measures to be taken up for de-siltation.

b) Inflow pattern:

The inflow pattern from 1995-96 to 2004-05 is gathered for 10 years and furnished in format – I (PART-A). As observed from the inflow data of the Nagarjuna Sagar Project for the last ten years, the annual inflow varies over a wide range of values ranging from a maximum inflow of about 1683 TMC or 47662.56 M.cum during the year 1998-99 and minimum of about 149 TMC or 4219.68 M.cum in the year 2003-04. As far as monthly inflows are concerned, the maximum inflow of 768.93 TMC or 21776.10 M.cum was received in the month of October 1998. Peak inflows were observed in the months of July to October every year 75 % dependable yield is relieved in only 4 years out of 10 years data observed i.e. from the year 1996-97 to 1999-2000.

Out of 10 years, the dam has surplussed in only 5 Yrs with a maximum of 849.35 TMC or 24,053.59 M.cum during 1998-99 and minimum of 3.31 TMC or 93.74 M.cum during 1995-96. There was no spill over during the years 2000-01 to 2004-05.

13. Conveyance efficiency:

a) Main Canals

i. Nagarjuna Sagar Right Main (Jowahar) Canal (from Km 42.44 to 68.19) 96.50 %

ii. Nagarjuna Sagar Left Main Canal (Lal Bahaddur Canal) (from Km 10.91 to 60.16) (Weighted average efficiency) 93.32 %

b) Branch Canals

i. NSRC Guntur Branch Canal (Km 4.16 to 16.93) 92.53 %

ii. Pedda Nandipadu Branch Canal (NSRC) Km 2.62 to 6.21 85.27 %

Conveyance efficiency of Nagarjuna Sagar Project Right Bank Canal (Jowahar Canal) System as a whole 61.45 %

Conveyance efficiency of Nagarjuna Sagar canal system (i.e. Distributory system) under Left and Right canal system 55.96 %

14. **Field application efficiencies for all major crops:**

The principal crop for cultivation under the project is irrigated wet paddy and I.D crops like Cotton and chillies. The project is designed to irrigate an ayacut of 9.32 Lakh acres or 3.77 Lakh ha wet and 12.11 Lakh acres or 4.90 Lakh ha I.D.

On farm application efficiencies have been evaluated for Nagarjuna Sagar Left Canal and Right Canal (i.e. Lal Bahaddur Canal and Jawahar Canal respectively) command areas for wet and I.D crops separately considering the irrigated areas of 2004-05 and the quantum of water let out through the canal system for the areas during Kharif season since there was no irrigation during Rabi season. The on farm application efficiency of the command area of Nagarjuna Sagar Project for wet crop command is working out to 33.10 % and for I.D crops command is working out to 44.76 %.

The average on farm application efficiency is working out to 38.93 % and the project efficiency is working out to 21.78 % or say 21.80 %.

Onfarm application efficiency	38.93 %
Overall project efficiency	21.80 %.

15. Drainage efficiency:

There is no existing drainage system in the command area of Nagarjuna Sagar Project. The command area lies in arid region where sufficient slopes are available to drain out surplus rain water and water from the command area to the nearest valleys and hence no specific drainage system is necessary. However the natural surface drainage of 100 Km is available on left canal command and 150 km length or right canal command and hence no drainage problem. The necessity of field drains have to be studied in depth after detailed investigation.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

TELANGANA STATE

(15) KADDAM PROJECT

1. Name of the project	:	KADDAM PROJECT
2. River / Main River / Basin	:	Kaddam
3. Type of project (Major/Medium)	:	Major irrigation project
4. Type of structure (Dam/Barrage/Weir)	:	Dam / Reservoir
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 19^0-07' N (b) Longitude : 78^0-47' E (ii) Village : Kaddam (iii) Mandal : Kaddam (iv) District : Adilabad (v) State : Telengana
6. Length / Period of data used for study	:	10 Years (i) Dam filling data (Inflow) : 1996-97 to 2005-06 (ii) With drawals : 1996-97 to 2005-06 (iii) Irrigated areas : 1996-97 to 2005-06 (iv) Rainfall data : 1996-97 to 2005-06
7. Culturable Command Area (C.C.A)	:	27,519 ha
8. Ultimate irrigation potential	:	27,519 ha
Left flank	:	26,305
Right flank	:	1214
9. Potential Created (P.C)	:	27,519 ha.
10. Potential Utilized (P.U)		
Kharif	:	5666 ha to 21,482 ha
Rabi	:	only 3 years 4047 to 8094 ha (1998-99, 2001-02, 2005-06)

11. Major recommendations:

I. Dam/Reservoir filling efficiency:

The dam is structurally safe since it with stood heavy flood during 2005 with minimum damage. The dam is susceptible for flash floods in view of the location of dam and shape nature of catchment area. Hence it is suggested to install automatic flood warning system in the catchment and to take all precautionary measures and vigilant during floods.

'V' notches are to be provided to observe seepage through dam, the repairs to the longitudinal cracks formed on non over flow dam are to be taken up. Pot holes on B.T road on top of composite dam need immediate repairs and so also the repairs to toe drain disturbed at the junction of right main canal and dam.

Repairs and improvements to spill way and Left head regulator are to be taken up in consultation with Andhra Pradesh Engineering Research lab for model studies and Chief Engineer, Central Designs organization for design.

II. Delivery system / Conveyance efficiency:

Lining is to be continued in the entire canal system including distributory system to minimize losses.

a) Suitable cross drainage works are to be constructed wherever inlets are existing to prevent silt entering the canal.
b) To ensure control over water delivery in the canal system proper regulating arrangements including installation of measuring devices which will ensure optimum use of water.
c) The existing distributory system has become old and needs re-sectioning, removal of weeds and proper regulating arrangements need be provided to minimize wastage of water.
d) Suitable communication system may be provided in the canal system.
e) Providing zones within the distributory system to feed the water to tail end reaches by introducing Warabandi system I.D crops may be encouraged in place of wet crops.

III. On farm application efficiency: On farm application efficiency has been evaluated for the wet crops (being major crop) considering the canal efficiency of Left and Right flank canal system (primary data) and the losses due to percolation and seepage at field. The on farm application efficiency of command area is working out to 36.13 % and the overall project efficiency is working out to 18.52 %. For improving the on farm application efficiency and the project efficiency, the following is suggested.

The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. To ensure effective optimum water supplies to fields, suitable management techniques including installation of water meters and measuring devices at field level are necessary. Shutters may be provided at D.P sluices to ensure regulated supplies to the farm. Watch and ward may be provided at the off take points for avoiding damages to the shutters and tampering of shutters. It is suggested for growing paddy during Kharif season and Irrigated dry crops like Maize, Ground Nut, Jowar, Sorgam etc., during Rabi season since paddy require more water than I.D crops and more areas could be brought under Irrigation. During Kharif rainfall supplements the irrigation requirement where as in Rabi season the crops are mostly dependent on canal water. So in Kharif water releases can suitably be scheduled considering the effective rainfall in the command and paddy can be successfully be irrigated and more areas could be brought under Irrigation with I.D crops in Rabi season.

12. Storage Efficiency:

a) Reservoir filling efficiency:

The reservoir has gross storage capacity of 215.3 $M.m^3$ and live storage capacity of 136.5 $M.m^3$. The gross storage, as seen from 10 years data is highest usually in the month of September and October months. The highest 210.4 $M.m^3$ was achieved during September, 2001-02.

As seen from the above, the dam efficiency is more than 90% during 6 years study i.e. during 1997-98, 1998-99, 1999-2000, 2000-01, 2001-02, 2002-03, 2003-04 and above 80% during 2000-01, 2005-06 (in 2 years) above 70 % during 1996-97 (one year) and only during 2004-05 it is just above 50%. Except in the year 2001-02 the full ayacut is not irrigated. The dam efficiencies are not in proportion to the ayacut irrigated. This is because of the other efficiencies like conveyance efficiency and on farm application efficiency which indicates that the system is not working properly as discussed in the respective efficiencies.

b) Inflow Pattern:

The reservoir receives inflows from Saraswati canal also, which off takes from SRSP dam and from its independent inflows from its catchment. The catchment is in circler shape located totally in the forest. The catchment is in steep slopes, causing instantaneous floods during heavy

rains. During August, 1958 the dam has received heavy floods of 5.19 Lakh cusecs or 14,710 cumecs causing breaches to dam. The dam was reconstructed by 1964.

The inflows of 1294 M.cum received in the year 2003-04 from its catchment and Saraswati canal was highest during study period. Month-wise data reveals that the inflows are, usually received in the South west monsoon period. The year, 2004-05 received lowest 195 M.cum inflows. Except 2004-05 year, the dam has spillovered in all the 10 years.

13. Conveyance efficiency:

The conveyance efficiency of Left flank canal, with its Distributory D13 and Right flank canal has been evaluated by conducting gaugings using Current meter and the results are tabulated below.

a) Main canals

1) Left main canal 73.50 %
(Km 8.43 to 29.00) (Weighted average efficiency)

2) Right main canal 62.20 %
(Km 0.200 to 1.00)

b) Branch canals No. Branch canals

c) Distributaries

1) Distributory D_{13} of Left flank canal 54.84 %
(Km 0.70 to 4.25)

Efficiency of Left main canal including and upto Distributory D_{13} = 40.30 %

Efficiency of Right Main canal = 62.20 %

Canal conveyance efficiency of Kaddam Project system= 51.25 %

14. Field application efficiencies for all major crops:

The major crop irrigated under Kaddam project is paddy. Water would be supplied from field to field continuously. On farm application efficiency for the major crop grown i.e. paddy in the command area of Kaddam Project has bee evaluated considering the irrigated areas of 2005-06 and the quantum of water let out through the canal system during the year for wet area.

On farm application efficiency is working out to 36.13 %
Overall efficiency works out to 18.52%.

15. Drainage efficiency:

There is no existing drainage system for the project. All the entire excess surface water after its utilization flows into the natural drain which in turn drains into Godavari River. The terrain is having adequate slopes and well drained. Entire water from the command will drain into the River. Further it is observed that the water releases plus rain water component put together is less than the crop water requirements and ground water potential and hence there is no drainage problem.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(16) KOIL SAGAR PROJECT

1. Name of the project	:	KOIL SAGAR PROJECT
2. River / Main River / Basin	:	River Peddavagu / Tributary to Krishna River / Krishna Basin
3. Type of project (Major/Medium)	:	Medium irrigation project
4. Type of structure (Dam/Barrage/Weir)	:	Reservoir
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 16^0-44' N (b) Longitude: 77^0-45' E The project site is situated near the historic and ancient town Koil Konda in Mahaboob Nagar District. (ii) Village : Koil Sagar (iii) Mandal : Devarkadra (iv) District : Mahaboob Nagar (v) State : Telangana
6. Length / Period of data used for study	:	10 Years (i) Dam filling data : 1995-96 to 2004-05 (Inflow) (ii) Withdrawals : 1995-96 to 2004-05 (iii) Irrigated areas : 1995-96 to 2004-05 (iv) Rainfall data : 1995-96 to 2004-05
7. Cultural Command Area (C.C.A)	:	11,700 Acres
8. Ultimate irrigation potential	:	12,000 Acres.
9. Potential Created (P.C)	:	11,700 Acres.
10. Potential Utilized (P.U)	:	9,200 Acres.

11. Major recommendations for overall improvement of the project:

I. Dam/Reservoir efficiency: The present condition of Koil Sagar Project is satisfactory. However certain improvements like construction of chute drains, rectification of disturbed flooring of composite dam, the undulations of downstream slopes of composite dam, are required to be attended and brought to the designed standards. Treatment to the white ant hills, removal of bushes, vegetation etc is to be done and turfing to be provided.

The rubber seals at spill way gates are required to be replaced. Repairs to masonry structure and the leakages found need be rectified. Similarly at Energy dissipaters, the disturbed stone pitching at downstream 2nd apron, and Joints between the stone blocks of apron have to be rectified.

The leaching on right side training wall is required to be stopped with suitable measures. The damaged hand railing on the top of spill way foot bridge is to be rectified duly bringing it to the standards. All the crest gates are required to be painted and annual maintenance done for its proper functioning duly replacing the worn out items.Similarly at head regulators also the mechanical parts need be maintained properly.

II. Delivery system / Conveyance efficiency:

a) Two main canals one from Right Flank and the other from Left flank take off from Koil Sagar Project.

b) Improvements to both the main canals and its Distributory system are required to minimize the seepage losses. The following suggestions are made.

c) Lining with suitable material over the existing side revetments (wherever slipped and disturbed) in certain reaches of main canals and in unlined portion of Distributaries

d) Improvements and repairs to structures (C.M and C.D works) of Distributaries and main canal system wherever necessary including reconstruction as per necessity.

e) Improvements and strengthening of bund of balancing reservoirs at Nagaram (V) and Thuniki Kunta (V).

f) Providing measuring devices like 'v' notches, Broad crested weirs partial flumes, and throat flumes, gauges etc on the canal distributory system up to field channel to increase operational efficiencies and also to measure seepage losses.

III. On farm application efficiency: The present practice of supply of water on continuous basis involves lack of uniform supply and wastage. To ensure effective optimum water supplies to fields, suitable management techniques including installation of water meters and measuring devices at field level are necessary. It is highly desirable to involve fully the farmers in irrigation management with latest techniques for optimum use of water. To ensure regulated supplies to the fields, shutters may also be provided.

Warabandi system or sprinkler irrigation system or SRI method for paddy crops may be introduced for the equitable distribution of water and to feed tail end reaches effectively. The practice of irrigation wet crops may be discouraged and in its place I.D. crops may be encouraged so that more areas could be irrigated with available water.

Recommended Cropping Pattern: Due to poor inflows and erratic rainfall, there was no cultivation in Kharif season. Paddy and ground nut are sown in Rabi. Farmers may be encouraged to sow I.D crops in Rabi season in place of Paddy, in view of poor inflows and erratic rainfall condition.

12. Storage Efficiency:

The Koil Sagar Project across peddavagu a tributary to Krishna River is constructed near Koil Konda (V) (an historic ancient place) Mahaboob Nagar District. (Hence named as Koil Sagar Project) to store 44.62 M.cum for irrigating an ayacut of 12000 Acres or 4856 Ha Kharif 3000 Acres or 1214 Ha in Rabi fed by the right and left flank canals. The capacity of the Reservoir is raised by raising the F.T.L and increasing storage capacity from 44.62 M.cum to 64.45 M.cum which is necessitated to safe guard the ayacut of 6000 acres or 2428 Ha under ooka chetty vagu Project @ Raman padu (V) Koil Konda (M) at down stream of Koil Sagar Project in normal seasonal conditions.

There is also proposal of Koil Sagar lift irrigation scheme to lift the water in two stages from the foreshore of Priyadarshini Jurala Project to Koil Sagar Project to serve the existing ayacut of 12000 Acres or 4856 Ha under Koil Sagar Project and additional ayacut of 9000 acres or 3642 Ha I.D in Kharif by utilizing 2,541 T.M.C or 69.41 M.cum water for irrigation and drinking water requirements of surrounding villages of the command area.

Inflow pattern: The inflow pattern from 1995-96 to 2004-05 is furnished (10 years) out of which the inflows for 5 years are not encouraging (for the years 1997-98, 2000-01 to 2003-04) and reached nil during 1999-2000 and 2004-05. In all the years the inflows are not sufficient to irrigate the contemplated ayacut of 12000 acres or 4856 Ha and even the cultural command area of 11,700

Acres or 4735 Ha. The maximum irrigation done is 83% in 1995-96 and minimum of 10.4% in 2000-01 in Rabi season.

13. Conveyance efficiency:

The conveyance efficiencies of both Right flank canal and left flank canal of the project have been studied During Rabi season and the conducted with current meter during Rabi season and the efficiencies are presented below:

1. Weighted Average Right main canal efficiency 86.63 %
2. Canal efficiency of Left Main Canal 78.62 %
3. Canal efficiency of Koil Sagar Project (L.F + R.F) canals 82.62 %

14. Field application efficiencies for all major crops:

The principal crop for cultivation under the project is paddy. The project is designed to irrigate an ayacut of 4856 Ha or 12000 acres paddy in Kharif season and 1214 Ha or 3000 acres paddy in Rabi. The area developed was only 4735 Hectares or 11,700 Acres only. The actual areas irrigated are paddy and I.D ground nut during Rabi season. (Due to late and insufficient inflows). Most of the D.P outlets are being operated without shutters and regulating arrangements. Much difficulty is being faced in measuring the correct discharges throughout lets.

On farm application efficiency 75 %

Overall project efficiency 61.96 %

15. Drainage efficiency:

There is no existing drainage system in the command area of Koil Sagar Project. The command area lies in arid region where sufficient slopes are available to drain out surplus rain water to the nearest valleys and no specific drainage system is necessary.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(17) NIZAMSAGAR PROJECT

1. Name of the project	:	NIZAMSAGAR PROJECT Across
2. River / Main River / Basin	:	Manjira River / Godavari basin (G_4)
3. Type of project (Major/Medium)	:	Major
4. Type of structure (Dam/Barrage/Weir)	:	Dam
5. Location – Latitude/Longitude Town / Dist / State	:	(i) (a) Latitude : 18-10'-0'' N (b) Longitude : 76-56'-0'' E (ii) Mandal : Achampet (V). Nizam Sagar (Mandal) (iii) Dist : Nizamabad (iv) State : Telangana
6. Length / Period of data used for study	:	11 Years
7. Cultural Command Area (C.C.A) Original	:	1.11 Lakh ha.
8. Ultimate irrigation potential	:	1.11 Lakh ha
9. Potential Created	:	93,659 ha (Relocalised ayacut)
10. Potential Utilized	:	93,659 ha (Relocalised ayacut)

11. Major recommendations for overall improvement of the project:

I. Dam/Reservoir filling efficiency:

Nizamsagar Project is a multipurpose project constructed in the year 1931 with a purpose of irrigating an ayacut of 93,659 ha with drinking water supply to Nizamabad and Bodhan towns and power generation of 5MW of 2 Units.

Reservoir siltation is a major problem. Raising of F.T.L earlier and supplementation to the ayacut by lift irrigation schemes are proved to-get over the problem. The condition of the dam in general is satisfactory. However the following safety measures need be attended to for increasing the present dam efficiency.

1) Immediate repairs to the settlements observed in earth backing to masonry dam.
2) Lubrication and general maintenance to Mechanical equipment.
3) Leakages in flood gates and gear boxes.
4) Maintenance to generator.

II. Canal Conveyance efficiency:

1) The Project and its Canal system is 75 years old. The condition of the canal system is very bad. The canal breached at many places. The structure constructed are of 75 years old in CRS masonry in lime mortar.
2) The total length of main canal is 156 kms of which 75-80 kms reach is in single banking. This being a contour canal, silt is being collected in beds and sides reducing the canal capacity.

Recommendations :

1) Lining to the canal is to be done to arrest the seepage losses.
2) Repairs and replacement of CM and CD works may have to be taken up wherever necessary adopting latest design procedures.
3) Canal bank need strengthening.
4) All OT sluices should be provided with adequate controlling arrangements.
5) Introduction of V.H.F Communication system is to be thought of as the length of canal is considerable.

6) Measuring devices are to be installed to increase operational efficiencies of the system.

In this connection it is further to be stated that in order to have optimum utilization of water and to arrest the seepage losses and to supply the water to the total ayacut, Modernization proposals of main canal and Distributory system including CM and CD works of Nizam Sagar Project are taken up at a cost of Rs. 549.60 Crores.

III. On farm application efficiency:

On farm application efficiency has been evaluated for the wet crops (being the major crop) considering the canal efficiency of canal system and the losses due to percolation and seepage at field command. The on farm application efficiency of the command area is working out to 45.32 % which is found to be less and the over all project efficiency is working out to 39.43 %. For improving the on farm application efficiency the following are suggested.

1) Most of the direct pipe out lets are being operated without shutters and the existing DP outlets are in leaky condition.
2) Suitable controlling arrangements to direct pipe outlets are to provided and maintained regularly.
3) The possibility of providing water meters at field level should be explored to ensure optimum use of water.
4) It is highly desirable to involve farmers in irrigation management to ensure sustainable water management.
5) Conjunctive use of water may be encouraged when the ground water potential is available in the command.
6) In addition to the above, instead of wet crops, the I.D crops are recommended both in Khariff and Rabi periods so that more areas could be brought under irrigation with less water utilization or wet crops may be grown in Kharif and I.D crops like Maize, Ground nut, Sunflower, Sorgam, Jowar etc during Rabi season, since the wet crops require more water during Rabi season. Wet crops may also be grown in Rabi season under the tank command depending on the availability of water.

IV. Drainage Efficiency:

Drainage system does not exist in the command area of Nizamsagar Project. There is no drainage problem as suitable slopes are available to drain out surplus and rain water to the nearest valley and as such no specific drainage system is necessary. There is no problem of water logging and Salinity.

12. Storage Efficiency:

a) Reservoir filling efficiency: Dam Reservoir efficiency is more than 90 % in the years 1995-96, 1996-97 (100 %), 1998-99 to 2000-01. Dam efficiency from 2001-02 to 2004-05 in very less due to poor inflows**.**

b) Inflow Pattern: It is observed that the inflows received during the years 1995-96, 1996-97, 1998-99 to 2000-01 were found to be sufficient. During the years 1999-2000 and 2005-06 the inflows are moderate. The inflows are not encouraging during the years 1997-98, 2001-02 to 2004-05.

13. Conveyance efficiency:

1. Weighted average efficiency of main canal 93.80 %
2. Weighted average efficiency of Distributory D_{28} 92.75 %
3. Efficiency of main canal including and upto Distributory D_{28} 87 %

The condition of the age old canal system is not upto the mark. Bungas are formed at many places plus breaches occurred which are temporarily closed. Hence the conveyance losses are more. The cross masonry and cross drainage works have become old and are in leaky condition.

It is suggested for lining the canals including repairs and replacement of CM and CD works. The shutters are also in leaky condition.

14. Field application efficiencies for all major crops:

Irrigation systems are planned to meet the water requirements of crops grown in the project command. The major crop grown in the project is paddy in Kharif and Rabi seasons, where water would be supplied from field to field.

The on farm application efficiency for the major crop grown i.e. paddy in the command area of Nizam Sagar Project has been evaluated considering the conveyance efficiency of main canal and distributory at head and tail reaches primary data and the quantum of water available at pipe out lets is arrived at. The quantum of water at field is arrived at by deducting the seepage and percolation losses on the command area from the quantum available at pipe outlets.

On farm application efficiency is working out to 45.32 %

Overall project efficiency is working out to 39.43 %

15. Drainage efficiency:

The drainage efficiency for the project is evaluated and it is noticed that there is no drainage problem in the command area of the project.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(18) RAJOLIBANDA DIVERSION SCHEME (RDS)

1. Name of the project	:	RAJOLIBANDA DIVERSION SCHEME (RDS)
2. River / Main River / Basin	:	Tungabhadra River / Krishna Basin
3. Type of project (Major/Medium)	:	Major irrigation project; Inter-state Project
4. Type of structure (Dam/Barrage/Weir)	:	Ogee type Masonry Anicut.
5. Location – Latitude/Longitude Town / Dist / State (M.P. Dam)	:	i. (a) Latitude : 15^0-58" N (b) Longitude : 77^0-11" E ii.Village : Rajolibanda iii.Taluk : Manvi iv.District : Raichur v. State : Karnataka
6. Length / Period of data used for study	:	10 Years
7. (a) Gross Command Area (in A.P)	:	61,777 Ha (1,52,589 Acres)
(b) Cultural Command Area (C.C.A)	:	41,616 Ha (1, 17,559 Acres) (in A.P)
(c) Localized Ayacut (in A.P)	:	35,410 Ha (87,500 Acres)
8. Ultimate irrigation potential (in A.P)	:	35,410 Ha (87,500 Acres)
9. Potential Created (P.C)	:	35,410 (87,500 Acres)
10. Potential Utilized (P.U)	:	Max: 18741 Ha & Min: 4830 Ha (2004-05 – 52.93 %) & (2002-03 – 13.6 %)

11. Major recommendations for overall improvement of the project:

I At the Head works, i.e. at Anicut site and canal upto Km 42.60 (lying in Karnataka area)

1. Providing proper river training works (Groynes etc) at entry point of head regulator for stream lining the flows and protecting the bed and side slopes of the river with rough stones.
2. Providing power hoist arrangements to all the gates of head regulators, scouring sluices duly repairing the gates and excavation of tail channel.
3. Reconstruction of energy dissipating arrangements and stilling basin to original standards, closing of construction sluices, closing of Right side sluices, repairs to crest cap of anicut and Raising of anicut by about one ft or 0.30 m.
4. Remodeling of main canal from Km 0.00 to 42.60 including repairs and reconstruction of cross masonry and cross drainage works so that the designed discharge of 771 cusecs and water allocated to A.P at the border (i.e. 15.90 TMC) could be realized.

Modernization of RDS canal system falling both in Karnataka area and A.P area including necessary repairs to head works is also being taken up under Stage – I at a cost of Rs 72.00 Crores and extra cost of Rs 20 Crores asked by the Karnataka Govt. is also under examination of Govt. of A.P. Further RDS Modernization proposals costing Rs 105 Crores not covered under the Stage – II is under consideration with Govt. of A.P for sanction.

II. **Delivery system / Conveyance efficiency:**

The shortfall in the development of ayacut can be attributed to two major factors.Short Supply of water & Deficient Distribution of water

SUPPLY OF WATER

Canal receipts at the AP border during last ten years i.e. from 1995-96 to 2005-06 are averaging only to 165.18 $M.m^3$ against the expected and agreed flows of 15.90 TMC or 450 $M.m^3$.

The following observations are made:

While paddy predominates in Kharif and ID crops in Rabi, the overall intensities are much lower than design (26% of the localized area in Kharif compared to 45 % and 35% in Rabi compared to 60%).

The cropping pattern has deviated substantially, from localization pattern. Major part of distribution system serves for mixed cropping pattern of both wet and I.D crops including long term I.D crops. There is difficulty in the operation system as the requirement is through out the year.

The irrigation intensities are much higher in the upper command (i.e. Head reach) than in the lower zones during Kharif (40% compared to 14%).

The canal is designed to discharge 771 cusecs but the same is not realized at the A.P. Border because of the FSL constraint to some extent and the diversion factor, at head works, including over utilisation in the Head reaches lying in Karnataka area. The FSL depth required at the point Km 42.60 shall be + 1063.95 ft to draw the designed discharge of 771 cusecs and the corresponding upstream side shall be + 1064.80 ft. It is necessary to improve and modernize the entire canal on the upstream reach i.e. from 0.00 to 42.60 Kms.

The canal receipts at the AP border during the last, 11 years are in the range of 95.71 to 221.16 averaging to 165.18 $M.m^3$ compared to the KWDT allocation of 450 Mm3. It can be seen that not only the total receipts have fallen short of the allocation, but also there is a steady decline in the water availability to RDS.

The shortfall in the total receipts is due largely to conveyance capacity constraint in the main canal resulting out of an over optimistic value of rugosity factor assumed in the canal design. In addition, the receipts at the RDS anicut have been dwindling as a result of steady increase in the abstraction of river flows upstream of the anicut by a number of lift irrigation schemes.

DISTRIBUTION OF WATER

Some of the major problems encountered in the distribution of water relate to the system deficiencies – both infrastructural and operational.

IMPROVING WATER DISTRIBUTION

With the one seasonal operation of most of the distributaries, the water distribution would greatly improve. In addition, the other measures aimed at achieving this objective are:

Systematic canal operation (SCO); and Intermittent supplies to ID crops and cotton.

Under the systematic canal operation the Kharif wet distributaries would be closed for one or two days in a week to avoid over irrigation and to push water to the tail areas. The ID and cotton areas would be served with intermittent supplies with all canals running full when 'ON'.

SUPPORTING PHYSICAL IMPROVEMENTS

Under the new water distribution plan, the RDS canal operations would be governed by the following hydraulic principles:

The main canal would be fully regulated so that FSL is maintained at each distributary's head for varying main canal flows.

The distributary's off takes and the minor off take of the mixed crop distributaries would be operated on a full ON/OFF schedule.

Below the distributary head (or the minor head in case of mixed crop distributaries) there would be proportional distribution of' water through un-gated outlets.

The Infrastructural improvements identified to support this operation include:

ON MAIN CANAL

1. Construction of cross regulators at intervals determined by the backwater curves.
2. Modification of the distributary's off takes to pass the designed flow with water at FSL in the main canal,
3. Treatment to vulnerable reaches and
4. Remodeling the last reach of main canal for 17 km; and

ON DISTRIBUTARIES/MINORS

1. Installation of measuring devices at the distributary's / minor head
2. Resizing of canal / structures
3. Replacing the outlets with un-gated proportional division structures.

Besides above, suitable Cement Concrete lining in vulnerable and bed filling reaches is necessary for both main canal and distributaries as the existing lining is badly damaged and good lot of vegetation has grown. The repairs and replacements to the cross drainage and cross masonry works as the existing one are damaged. Installation of measuring devises on canal and distributaries for ensuring optimum use of water to irrigation.

III. On farm application efficiency:

The on farm application efficiency considering the Rajolibanda Diversion Scheme main canal as representative sample (considering the length from Km 43.60 to 92.85) of the whole canal distribution system have been evaluated for wet and Irrigated dry crops separately.

The following are the recommendations for improving the on farm application efficiencies.

1. Direct pipe sluices are operated for supply of water to field without any shutters resulting in wastage of water. Shutters are to be fixed to ensure regulated Supplies to the farmers.
2. The possibility of providing water meters at field level to be explored to supply water as per actual requirements.
3. Farmers are to be involved fully in water management with latest techniques for optimum use of water.
4. It is recommended to grow Irrigated dry crops like Maize, Ground nut, Jowar, commercial crops like Cotton, Chillies, Sunflower etc., as the I.D crops require less water than the wet crops and hence more areas could irrigated mitigating tail end problem to same extent.
5. Watch and ward may be provided at the head works and off take points for avoiding damages to the system and tampering.

12. Storage Efficiency:

(a) Anicut Filling Efficiency: The anicut is purely a diversion scheme mainly intended to divert the waters of Tungabhadra River to Rajolibanda Diversion Scheme canal system with a very meager storage capacity and is located in Raichur District, Karnataka State. The anicut does not have reservoir status. The aspects of dam filling spillage etc are not applicable to Rajolibanda Diversion scheme canal system. However the dam efficiency / Reservoir efficiencies of T.B. Project are considered and furnished, since about 7 TMC or 198.24 M.cum are to be supplied from Tungabhadra Project reservoir to the RDS canal system.

(b) Inflow Pattern: Actual inflows of Tunga Bhadra Reservoir from the year 1995-96 to 2004-05 are furnished in the working tables @ Format-I (Part-A). As seen from the inflow pattern, the inflows during the year 1997-98 to 2000-01 are found to be very encouraging when compared to other years (out of 10 years 4 years encouraging).

13. Conveyance efficiency:

Conveyance studies have been conducted on main canal with current meter from Km 43.60 to 92.85 at head reach (from Km 43.60 to 62.50) Middle reach (from Km 62.50 to 76.20) and Tail reach (from Km 76.20 to 92.85) and the conveyance efficiency is as follows.

Main Canal Weighted average Efficiency of main canal 82.83 %

Though the conveyance efficiencies are moderate, the canal losses for the lined canal are found to be more. The lining to the canal is damaged and good lot of vegetation has grown. Hence the canal requires remodeling specially at vulnerable reaches. Similarly the CD and CM works, outlets requires repairs and replacement as the same are leaking.

14. Field application efficiencies for all major crops:

The principal crop for cultivation under this project is paddy in Kharif season. The I.D crops are grown in Rabi and perennial crops like sugarcane in both Kharif and Rabi season as per contemplation. But in practice, paddy is also grown in Rabi season and I.D crops like Maize, Cotton, Chillies etc are also grown both in Kharif and Rabi season, the irrigation under the RDS canal system being adopted is mixed cropping pattern.

On farm application efficiencies of the Rajolibanda Diversion Scheme system have been evaluated for wet and dry crops separately.

On farm application efficiency for wet crops	40.89 %
Irrigated dry crops	62.13 %
Average on farm application efficiency	51.51 %
Over all project efficiency	42.65 %

The contemplated localized ayacut of 35,410 Ha could not be irrigated as the receipts at A.P border are less than that allotted due to various reasons and the Head works and Main canal upto Km 42.60 are in Karnataka area. The following is suggested for better functioning of the system.

1. It is better to entrust the operation and maintenance of the system to a Joint Committee constituted by the state Govt of A.P and Karnataka.
2. Watch and ward may be provided at the Head works and off take points for avoiding damages to the system and tampering.
3. The possibility of providing water meters at the field level for supply of water as per actual requirement is to be explored so as to restrict the unauthorized cultivation at the head reaches.
4. Better water management practices may be implemented through Water Users Association in particular during the monsoon period.
5. It is recommended to grow Irrigated dry crops like Maize, Ground nut, Jowar, commercial crops like Cotton, Chillies, Sunflower etc., as the I.D crops require less water than the wet crops and hence more areas could be irrigated mitigating tail end problems to some extent.

15. Drainage efficiency:

1. There is no drainage problem in the command area of the project.
2. There are no cases of water logging and salinity in the area.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(19) SRI RAM SAGAR PROJECT

1. Name of the project	:	SRI RAM SAGAR PROJECT
2. River / Main River / Basin	:	Across Godavari River / Godavari Basin
3. Type of project (Major/Medium)	:	Major Multipurpose Project
4. Type of structure (Dam/Barrage/Weir)	:	Dam
5. Location – Latitude/Longitude Town / Dist / State (M.P. Dam)	:	i. (a) Latitude : 18^0-58' - 0" N (b) Longitude : 78^0-20' - 0" E ii) Village : Pochampad iii)Mandal : Balakonda iv) District : Nizamabad v)State : Telangana
6. Length / Period of data used for study	:	11 Years
7. Cultural Command Area	:	5, 81,611 ha
8. Ultimate irrigation potential	:	3, 92,000 ha
9. Potential Created	:	3, 71,054 ha (2005)
10. Potential Utilized	:	3, 06,558 ha

11. Major recommendations for overall improvement of the project:

I. Dam / Reservoir filling efficiency:

Sri Ram Sagar Project is a multipurpose project constructed in the year 1982 (first impounding) for irrigating an ayacut of 3,92,000 Ha or 9,68,632 (under Stage – I programme) with drinking water supply to Karimnagar, Warangal towns and power generation of 36….M.W and water supply to Ramagundam power project (NTPC), through (3) Three main canals namely Kakatiya canal (0 to 284 Kms 0 to 146 Kms above LMD and 146 to 284 below L.M.D), Saraswathi canal and Laxmi canal.

Findings and Recommendations:

1. The dam is structurally safe. The PMF is to be evaluated and the adequacy of free board to be observed.
2. The toe drains have to be cleared for its vegetation and chute drains need immediate replacement. Some more 'V' notches are to be installed for observing seepage losses zone wise.
3. The vegetation growth on downstream slopes of Earth dam need be cleared and the black topped road on the top requires repairs.
4. Dam deformation studies are to be taken up.
5. Measures are to be taken for de-silting behind the river sluices by means of machinery.
6. Operation and Maintenance of spill way and gates, observation of drainage through drainage holes and performance there on has to be observed. Lightening in the galleries need be improved, clearing of ventilation pipes, duct of gallery has to be done regularly.
7. The scope of problems to the gates of Head regulators has to be referred to Mechanical wing for rectification on all fronts including seals and Rollers.
8. The un attended river sluices are of potential risk and hence need immediate attention.
9. The leakages in the seals of the gates 1,7,9,11 to 15 and 36 are to be rectified. The turn bucket of radial gates getting jammed need rectification. Painting to the gates and hoist

equipment has to be attended to. A ladder is to be provided for approaching the walk way bridge for maintenance staff operation.

10. The deficiencies either in the gantry crane or in the stop log elements may be checked and got rectified.

The siltation problem existing in the reservoir has to be studied in depth and necessary measures taken in arresting the silt problem for which special sophisticated studies are to be done. The following measures are suggested for arresting silt into the reservoir:

1. Flushing out the deposited silt over certain period in view of favorable structural condition. The flushing has to be done followed by agitators and dredgers, using the later judiciously.
2. Reductions of sediment inflow by soil conservation. This is most effective method in which soil is prevented from entering into main streams by water shed management.
3. Trapping and retention of sediment of vegetative screens at Head of Reservoir.
4. By passing of heavily sediment laden flows by providing by passing channels or tunnels which drain heavily sediment laden flow down streams of the dam.
5. Flow regulation during flood by opening low level out lets.
6. Venting of Density currents.
7. Dredging or Siphoning of reservoir.

II. Canal Conveyance efficiency:

There are three main canals existing under Sri Ram Sagar Project namely 1. Kakatiya Canal 2. Saraswathi Canal and 3. Laxmi Canal.Canal conveyance efficiencies (on weighted average method) of Kakatiya canal above L.M.D and below L.M.D with its distributaries D_{29} and DBM15 respectively and Saraswathi canal with its Distributory D_{16} have been carried out. The following recommendations are made for improving the system:

1. Water releases are to be made as per the schedule prepared based on the overall crop demands, area and taking into consideration the constraints in the physical system related to soil status, stage and type of crops and climatic condition.
2. Over irrigation has to be discouraged where people are in the habit of using more water throughout the crop period.
3. Suitable operation plan may be developed for equitable distribution of water to increase the efficiencies.
4. Providing zones within the distributory system to feed the water to the tail end, by introducing warabandi system I.D crops in place of wet crops may be provided since the wet areas require more water than I.D crops.

III. On farm application efficiency :

The on farm application efficiency considering the Kakatiya Canal as representative sample of Sri Ram Sagar Project since Major areas are being irrigated through this canal have been evaluated for wet and Irrigated dry crops separately,To improve the on farm application efficiency the following are suggested.

1. The possibility of providing water meters at field level for supply of water as per the actual requirement is to be explored.
2. Watch and ward may be provided at the off take points for avoiding damages to the shutters and tampering of shutters by the ryots.
3. Better water management practices may be implemented through the Water Users Association in particular during the monsoon period.
4. Conjunctive use may be advised as the ground potential is available at shallow depths, specially for I.D crops where the canal water will be issued on and off basis.

5. To ensure sustainable water management in conservation of water and equitable distribution to farmers, it is highly desirable to involve the farmers fully in irrigation water management. This is being attended to by conducting workshops both in Kharif and Rabi under Sri Ram Sagar Project for deciding cropping pattern, discussing the system deficiencies and preparation of water schedule etc.
6. Warabandi system or sprinkler irrigation system or 'SRI' method of paddy cultivation or short crop duration variety may be introduced for equitable distribution of water and to feed tail end ayacut effectively.
7. It is recommended to grow I.D crops than wet crops and dofassal crops since the wet crops require more water and more areas could be brought under irrigation with the I.D cropping pattern, There will not be any tail end problem if I.D crops of short term are grown instead of wet crops. Paddy can be grown under tank commands. On farm application efficiency will be more in case of I.D crops as seen from the data prepared.

IV. Drainage Efficiency:

In the Sri Ram Sagar Project command, there is no surface drainage problem since the command is having sufficient slopes to drain out the surplus water to the nearest valleys or streams. The sub surface water adds to the irrigation potential, which is being utilized as conjunctive use. The following are suggested for conjunctive use.

1. Canal I.D supplies can be supplemented for growing paddy crop / Sugar cane.
2. Sugarcane crop can be supported during non canal supplies season.
3. Initial requirement of water can be met with from ground water potential and paddy nurseries can be grown using ground water.
4. I.D crops can be grown during lean supply period and supplies can be made for crops in Rabi season.
5. Land reclamation correction of zinc deficiency leaching of salts by arranging underground filters may solve the problem of water logging. The water logging area in Sri Ram Sagar Project is to an extent of 48,594 Ha and the area prone to water logging is 1, 36,381 ha. The problem has to be studied in depth to avoid Salinity or Alkalinity.
6. Tolerance crops like Maize, cotton etc are recommended in the areas where water logging, prone to water logging exists.

.

12. Storage Efficiency:

a) Reservoir filling efficiency:

It is observed that sedimentation problem is existing in the reservoir. As per the hydrographic surveys conducted in 1994 the gross capacity and the live capacity of the reservoir have come down to 90.31 TMC or 2557.25 $M.m^3$ and 2002.44 $M.m^3$ or 70.72 TMC from 112.02 TMC or 3171.94 $M.m^3$ and 81.99 TMC or 2322 $M.m^3$ respectively in the year 1970. (Original capacity). In this command, further hydrographic studies have also been conducted during the year 2006 and the capacities have to be confirmed.

c) Inflow Pattern: It is observed that the inflows received during the years 1998-99 were found to be maximum and during the year 1997-98 found to be minimum. During the years 2004-05, the inflows are not sufficient to irrigate the command, practically there was no irrigation during the year 2004-05. During the other years the inflows are moderate. Month wise data reveals that the inflows are usually received during the South west monsoon period.

13. Conveyance efficiency:

a) Main canal

i. Kakatiya canal above L.M.D (Km 7.27 to 45.725) — 97.93 %

ii. Kakatiya canal below L.M.D (Km 148.46 to 193.594) — 90.77 %
(Lower Manair reservoir is a Balancing Reservoir)

iii. Saraswathi Canal (Km 0.100 to Km 24.00) — 97.37 %

b) Branch canal — No Branch Canal

c) Distributaries

i. Kakatiya canal Distributaries above LMD Distributory D_{29} (Km 0.3 to 16.00) — 84.77 %

ii. Kakatiya canal Distributory below LMD Distributor DBM_{15} (Km 0.3 to 14) — 73.34 %

iii. Saraswathi Canal Distributory D_{16} (Km 1.43 to 6) — 94.46 %

14. Field application efficiencies for all major crops:

Irrigation systems are usually planned to meet the water requirements of crops grown in the project command. The Sri Ram Sagar Project command is originally designed for $1/3^{rd}$ paddy and $2/3^{rd}$ I.D crops which is subsequently redesigned for I.D crops. However farmers are permitted to grow crops of their choice. The predominant (Major) crop grown in the command is paddy both in Kharif and Rabi seasons.

On farm application studies have been evaluated for the Kakatiya canal system for wet and irrigated dry crops separately considering the Kakatiya canal as representative sample of the entire Sri Ram Sagar Project. The on farm application efficiency and overall project efficiency worked out is as follows.

1. On farm application efficiency for wet crops — 34.56 %
2. Irrigated Dry crops — 80.00 %
3. Average on farm application efficiency — 57.28 %
4. Overall project efficiency — 44.66 %.

As seen the project efficiency is found to be less

15. Drainage efficiency:

The drainage efficiency for the project is evaluated and it is noticed that there is no problem in the command area of Sri Ram Sagar Project. The natural drains are sufficient to drain out the surface water to the nearest valleys. However, certain water logging and prone to water logging areas are identified in the command where conjunctive use of water is proposed. Leaching of salts by arranging sub surface filters, land reclamation correction of zinc deficiency, growing tolerance crops like Maize, cotton etc may solve the problem to some extent.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(20) UPPER MANAIR PROJECT

1. Name of the project	:	UPPER MANAIR PROJECT
2. River / Main River / Basin		:Manair River a tributary to river Godavari, Godavari Basin
3. Type of project (Major/Medium)	:	Medium irrigation project
4. Type of structure (Dam/Barrage/Weir)	:	Dam (Reservoir)
5. Location – Latitude/Longitude Town / Dist / State	:	(I) (a) Latitude : 18^0-16'-0" N (b) Longitude : 78^0-33'-0" E (ii) Village : Narmal (iv) Mandal: Gambhirao pet (v) District: Karim Nagar (vi) State : Telangana
6. Length / Period of data used for study	:	10 Years
7. Cultural Command Area (C.C.A)	:	6984 Ha
8. Ultimate irrigation potential (Relocalised in 1990)	:	6511 Ha 5296 Ha Kharif Paddy 1215 Ha Rabi paddy
9. Potential Created (P.C)	:	5296 Ha Kharif Paddy 1215 Ha Rabi paddy
10. Potential Utilized (P.U)	:	4000 Ha Rabi paddy in 2000-01

11. **Major recommendations for overall improvement of the project:**

I. Dam/Reservoir efficiency:

Toe drains, chutes and out fall drains may be provided to drain off the rain water. Relief wells may be provided as suggested by dam safety cell. Top of the road requires repairs. Communication system may be provided. Gates to the emergency gates need be provided. Repairs to shutters of the sluices, cracks observed on coping of masonry dam and damages on the ogee surface need rectification to avoid further complications.

II. Delivery system / Conveyance efficiency:

The modernization and improvements to main canals and distributaries of the conveyance system up to 40 Ha have been done under APERP SIFT programme. The following further items are required to be attended to for improving the conveyance efficiency.

1. Proper maintenance of field / supply channels. i.e. micro level net work system beyond out let.
2. Repairs and replacement of shutters for main and distributaries wherever necessary.
3. Removal of weed growth from canal prism and development of communication system along the canals for speedy transmission of water demand in various segments of the canal system etc.

III. On farm application efficiency:

a) The possibility of providing water meters at field level for supply of water as per actual requirement is to be explored.
b) Construction of distribution boxes for effective distribution of water equally to the ayacut with in the distributory.
c) Educating the ayacut-dars about proper utilization of water and training of farmers with latest techniques of water management.
d) Warabandi system or Rotational water supply or sprinkler irrigation or SRI method for wet crops or short duration variety crops may be introduced for equitable distribution of water for more areas and to feed tail end reaches effectively.

e) The change in mode of reservoir operation, conservation of water, improved agronomical practices and conjunctive use of water regenerated / ground water may solve the problem of irrigating entire settled ayacut under the project.

f) Recommended Pattern: Rice being the staple food, with good market conditions and reasonably assured income, cultivators prefer to grow paddy. However, to offset the late inflows into the reservoir, if carry over storage is maintained in the reservoir for utilization in the next Kharif season short duration paddy varieties could be encouraged for effective utilization of rainfall during South West monsoon as well. .

12. Storage Efficiency:

Due to siltation, the gross and live storage of the project has reduced from 85.50 M.cum and 70 M.cum to 62.30 M.cum and 61.43 M.cum respectively as per the studies conducted. The ayacut under the project was subsequently relocalised to 5296 Ha Kharif paddy and 1215 Ha Rabi paddy in 1990 through G.O Rt No. 457 dt 02-04-1990 against the original conceived ayacut of 5769 Ha Abi paddy (Kharif) and 1215 Ha Tabi paddy (Rabi). .

Inflow pattern: The inflow pattern in study period was very much un-study in view of erratic rainfall and insufficient inflows. The highest inflows of 117.79 $M.m^3$ were received during 1996-97. There were no inflows during 2002-03 and 2003-04 years.During the last 9 years, the inflows were insufficient for release during Kharif. Due to late inflows the water is released in Rabi season only to the extent available. Out of 9 years from 1995-96 to 2003-04 irrigation was done only in 4 years.

13. Conveyance efficiency:

The conveyance efficiency of both the Right and Left main canals could not be conducted as there is no sufficient water available for irrigation during the year under study. In this connection, it is to specifically stated that while selecting the project for studies there was water. Subsequently the water was not let out to the crops in Rabi season. Hence, field studies could not be taken up.

1**4. Field Application efficiencies for all major crops:**

The principal crop cultivation under this project is paddy in Rabi season against the contemplation of paddy both in Kharif and Rabi seasons. The farmers are not willing for the change of cropping pattern in the command area. Hence better water management techniques are proposed to be adopted by introducing warabandi system etc. As there is no sufficient water for release to crops, the studies were not taken up.

15. Drainage efficiency:

There is no existing drainage system for the project command. The terrain is having adequate slopes and is well drained. Hence there is no drainage problem for the command area.

16. Final Report of WUE study of the project sent to then Principal Secretary (I & CAD), Government of Andhra Pradesh vide TOL CWC/IPO/D-13/2010/367 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

HARYANA STATE

(21) AUGMENTATION CANAL PROJECT

The Yamuna waters were deficient in meeting the requirements of the Kharif and Rabi crops in the Western Jamuna Canal (WJC) command. A proposal was envisaged way back in 1969 wherein the ground water strata in the command area between Jagadhri and Munak were studied and it was observed that there was considerable scope of extraction of ground water to supplement the surface water flow in the WJC.

With this proposal in view, it was envisaged to construct an Augmentation canal starting from a place opposite Jamuna Nagar running close and parallel to River Yamuna and outfalling into the WJC near Munak. The Augmentation Canal off takes from RD 68026 from the left of the Main Line Lower of the WJC about 8 Kms. downstream of Yamunanagar. At the off-take point there is a cross-regulator on the WJC and a head regulator on the Augmentation Canal. This canal was constructed in the year 1970. After covering a distance of 75200 m (246650 feet) the Augmentation canal joins the WJC at RD 126000 (feet) (Picholia Head) left of the Main Branch. The initial proposal was to feed the canal by using 262 tube well with an assured discharge of 28.02 cumec (992 cusec) upto a depth of about 304.88m (1000 feet). The capacity of channel was increased from 104.525 cumec (3700 cusec) to 127.125 cumec (4500 cusec) during the year 1977 by raising the existing top of lining by 0.30 to 0.76 m. (1 to 2.5 feet).

It was also proposed that the tube wells shall work only for the sowing, growing and maturing of Rabi crops. These withdrawals did not account for the cotton crop as it was felt that the extraction should be the bare minimum. These tube wells were initially extracting ground water to supplement flows in the WJC. Apart from the discharge from the tube wells, the augmentation canal was also receiving the seepage waters of the WJC Main Canal due to its unlined status. With the over-extraction of the ground water in the area, the tube wells could not supplement the WJC and the system of tube wells stands defunct.

The salient features of the Augmentation Canal are:

A. Main Canal

1.	Length of the main canal	=	75200 m (246650 feet)
2.	Maximum carrying Capacity	=	124.75 cumec (4416 cusec)

3.	Type of the canal	=	Lined
4.	Full Supply Water Depth	=	Varies from 3.96 m (13 feet) to 5.18 m (17 feet) in different sections.
5.	Bed width	=	Varies from 5.18 m (17 feet) to 9.15 m (30 feet) in different sections.
6.	Bed gradient	=	Varies from 0.20% to 0.15%.

Project Specific Observations:

The following project specific observations were made during the study:

- The system does not have any storage reservoir or dam divergence structure.
- The Augmentation canal was constructed to augment the water in the Western Yamuna Canal by pumping the ground water from the Karnal District. At present the ground water has depleted to such a depth that no tube well constructed to augment the supplies is in a working condition.
- The Augmentation canal does not have any outlet – authorized or unauthorized in its total length of 75.20 Km.
- The canal does not have any distributory and minor.
- No water – authorized or unauthorized is drawn from the canal.
- The canal is being used as a by-pass arrangement to convey water from Yamunanagar to upstream of Munak headworks to prevent water losses in the unlined Western Yamuna Canal.
- The point where the augmentation canal meets the WJC, the bed level is lower than that of Western Jamuna Canal by 1.933 m (6.34 feet)
- The full supply water level of the Augmentation Canal is 0.15 m higher than that of the WJC.
- The full supply depth of the Augmentation canal before it joins the WJC is 4.877 m.
- The bed level of Augmentation canal at RD 67.20 Km matches with the bed level of the WJC. Thus back flow and silt deposit upto 8 km upstream of the meeting point cannot be ruled out.
- At a discharge of 3200 cusec, the canal section in various reaches touches its top designed level.
- The canal section between RD 42 km to RD 58 Km encroaches the free board at a discharge of 3200 cusec.
- It is practically impossible to have closure in the Augmentation canal.
- Annual maintenance is a big problem and practically not possible due to non-closure of the canal for longer period.

Dam / Reservoir Efficiency (inflow and release pattern):

Site Observations:

- The maximum designed discharge of 13500 cusec in the main canal between Dadupur and Yamunanagar is achieved during the months of August and September.Thus the canal section has the capacity to carry its full designed discharge.
- The months of July, August, September and October are the peak flow discharge months

- During the months of July and October the discharge in the canal is about 2 times the lean months discharge
- During the months of August and September the discharge in the canal is about 4 times the lean months discharge
- Apart from the months of July, August, September and October (which are the peak flow months) the discharge in the main canal is negligible when compared to its carrying capacity
- When the main canal is not in full operation, about 80% of the total water released from Dadupur Water works is routed through the augmentation Canal.
- During the peak flow months, the augmentation canal carries about 20% of the total inflow from Dadupur. This figure matches the lean flow discharge as during the months of July, August, September and October the discharge in the canal is about 4 times the lean months discharge. Thus the major inflows are carried by the WJC main canal.
- The water lines along the side slopes of the Augmentation canal clearly show that the canal is being run to its maximum design depth.
- The Augmentation canal is being run to its maximum carrying capacity throughout the year.
- The augmentation canal has never been closed for any repairs, desilting or maintenance since January 2000.

Delivery / Conveyance Efficiency:

Main Canal :

It can thus be concluded from this secondary data that -

The discharge in the Augmentation canal was calculated based on the area-velocity method. The cross-sections of the canal were taken by actual measurement and the velocity of flow at 0.6 m depth was measured using the current meter. The efficiency derived was 95% from the secondary data. Thus, it can be concluded that there is a conveyance loss of not more than 4-5% in the Augmentation canal.

Delivery / Conveyance Efficiency of Distribution System: found 79%.

On farm Application Efficiency:

As highlighted earlier, since the Augmentation canal doesnot possess any command area, about 85,000 ha. of CCA in the regions of Jind and Hissar were studied to assess the various on-farm efficiencies. This area was covered by 310 outlets spread in an area of about 2,51,000 ha. The details of the study are as under:

OVERALL EFFICIENCY:

There has been a considerable increase in the irrigated area during Kharif and Rabi season. In 1995-96 the proposed intensity of irrigation was 78% i.e. the gross utilization of 66,650 ha. but project authorities assumed the ultimate irrigation potential of 85,440 ha. It is seen that during a period of six years, the average annual gross utilization has gone up to 92,580 ha. against the

proposed gross utilization of 85,440 ha. showing an increase of 7,140 ha. If the gross utilization of 66,650 ha. is considered based on 78% intensity of irrigation, the increase in gross utilization works out to 25,940 ha. It is established that irrigated area has increased due to efficient utilization of irrigation water. Per cubic metre of water supplied yielded 2.14kg of produce & each hacter of irrigated area,70.65 qtls of produce, which is satisfactory.

Drainage Efficiency:

There are about 32 major and minor natural drains existing in the area which drain the run-off from the area. The major drain is the Indri escape which has a maximum capacity of about 2600 cusec. It is surprising to note that none of the drains have any measuring device for the water being drained by them. Also no records have been kept regarding the run-off into these drains. These drains were completely dry during the non-monsoon months. On enquiry from the local villagers, it was revealed that these drains carry water for about 15 -20 days during the peak monsoon period. The drains are effective and efficient as no problem of water logging in the area was experience by any village.

CONCLUSION

Based on the overall study of the project measures like, maintenance of the augmentation canal, recording of flows in the augmentation canal, Repair of canal lining. Warabandi, Conjunctive Use of Surface and Ground Water etc were detailed in the report.

Final Report of WUE study of the project sent to then Commissioner & Principal Secretary (Irrigation), Government of Haryana vide TOL CWC/IPO/D-16/2010/364 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(22) NAGGAL LIFT IRRIGATION PROJECT

Haryana is drawing its share of Bhakra Waters from the Narwana Branch downstream of Sonda Hand in Punjab. The Narwana Branch offtakes from the left bank of the Bhakra Main Canal at RD 158230. The designed capacity of the Narwana Branch is 127.50 cumec (4500 cusec) which is the Haryana share in the system. The length of the Branch is 97.56 Km. (320000 feet). After starting from the Haryana-Punjab Border, the water of this Branch reaches the Budhera Complex where the Sirsa Branch and the rain water flowing in the non-operative Satlej Yamuna Link (SYL) is collected in a pondage and distributed further downstream.

The Narwana Branch was flowing through the Ambala District but some command of Ambala District including the area of Ambala City and Ambala Cantt. was left out from the culturable command area because of the topographical constraints. The area was on a higher elevation and had reverse slopes when compared to the Narwana Branch Bed levels and hence could not be provided water by gravity. To provide this area with Bhakra waters, it was thought to provide a lift irrigation scheme at RD 166919 (50.90 Km.) of the Narwana Branch. This scheme was titled Naggal Lift Irrigation Scheme.

The purpose of the Naggal Lift Irrigation Scheme was to cater for the drinking water requirements of the Ambala City, Ambala Cantt and provide irrigation to about 19,500 ha. of command area. It was proposed to lift 4.74 cumec (167.30 cusec) of water from the Narwana Branch for this purpose. The distribution of the water in the Naggal Lift Irrigation Scheme is as follows:

S. No.	Use of Water	Allocation in cumec	Allocation in cusec
1	**Irrigation**	**3.60**	**127.30**
2	**Water Supply for Ambala City**	**0.57**	**20.0**
3	**Water Supply for Ambala Cantt.**	**0.57**	**20.0**
	TOTAL	4.74	167.30

CANAL SYSTEM

The following project specific observations were made during the study:

- The Naggal Irrigation Project is a lift scheme whose functioning is totally dependent on electricity and the pump efficiency of the various stages of pumping.
- The main distributory has five pumping stages and the minors off taking from these pump stations too have pumping facilities.
- The water in the minors after being lifted from the distributory runs by gravity.
- Earlier these were an independent power supply line for the pump house but subsequently some other connections to villages have been provided resulting in power breakdowns and voltage fluctuations.
- The efficiency of the conveyance system has drastically reduced due to deferred maintenance over the years.
- The system cannot be closed for more than 8-10 days as the water supply of Ambala Township and cantt. area is completely dependent on it.
- The tail end Panjokhra minor rarely gets water which is of concern for all officials and staff.
- No record of flow in Dhurali, Quarbanpur and Panjokhra being maintained.
- At most of the places, the cultivators have removed the outlets and irrigation is being done indiscriminately through direct cutting.
- Though the water at the head is available in sufficient quantity, the system is unable to run at even 50% efficiency.
- The pumps have to run for long hours because of reduced efficiency and frequent breakdowns.
- Lot of unauthorized withdrawals by cutting the minor or running the pumps at unscheduled period takes place.
- The canal bank at certain sections has collapsed and need immediate remodeling and restoration.
- The details of the various pumps installed on the Distributory and minors is given as under :

Delivery / Conveyance Efficiency:

Main Distributory:

The Kanwala Distributory has five pumping stations in its entire length. The data for the Pump operation was collected and analyzed to assess the pumping efficiency of the pumps at the five stations. The efficiency in the main distributory and the minors is 47.82%.

The crop water requirement and, the irrigation water supplied based on 5 years average irrigation in respect of the data availability on the minors of the command has worked out as 2314.224 Ha. m for Kharif, 4512.48 Ha. m for Rabi and total of Kharif and Rabi as 6826.704 Ha.m. The On-farm Application Efficiency is worked out to be 27%.It indicates that the supply is 73% short in the system. The shortage is normally met from ground water.

The system is running much below its potential and all figures indicate that the irrigation potential of 62% as indicated in the Project report is not being achieved. The data of last 10 years clearly indicates a short fall of about 25% in the Potential created and that utilized.

Drainage Efficiency:

There are natural drains existing in the area which drain the run-off from the area. No major drain exists in the command area. It is surprising to note that none of the drains have any measuring device for the water being drained by them. Also no records have been kept regarding the run-off into these drains. These drains were completely dry during the non-monsoon months. On enquiry from the local villagers, it was revealed that these drains carry water for about 15 -20 days during the peak monsoon period. The drains are effective and efficient and no problem of water logging in the area was experience by any village. One of the drains is being utilized to discharge the city sewer into the command area. The farmers are using this water to irrigate their fields as a supplement to the canal water. As no water logging is experienced in the area, it can be concluded that the drainage system is quiet efficient and effective.

RECOMMENDATIONS:

Based on the study of the system, it may be concluded that the system is not running to its desired / designed efficiency. To achieve the desired results the measures like bifurcation of the irrigation and water supply systems, strict measures to prevent unauthorized drawing of water ,renovation of all pumping stations to increase pump efficiency, regular observation of discharge in distributory and minors, record maintenance of discharge in distributory and minors uninterrupted power supply , authorized water allocation, warabandi etc were detalided in the report.

Drainage Aspects:

Proper drainage recording devices need to be provided in the command area. This would prevent escaping of water in non-monsoon periods. The normal discharge tables of escapes should be maintained and frequently revised. Record of escaping should be maintained so that correct amount of escaping is known.

With proper maintenance and running of the system, it is felt that the system would run to its desired capacity and potential. In case proper funding related to the modernization of the system is provided, the lower command area could be highly benefited.

Final Report of WUE study of the project sent to then Commissioner & Principal Secretary (Irrigation), Government of Haryana vide TOL CWC/IPO/D-16/2010/364 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

PUNJAB STATE

(23) DHOLBAHA DAM PROJECT

1. Name of the Project : Dholbaha Dam , Punjab.
2. River/ Main River/ Basin : Dholbaha Choe, in Kandi Water Shed of Punjab
3. Type of Project – Major/ Medium : Medium Irrigation Project
4. Type of Structure – Dam : Earth fill dam
5. Location – Latitude/ Longitude : Latitude :$31^0\,44'10''$
   Town/ Distt/ State Longitude :$75^0\,53'18''$
   Near Village Dholbaha, 32 Km from Distt. Head Quarter of Hoshiarpur in the Kandi Area of Punjab
6. Length/ Period of data used for study : 1. Reservoir Filling data, 7 years(1999-2006)
   2. Inflow, Withdrawal and spillover from reservoir, 11 years (1995-2006)
   3. Irrigated Area, cropwise 4 years (2001-05)
   4. Rain fall data 11 years (1995-2006)
   5. Irrigation potential created/utilised, 16 years (1990-91 to 2005-06)
   6. Field Application Efficiency/Water supply Adequacy Index 4 years (2001-05)
7. Culturable Command Area (CCA) : 3745 ha
8. Ultimate Irrigation Potential (UIP) : 2622 ha
9. Potential Created (PC) : 2600 ha
10. Potential Utilised (PU) : Maximum, 3117 ha in 1999-2000
    Minimum, 1060 ha in 1990-91
    Average, 1782 ha (68%)
11. **Main recommendations for overall improvement of the project:**

A- Dam/Reservoir Efficiency:

1. General annual maintenance of Dam and its appurtenant structures need to be improved.
2. The frequency of daily measurement of inflow to the reservoir must be increased to assess the accurate inflow into the reservoir. Keeping in view the short duration of floods, the inflow must be measured hourly at least in the monsoon season.
3. Suitable treatment of the catchment area should be carried out to reduce the sedimentation in the reservoir.

B Delivery System/Conveyance Efficiency:

1. The sections of all channels need to be cleared off the vegetation growth and silt deposit to improve their carrying capacity. Also the damaged portion of the lining should be repaired to reduce the Conveyance losses.
2. Gauge discharge table for regulators should be revised after measuring actual discharge at different levels and the gauges be painted at the regulators to determine the discharge in each channel.
3. The tempered regulators should be restored to their original position to ensure that the due share of discharge reaches every outlet.

C On Farm Application Efficiency:

1. Soils in the command area are sandy to sandy loam due to which percolation losses are more. Depth of water per irrigation should not be more than required to prevent the wastage of water through percolation.

D Drainage Efficiency:

1. There is no water logging in the command of Dholbaha dam and thus there is no drainage problem in the command.
2. Ground water table is not a factor in the drainage problem.

E Irrigation Potential Created and Utilized:

1. The irrigation system is not able to meet its target potential mainly due to heavy conveyance losses (27.6 %), it is therefore, pertinent that the rehabilitation of distribution system be taken up to minimize the seepage and other losses.

12. **Name of the Consultant/ Agency who carried out the study:** : Vijay Kumar, Research Officer, Hydraulics Division No. I, Irrigation and Power Research Institute, Punjab, Amritsar

13. **Storage Efficiency:**

(a) Reservoir Filling Efficiency : Average 61.50%, Maximum and Minimum being 94.01 and 27.77% during the period 1999 to 2006.

(b) Inflow Patterns:

The inflow is mainly during Monsoon season. The floods are flash and of short duration. But the frequency of measurement of Inflow is required to be increased sufficiently to assess the true inflow into the reservoir and also the percolation losses.

14. **Conveyance Efficiency (%):**

(a)	Main Canal	: Feeder Channel	98.38 *
(b)	Distributaries:	: 1. Phambra Distributary	79.69
		2 Chak Ladian Distributary	90.91
(c)	Minors	: 1 Tahliwala Minor	72.47
		2. Nangal Musa Minor	77.75
		3. Sheikhan Minor	81.80
		4. Bhatoli Sub Minor	76.09

(d) Average Conveyance Efficiency of Irrigation System of Dholbaha Dam is 74.27%

15. **Field Application Efficiency/Water Supply Adequacy Index for all Major Crops:**

(a) Average Field Application Efficiency 71%.

(b) Water supply Adequacy Index for Rabi Crops : 77.16%

(c) Water supply Adequacy Index for Kharif Crops : 71.61 %

16. **Drainage Efficiency**: The study of drainage efficiency in this project is not needed.

Overall System Efficiency is 52.73% , as all the Irrigation System upto water courses is lined.

17. Final Report of WUE study of the project sent to Secretary (Department of Irrigation and Power), Government of Punjab vide TOL CWC/IPO/D-13/2010/365 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(24) <u>RANJIT SAGAR DAM</u>

1. Name of the Project : Ranjit Sagar Dam
2. River/ Main River/ Basin : Ravi River, Indus Basin
3. Type of Project : Major Irrigation and Power Project
4. Type of Structure- Dam : Earth fill dam with concrete spillway
5. Location - Latitude/ Longitude : Latitude 32^0 26' 30"N
   Town/ Distt./ State Longitude 75^0 43' 30"E
   Near Village Thein, 24 Km from Madhopur
   Head Works, Gurdaspur District in Punjab

6. Length/ Period of Data Used for Study:
   a. Reservoir Filling Data : 6 years (2001-02 to 2006-07)
   b. Rain fall in the Catchment of Ravi : 13 years (1995-96 to-2007-08)
   c. Rain fall in the Command Area of UBDC : 12 years (1995-96 to-2006-07)
   d. Cropping Pattern : 5 years (2001-02 to-2005-06)
   e. Water Supply Adequacy Index : 5 years (2001-02 to-2005-06)
   f. Irrigation Potential Utilization : 11 years (1991-92 to 2001-02)
   g. Groundwater Levels in Different Blocks of Command Area : 1991, 1996, 2001and 2005
   h. Conveyance Losses : Actual observation of discharge on 22 channels which includes 3 main canals, 6 distributaries and 13 minors as well as 36 water courses
7. Culturable Command Area (CCA) : 554802 ha
8. Ultimate Irrigation Potential (UIP) : 554802 ha
9. Potential Created (PC) : Potential Created cannot be given as the system being more than 100 year old, the data is not available.

10. Potential Utilised (Rabi + Kharif)) : Maximum, 376742 ha (67.91% of CCA) in 2001- 02
    : Minimum, 307889 ha (55.50% of CCA) in 1991-92
    : Average, 361052 ha (65.08%)

11. Main recommendations for overall improvement of the project:

A- Dam/Reservoir Efficiency:

1. The capacity survey of the reservoir should be conducted upto full reservoir level for accurate assessment of present storage capacity and surface area of the reservoir at different elevation above 515.0m.
2. The discharge measurement gauges need to be fixed in all streams flowing into the reservoir for correct assessment of inflow and the percolation losses from the reservoir.
3. Evaporation measurement from the reservoir should be done at some more locations along its periphery and if possible in the reservoir using floating evaporimeter for accurate assessment of evaporation losses.

B- Delivery System/Conveyance Efficiency:

1. The sections of all channels need to be restored to their designed ones and cleared off the vegetation growth and silt deposit to improve their carrying capacity and reduce the conveyance losses. The damaged lining of lined channels should also be repaired.
2. Gauge discharge table for head regulators should be prepared after measuring actual discharge at site at different levels and the gauges be painted at the regulators for correct assessment of discharge in each channel.
3. The tempered regulators should be restored to their original position to ensure that the due share of discharge reaches every minor/outlet.

C- On Farm Application Efficiency:

1. Depth of water per irrigation should not be more than required to prevent the wastage of water through percolation.
2. The paddy cultivation should be discouraged and other crops requiring less water should be grown to minimize the use of groundwater and save the groundwater levels from further decline.
3. All possible measures for Artificial Recharge of groundwater must be adopted to stabilize the continuously falling groundwater levels.

D- Drainage Efficiency:

Since there is no problem of water logging or drainage and rather Ground Water levels are falling continuously, it is, therefore, need of the hour that rain water harvesting be adopted on large scale for artificial recharging of groundwater.

E- Irrigation Potential Created and Utilized:

1. The UBDC irrigation system cannot meet with the water requirement of crops in its whole CCA. However, if cross-sections of the channels are restored to their design and vegetation growth is removed regularly so that water lost due to seepage decreases thereby increasing the conveyance efficiency, then the UBDC system will definitely be able to improve its performance as regards the potential utilized.

2 The collection of data regarding cropping pattern in the command , total irrigated area in Rabi and Kharif (Locally called Girdawari) which is not being done at present should be restarted.

12. Name of the Consultant/ Agency : Vijay Kumar, Research Officer,Hydraulics Division
Who carried out the Study Irrigation and Power Research Institute, Punjab, Amritsar

13. Storage Efficiency:

(a**)** Reservoir Filling Efficiency : Average 57.35%, Maximum and Minimum being 0.89% and 34.17% during the year 2006-07 and to 2004-05 respectively.

(b) Inflow Patterns**:** The observed average annual inflow during 2001-02 to 2006-07 is 5838.88 MCM (Table 2) which is about 86.45% of mean annual inflow during the pre-project period of 1921-22 to 1977-78. The minimum and maximum inflow during this period is 4737.13 and 6908.82 MCM during the years 2001-02 and 2005-06 respectively. About 75 % of annual inflow is received from April to September.

14. Conveyance Efficiency:

Main Canals	1 UBDC Main	97.57
	2 MBU	93.07
	3 MBL	77.17
Distributaries	1 Awankha Distributary	66.01
	2 Bhatoa Distributary	67.71
	3 Babehali Distributary	65.69
	4 Aminpur Distributary	59.13
	5 Chabhal Distributary	60.41
	6 Amritsar Distributary	53.22
Minors	1 Haveli Minor	68.84
	2 Majithi Minor	55.68
	3 Talwandi Minor	40.18
	4 Allowal Minor	66.82

5 Attari Minor	58.67
6 Bohru Minor	60.22
7 Pandori Harsan Minor	64.33
8 New Chabhal Minor	64.63
9 Musse Minor	62.33
10 Tatle Minor	42.50
11 Dhattal Minor	63.83
12 Amritsar Escape Minor	68.82
13 Khairdin Sub Minor	59.91

15. Field Application Efficiency/Water Supply Adequacy Index for all Major Crops:

(a) Water supply Adequacy Index for Rabi Crops : 9.89%

(a) Water supply Adequacy Index for Kharif Crops : 12.56 %

16. Drainage Efficiency: The study of drainage efficiency in this project is not needed.

Overall Conveyance Efficiency of UBDC Irrigation System is 50.83%

17. Final Report of WUE study of the project sent to Secretary (Department of Irrigation and Power), Government of Punjab vide TOL CWC/IPO/D-13/2010/365 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

UTTAR PRADESH STATE

(25) AHRAURA DAM IRRIGATION PROJECT,

1. Name of the Project :Ahraura Dam Irrigation Project

2. River/Main river/Basin :Garai river /Garai river/ Ganga Basin

3. Type of Project :Medium Dam Project

4. Type of Structure : Earthen Dam with masonry spillway

5. Location : Town - Ahraura

Distt. – Mirzapur

State- Uttar Pradesh

Latitude -25^0 $02^{/}$ N

Longitude -83^0 $02^{/}$ $20^{//}$ E

6. Length/ period of data used for study:

For Irrigation water requirement - 3 years

For water supply to crops (Adequacy index)- 3 years

For Potential Utilization - 9 years

For on Farm Efficiency –Actual observation of head discharges on 9 canals and observations for water loss on 4 canals.

7. Culturable Command Area : 15394 hect. (As per project)

8. Ultimate Irrigation Potential: 14964 hect.

9. (a) Potential Created (As per project): 14964 hect.

(b) Existing proposed potential : 13675 hect

} As adopted by I.D, U.P.

10. Potential Utilized: 15351 hect. (Avg. 9 years)

11. **Main recommendations for overall improvement of the Project**:

(i) Annual maintenance needs improvement

(ii) Gauge discharge curve/graph of channels to be prepared

(iii) Off takings of a channel should be run in roster depending on availability of water in parent channel.

(iv) Proposed area for Rabi fasal should be revised as recommended in the report.

(v) Commands of channels of Bhagwat Branch system and Mugalsarai Branch systems, which are irrigating more than C.C.A. in Kharif, should be corrected and

proposed area as revised accordingly.

12. Storage Efficiency :

(a) Reservoir filling efficiency- Avg. 91.3% of designed storage in 10 years

(b) Inflow Patterns- Not available

13. Canal efficiency:

Main Canals- Ahraura Main Canal- 105. %

Branch Canal- Chaukia Branch - 123.4%

Distributaries - Between 80% and 83%

Minors- Between 52 % and 133%

14. Distribution efficiency: (i) At head of channel systems with discharge less than 4.245 cumecs- 69.4%

(ii) At head of channel systems with discharge more than 4.245 cumecs- 70.2%

(iii) At head of project(Ahraura Dam)- 70%

15 Overall efficiency at project head (Ahraura Dam): 49.2%

16. Drainage efficiency : Record not available

Length of existing drains: 146.82 km.

17. Data base collected:

(i) Filling of reservoir – 10 years

(ii) Spillovers from dam – 10 years

(iii) Withdrawal from dam- 10 years

(iv) Values of parameters required for calculation crop water requirement- by Penman Method 8 years

(v) Irrigated area of full system(cropping pattern) – 3 years

(vi) Designed discharges, Lengths, CCA, proposed area of Kharif and Rabi- For all canals.

18. Final Report of WUE study of the project sent to Principal Secretary (Land Development and Water Resources), Government of Uttar Pradesh vide TOL CWC/IPO/D-18/2010/366 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(26) WALMIKI SAROVAR (OHAN DAM) IRRIGATION PROJECT

1. Main river/ Doab : (i) Ohan river running in south East hills of Banda district and flowing North ward in Yamuna river.
(ii) Tributary of river Yamuna
(iii) Ganti – Ohan Doab

2. Type of Project : Medium Irrigation Project

3. Type of structure : Earthen Dam with masonry spillway

4. Location : Latitude 25^0 17.5' N
Longitude $81^0$16.5'E
Village – Simardha on Karwi- Manikpur Road,
Tehsil – Karwi
District- Chitrakoot
State – Uttar Pradesh

5. Length/Period of data used for study:

For Irrigation water availability : 12 years (1994-95 to 2005-2006)
For water supply to crops : 12 years (1994-95 to 2005-2006)
For Potential Utilization : 10 years (1996-97 to 2005-2006)
For on farm Efficiency : 11 years (1994-95 to 2004-2005)
For Discharge Carrying Capacity : Actual observation of discharge on 7 Nos. canals
For channel conveyance losses : Observation for water loss on 3Nos. canals.

6. Culturable Command Area (CCA) as per Project : 23288 Hect.

7. Ultimate Proposed Irrigation Potential as per Project (PPA) : Rabi- 6271 Hect.
Kharif- Nil

8. Potential Created : 6271 Hect.

9. Potential Utilized : Maximum 5 year (2000-01 to 2004-05) – 4540 Hect (02-03)
Average of 5 year (2000-01 to 2004-05) – 2864 Hect.

10	**Storage Efficiency**	:	
	(a) Reservoir Filling Efficiency	:	Average 61.15%
	(b) Inflow Pattern	:	Not available
11	**Canal Water Carrying Efficiency**	:	
	(a) Main Canal	:	- 43%
	(b) Branch Canals	:	1. Ohan West Br. Canal - 59% 2. Ohan East Br. Canal - 63%
	(c) Distributaries	:	No Dy in system
	(d) Minors	:	61 to 72 %
12	**Field Application Efficiency**	:	62% at Project Head
13	**Drainage Efficiency**	:	Drainage efficiency study not required
14	**Database collected**	:	(i) Filling of Reservoir - 12 Years (ii) Spillover for Dam - 12 Years (iii) Withdrawals from Dam - 12 Years (iv) Value of Parameters required for calculation of crops water requirement by Penman Method - 10 Years (v) Irrigated area (cropping pattern) - 10Years (vi) Designed discharge/ Authorized discharge, CCA, PPA for all canals - 10 Years

15. Main recommendations for overall improvement of the Project:

A-Dam/Reservoir efficiency	:	• Treatment by clay blanket done during construction (now ineffective) in the Reservoir area is recommended to reduce percolation losses.
B. Delivery System/ Conveyance Efficiency	:	• Rehabilitation of all channels to its designed/authorized carrying capacity along with its structures is required. • Gauge discharge curves/tables need to be prepared a fresh for all canals.

C- On Farm Application Efficiency	:	• Against the existing cropping pattern of 2520 Hect. of wheat and 344 Hect. other Rabi crop, the cropping pattern (as per water requirement and water availability) of 1800 Hect. wheat, 550 Hect. gram, 364 Hect. Lentil and 150 Hect. Pea is beneficial.
D. Drainage Efficiency	:	• This study is not required as there is no existing drainage system, no water logging, no salinity, no additional drainage required due to command being water starved.
E. Irrigation Potential Created & Utilized	:	• The average utilization of potential of Ohan Canal System during Rabi from 2000-01 to 2004-05 (5 years) being 2864 Hect. against created potential of 6271 Hect. reallocation of sowing areas for wheat & other Rabi is needed to match the water availability in the reservoir.

16. Final Report of WUE study of the project sent to Principal Secretary (Land Development and Water Resources), Government of Uttar Pradesh vide TOL CWC/IPO/D-18/2010/366 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(27) MATATILA DAM PROJECT

1.	Name of Project	:	Matatila Dam Project.
2.	River/Main river /Basin	:	(i) Betwa River. (ii) Betwa river joins Yamuna river Both the rivers (iii) Yamuna Basin
3.	Type of Project	:	Major Irrigation Project
4.	Type of structure	:	Dam
5.	Location	:	Latitude- 25^0 14' 15" N. Longitude- 78^0 23' 00" E. Village - Matatila Tehsil - Lalitpur District - Lalitpur State - Uttar Pradesh
6.	Length/Period of data used for study	:	1. Dam filling data 5 years (2001-02 to 2005-06) 2. Withdrawals into canal fasalwise-5 years (2001-02 to 2005-06) 3. Irrigated area fasalwise - 5 years (2001-02 to 2005-06) 4. Rainfall data - 15 years (1991 to 2005)
7.	Culturable Command Area (CCA)	:	Betwa Canal System -3,80,592 hect. Gursarai Canal System - 47,213 hect.
8.	Ultimate Irrigation Potential (UIP)	:	Betwa Canal System- 1,79,880 hect. Gursarai Canal System - 19,230 hect.
9.	Potential Created (PC)	:	Betwa Canal System- 1,79,880 hect. Gursarai Canal System - 19,230 hect.
10.	Potential Utilized (PU)	:	Betwa Canal System- 2,13,906 hect Gursarai Canal System-28,337 hect. average of 5 years (2001-02 to 2005-06).
11.	**Storage Efficiency**		
	(a) Reservoir filling efficiency	:	Average annual filling of reservoir from 2001-02 to 2005-06 (5 years) was 649.28 MCM i.e. 67.36% of designed storage capacity of 963.90 MCM
	(b) Inflow Patterns	:	Average annual rainfall before 1952 for Matatila Dam catchment was 1140 mm. as per Project, while average annual rainfall from 1991-2005 (15 years) is 824.50 mm. as per Agric Statistics Deptt records. Which shows inflow into the reservoir is continuously reducing.

12. Conveyance Efficiency:

(a) Main Canal Systems	:	Betwa Canal System	-	68.2%
		Gursarai Canal System	-	67.8%
(b) Branch Systems	:	1. Hamirpur Branch System	-	68%
		2. Kuthond Branch System	-	68.4%
(c) Some Major Distributory Systems	:	1. Semri Dy. System	-	68.3%
		2. Amargarh Dy. System	-	68.0%
		3. Ata Dy. System	-	68.4%
		4. Garhwai Dy. System	-	68.9%
		5. Kalpi Dy. System	-	69.4%
		6. Semariya Dy. System	-	68.4%
		7. Tarsaur Dy. System	-	69.2%

13.Field Application Efficiency for all major crops :

Wheat, Pea, Gram, Lentil & Mustard are the major crops in the project area. Percolation loss 300 mm has been considered in the case of paddy only. Field application efficiency has been taken as 80%

Ratio of water delivered to fields to field irrigation requirement is as follows.

Betwa Canal System	1.	Kharif	-	0.80
	2.	Rabi	-	0.91
Gursarai Canal System	1.	Kharif	-	Not applicable
	2.	Rabi	-	0.79

14. Overall Efficiency Irrigation System :

Name of System	Efficiency
Betwa Canal System	54.60%
Gursarai Canal System	54.20%

15. Drainage Efficiency :

1. There is no drainage problem in the command area of Matatila Dam Command Distribution Systems.

2. There is no water logging in the command of Matatila Dam.

3. Ground water table is not a factor in drainage problem of the command.

16. Database Collected : (i) Irrigated area fasal wise 5-15 years

17. Main recommendations for overall improvement of the Project:

(a) Dam/ Reservoir Efficiencies:

1. Matatila Dam is under distress as the water escaping capacity of Rajghat Dam spillway is 40,555 cumecs while the capacity of Matatila Dam spillway is 15,857 cumecs. It is recommended that an auxiliary spillway of 24,700 cumecs capacity is proposed to be constructed at Matatila Dam.

2. As per satellite remote sensing survey in 1998-99 silting rate of reservoir was 369.64 M^3/sqkm/year against 132.0 M^3/sqkm/year at the time of planning. It is recommended that areas in the catchment may be identified which are responsible for more silt yield. The soil of these areas be stabilized by growing vegetation or taking some specific measures in consultation with Soil Conservation & Forest Departments.

3. There is need to have specific & faultless regulation network taking Rajghat Dam and Matatiala Dam as single mother project with two babies with complete coordination among the authorities of Govt. of U.P. & Govt. of M.P., as the single unqualified move may endanger the Dam.

(b) Canal /Conveyance Efficiencies:

1. Head regulators, gates and other pucca works to be repaired on priority basis, head gauges to be painted on head regulators, discharge sites & bed bars to be constructed.
2. It is recommended that internal and external sections of the canals to be kept as designed.
3. It is recommended that gauge discharge table/curve should be prepared for canals and discharge of running channel should be written along with gauge in daily gauge register.
4. Off taking channels in head reach of Kalpi Dy. are drawing more discharge than authorized discharge such as Jaurakhera Minor drawing 130.60% discharge and Sandi Minor is drawing 171.10% of the authorized discharge. Due to this excess withdrawal Ata Dy. (off taking at Km. 4.012 of Kalpi Dy.) is suffering badly and drawing only 49.10% of its designed discharge. It is recommended that internal section of Ata Dy. should be improved and regulation should such be adjusted so that the Ata Dy. may take its due share of water for irrigation.
5. From irrigated area details of different channels during Rabi it is clear that 29 channels out of Total 396 channels of Betwa Canal System & Gursarai Canal System are irrigating less than 50% of their proposed area in Rabi and out of these 29 channels 13 channels are irrigating less than 20% of their proposed area in Rabi (See list and details of irrigated area of these channels in chapter 6.4 of this report on page 51) It is recommended that performance of these channels

during Rabi should be improved on priority basis by correcting internal sections and it is to be ensured that due share of discharge may reach at head of each channel by improving regulation.

(c) On Farm Application Efficiency:

1. Canal regulation pattern should be developed based on the water balance in the command area including rainfall, soil moisture and storage within the potential crop root zone.
2. The irrigation should be done at critical stages of the crops to get judicious use of water.
3. There is possibility to irrigate more area under kharif against present status. Though the scope of increasing area under paddy & sugarcane is no much, but there is sufficient scope to increase area under other kharif crops, specially soyabean, a best suited crop for Bundelkhand region.

Keeping in view the water supply by canal in kharif and rabi, the cropping patterns have been designed as below:-

Existing & Proposed Cropping Pattern

Sl. No.	Name of Crops	Existing area (hect.)		Proposed area (hect.)	
		Betwa System	Gursarai System	Betwa System	Gursarai System
1	Paddy	3077	-	4500	-
2	Sugarcane	1302	-	3055	-
3	Soyabean	3946	-	21000	-
4	Wheat	104356	10872	74294	4262
5	Pea	47410	11257	47410	7040
6	Gram	53812	6192	45250	7800
7	Lentil			28521 (83876)	5820 (16447)
8	Mustard			10105	2827

18. Final Report of WUE study of the project sent to Principal Secretary (Land Development and Water Resources), Government of Uttar Pradesh vide TOL CWC/IPO/D-18/2010/366 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

(28) NAUGARH DAM IRRIGATION PROJECT

1 Name of the Project **:** Naugarh Dam Irrigation Project

2 River/Main river/Basin: Karmnasa river /Karmnasa river/ Ganga Basin

3 Type of Project: Major Dam Project

4 Type of Structure: Earthen Dam with masonry spillway

5 Location -: Town - Naugarh

Distt. – Chandauli

State- Uttar Pradesh

Latitude -24^0 $51^/$ N

Longitude -83^0 $16^/$ E

6 Length/ period of data used for study:

For Irrigation water requirement - 3 year

For water supply to crops (Adequacy index)- 3 year

For Potential Utilization - 10 years

For on farm efficiency – Actual observation of head discharges on 11 canals and observations for water loss on 2 canals.

7 Culturable Command Area : 44647 hect.

8 Ultimate Irrigation Potential: 64221 hect. } As adopted by I.D., U.P.

9 Proposed Potential : 64221 hect.

51277 hect. (Avg. 10 years)

10 Potential Utilized:

11. Main recommendations for overall improvement of the Project:

(i) Capacity survey of Naugarh reservoir to be got done.
(ii) Proper maintenance of canals required
(iii) Gauge-discharge curves / tables of canals to be prepared
(iv) Rosters of individual channel to be prepared in each fasal.

12. Storage Efficiency :

(a)Reservoir filling efficiency: Avg. 81.4% of designed storage in 10 years

(b) Inflow Patterns: Not available

13. Canal Efficiencies

Main Canals-	50% (Adopted by I.D.U.P.)
Branch Canals-	No branch
Distributaries -	42% to 164 %
Minors-	80% to 296%

14. Distribution Efficiency: (a) At head of canal systems with discharge less than 4.245 cumecs -71.1 %

(b) At head of canal systems with discharge more than 4.245 cumecs -70.0%

(c) At project head- 70.7%

15 Overall efficiency at project head : 49.5%

16. Drainage efficiency : Record not available

Length of Existing drains- 792 km.

17. Data base collected:

(i) Filling of reservoir – 10 years

(ii) Spillovers from dam – 10 years

(iii) Withdraw from dam- 3 years

(iv) Values of parameters required for calculation of crop water requirement- 8 years by Penman Method

(v) Irrigated area of full system(cropping pattern) – 10 years

(vi) Designed discharges, Lengths, CCA, proposed area of Kharif and Rabi- For all canals.

18. Final Report of WUE study of the project sent to Principal Secretary (Land Development and Water Resources), Government of Uttar Pradesh vide TOL CWC/IPO/D-18/2010/366 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

UTTAR PRADESH & UTTARAKHAND STATE

(29) PILI DAM IRRIGATION PROJECT

1.	Name of Project	:	Pili Dam Project.
2.	River/Main river/Basin : feed Pili Reservoir.		(i) Pili river, Baneli river and Dhara river (ii) All the three rivers join Ramganga River (iii) Ganga Basin
3.	Type of Project	:	Medium Irrigation Project
4.	Type of structure	:	Dam
5.	Location	:	Latitude- $29^0$23' N Longitude- $78^0$48' E Village - Rehan Block - Afzalgarh District - Bijnor State - Uttar Pradesh & Uttarakhand
6.	Length/Period of data used for study	:	1. Dam filling data 10 years (1995-2004)
7.	Culturable Command Area (CCA)	:	Jatapura Canal System -7356 hect.
8.	Ultimate Irrigation Potential (UIP)	:	Jatapura Canal System- 4044 hect.
9.	Potential Created (PC)	:	Jatapura Canal System - 4044 hect.
10.	Potential Utilised (PU)	:	Jatapura Canal System average of 8 years - 4753 hect. (1998-99 to 2005-06)

11. **Storage Efficiency:**

(a) Reservoir filling efficiency : Average annual filling of reservoir from 1995-2004 (10 years) was 20.07 MCM i.e. 47.53% of storage capacity of 42.214 MCM (as per 1991 study)

(b) Inflow Patterns : Average annual rainfall before 1960 for Pili Dam catchment was 1689 mm. as per project, while average annual rainfall from 1991-2005 (15 years) is 1118 mm. as per Agriculture Deptt records.

As per IMD Pune average annual rainfall of Nazibabad station (about 100 Km. from Pili Dam) from 1970 to 2003 (22 years) is 999.5mm., which shows inflow into the reservoir is continuously reducing.

12. Conveyance Efficiency:

(a) Main Canal System	:	Jatapura Canal System	-	58%
(b) Distributories	:	Pooranpur Distributory	-	57%
(c) Minors	:	1. Jawahar Minor	-	61%
		2. Baheri Minor	-	68%
		3. Umarpur Minor	-	73%
		4. Dharampur Minor	-	63%
		5. Rajpur Minor	-	69%
		6. Shergarh Minor	-	60%
		7. Mahawatpur Minor	-	54%

13. Field Application Efficiency for all major crops : Paddy, Sugarcane and wheat are the major crops in the project area. Percolation loss 2 mm/day has been considered in the case of paddy only. Other losses like seepage loss and runoff loss are negligible. The ratio of water delivered to fields to field irrigation requirement is as follows.

1. Kharif - 0.54
2. Rabi - 0.70

14.(a) Overall Efficiency of Irrigation System :

a. During Kharif - 43.5%

b. During Rabi - 37.7%

15. Drainage Efficiency :

1. There is no drainage problem in the command area of Jatapura Canal System.
2. There is no water logging in the command of Pili Dam.
3. Ground water table is not a factor in drainage problem of the command.

16. Database Collected :

(i) Irrigated area cropwise -8 years

(ii) Values of Parameters required for calculation of crops water requirement by Penman Method. -15 years (iii) Other data regarding cropping pattern, Irrigation water requirement etc. -Enclosed

17. Main recommendations for overall improvement of the Project:

(a) Dam/ Reservoir efficiencies :

1. Storage assessment study 1991 results were adopted and are in practice & use, but the results of storage assessment study 2005 have not yet been adopted or rejected due to which a state of confusion & uncertainty is there.
2. It is recommended to regain the storage capacity near about 60 % of its original capacity i.e. about 33. MCM at F.S.L. of 257.86 M. level, which is sufficient to feed Jatapura Dy. System alone.
3. The Inflow of river Baneli and Dhara together about 28000 cusecs (792.89 cumecs) goes into main Pili reservoir through a feeder channel of 5000 cusecs (141.60 cumecs) capacity. It is recommended to remodel this feeder channel for a higher capacity to improve the flood status and safety of the dam during flood.

(b) Canal/Conveyance efficiencies:

1. works to be repaired on priority basis, head gauges to be painted on Head Regulators, discharge sites & bed bars to be constructed.
2. It is recommended that internal and external sections of the canals to be kept as designed.
3. It is recommended that gauge discharge table/curve should be prepared for canals and discharge of running channel should be written in daily gauge register.
4. Pooranpur Dy. is drawing only 47.7 % discharge. It is recommended that special attention is needed to improve head regulator and internal section of distributory so that it may take its due share of discharge

(c) On Farm Application:

Project area falls under *Tarai* region, where the soils remain fairly moist during major part of the year.Water table found between 1.85 m. to 3.71 meter in post monsoon and pre monsoon respectively, on average, below the ground surface. Even though there is no water logging condition due to gradient. The main crops are paddy (51.8 %), sugarcane (33.4 %) and wheat (65.8%) of proposed irrigated area. The ratio of water delivered to field in Kharif to field irrigation requirement (FIR) was found to be 54% in Kharif and 70% in Rabi *Fasal.* Thus water supply is scarce. Keeping in view the water supply by canal in kharif and rabi, the cropping patterns have been designed to match the water supply as below:-

Kharif	Existing Cropping pattern (area. hect.)	Designed Cropping pattern (area. hect.)
1. Paddy	1142	786
2. Sugarcane	736	288
3. Other Kharif	246	1050
Total	2124	2124
Rabi		
1. Wheat	1210	825
2. Other Rabi	1346	1015
Total	2556	1840

There is sufficient number of private tubewells in the command area, which supplement canal irrigation. Hence it may not require to change the existing cropping pattern.

(d) **Drainage Efficiency**:

It is recommended that the small drains present in command of Jatapura Dy. should be cleared periodically and be maintained.

(e**) Irrigation Potential created:**

By seeing performance of system in 8 years,and utilisedit is evident that irrigated area of Jatapura canal system in Rabi is 2556 hect., which is more than proposed area of 1839 hects. As per water requirement of crops there is scarcity of water in both seasons. As such area under Rabi has been designed to match the proposed area (PPA) of the project, that is 1839 hect. Rest of existing irrigated area is supplemented by private tube wells in the command.

18. Final Report of WUE study of the project sent to Principal Secretary (Land Development and Water Resources), Government of Uttar Pradesh vide TOL CWC/IPO/D-18/2010/366 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

UTTARAKHAND STATE

(30) EAST BAIGUL RESERVOIR PROJECT

1.	Name of Project	:	East Baigul Reservoir Project.
2.	River/Main river /Basin	:	(i) Sukhi river & Baigul river feed Baigul Reservoir. (ii) Both the rivers join Ramganga River (iii) Ganga Basin
3.	Type of Project	:	Medium Irrigation Project
4.	Type of structure	:	Dam
5.	Location	:	Latitude- $28^0$54' N Longitude- $79^0$38' E Block - Sitarganj Tehsil - Kitchha District - Udhamsingh Nagar State - Uttarakhand
6.	Length/Period of data used for study	:	1. Dam filling data 11 years (1994-95 to 2004-05) 2. Withdrawals into canal fasalwise-4years (2001-02 to 2004-05) 3. Irrigated area fasalwise - 9 years (1994-95 to1998-99 & 2001-02 to 2004-05) 4. Rainfall data - 15 years (1991 to 2005)
7.	Culturable Command Area (CCA)	:	UBC Feeder System -13564 hect. Bara Canal System - 3041 hect.
8.	Ultimate Irrigation Potential (UIP)	:	UBC Feeder System- 11230 hect. Bara Canal System - 2354 hect.
9.	Potential Created (PC)	:	UBC Feeder System- 11230 hect. Bara Canal System - 2354 hect.
10.	Potential Utilised (PU)	:	UBC Feeder System- 13439 hect Bara Canal System - 2259 hect. average of 9 years (1994-95 to1998-99 & 2001-02 to 2004-05)

11. Storage Efficiency:

(a) Reservoir filling efficiency: Average annual filling of reservoir from 1994-95- to 2004-05 (11 years) was 55.10 MCM i.e. 84.77% of present storage capacity of 65.0 MCM

(b) Inflow Patterns: Average annual rainfall before 1960 for East Baigul dam catchment was 1750 mm. as per Project, while average annual rainfall from 1991-2005 (15 years) is 1277 mm. as per Irrigation Deptt records. As per IMD Pune average annual rainfall of Bareilly station (about80 Km.from East Baigul Dam) from 1988 to 2003 (14 years) is 1137 mm., which shows inflow into the reservoir is continuously reducing.

12. Conveyance Efficiency:

(a) Main Canal Systems:		UBC Feeder System	-	64%
		Bara Canal System	-	63%
(b) Distributories	:	1. Sabepur Branch	-	64%
		2. RT. Oganpur Dy.	-	64%
		3. LT. Oganpur Dy.	-	66%
		4. Nakatpura Dy.	-	67%
(c) Minors	:	1. Sisaiya Minor	-	69%
		2. Maholia Minor	-	61%
		3. Mudalia Minor	-	67%
		4. Ajitpur Minor	-	62%

13.**Field Application Efficiency**: for all major crops Paddy, Sugarcane and wheat are the major crops in the project area. Percolation loss has been considered in the case of paddy only. Other losses like seepage loss and runoff loss are negligible. Ratio of water delivered to fields to field irrigation requirement is as follows.

U.B.C. Feeder System	1.	Kharif	-	0.71
	2.	Rabi	-	0.66
Bara Canal System	1.	Kharif	-	0.80
	2.	Rabi	-	0.92

14. (a) **Overall Efficiency of Irrigation System**

:Name of System	Kharif	Rabi
UBC Feeder System	48.0%	41.6%
Bara Canal System	47.3%	41.0%

15. **Drainage Efficiency:**

1. There is no drainage problem in the command area of East Baigul Dam distribution System
2. There is no water logging in the command of East Baigul Dam.
3. Ground water table is not a factor in drainage problem of the command.

16.**Database Collected:**

(i) Irrigated area crop wise -9 years
(ii) Values of Parameters required for calculation of crop water requirement by Penman Method. -15years
(iii) Other data regarding cropping pattern, Irrigation water requirement etc. -Enclosed

17. Main recommendations for overall improvement of the Project:

(a) Dam/ Reservoir efficiencies :

1. As per study, maximum annual filling of reservoir (average of 11 years 1994-95 to 2004-05) is 55.10 MCM i.e. 84.77% of the present storage capacity of reservoir (65.0 MCM). Water is available for both the canal systems off taking from reservoir. A lot of water is being spilled over almost every year during Kharif and total water requirement of Rabi on both the systems is of the order of 24.40 MCM only (See state-12, page-64) for present sown area. This requirement can be meet out by improving water management with present storage capacity. Thus, it is of no use to restore & regain the original storage capacity of reservoir i.e. 86.0 MCM. by incurring huge expenditure.

2. There is need to have a specific & detailed regulation order to operate the gates of spillway timely and to take other safety measures when a possible flood of 87.82 MCM (71200 Acrft.) suddenly occurs. So that dam may remain safe in all the odd circumstances.

(b) Canal /Conveyance Efficiencies:

1. Head regulators, gates and other pucca works to be repaired on priority basis, head gauges to be painted on head regulators, discharge sites & bed bars to be constructed.
2. It is recommended that internal and external sections of the canals to be kept as designed.
3. It is recommended that gauge discharge table/curve should be prepared for canals and discharge of running channel should be written along with gauge in daily gauge register.
4. RT Oganpur Dy. and LT Oganpur Dy. are drawing only 56.10% and 55.83% discharge respectively. It is recommended that special attention is needed to improve head regulators and internal sections of distributories so that these may take their due share of discharge.

(c) On Farm Application Efficiency :

Project area falls under *Tarai* region, where the soils remain fairly moist during major part of the year. Water table found between 1.95 m. to 3.53 meter in post monsoon and pre monsoon respectively, on average, below the ground surface. Even though there is no water logging condition due to gradient. The main crops are paddy (65.5 %), sugarcane (31.0 %) and wheat (89.0%) of proposed irrigated area.

The ratio of water delivered to field in Kharif to field irrigation requirement (FIR) was found to be 71 % and 80 % in UBC and Bara canal respectively and in Rabi, it is 66 % and 92% in UBC and Bara canal respectively. Thus water supply in Kharif, in both systems, is scarce. In Rabi, UBC system has scarce supply. Keeping in view the water supply by canal in kharif and rabi, the cropping patterns have been designed to match the water supply as below:-

	Existing Cropping Pattern (area. hect.)		Designed cropping pattern (area. hect.)	
Kharif	UBC	Bara	UBC	Bara
1. Paddy	4766	908	3800	811
2. Sugarcane	2210	432	1369	302
3. Other Kharif	1421	269	1765	335
Total	8397	1609	6934	1448
Rabi				
1. Wheat	4225	452	2682	400

2. Other Rabi	1733	183	1630	250
Total	5958	635	4312	650

There is sufficient number of private tubewells in the command area, which supplement canal irrigation. Hence it may not require changing the existing cropping pattern.

(d) Drainage Efficiency:

It is recommended that the drains present in command of Baigul Dam Canal system should be cleared periodically and be maintained.

(e) Irrigation Potential created and utilized:

Seeing the performance of UBC Feeder System during Rabi from 1994-95 to 1998-99 & 2001-02 to 2004-05 (9 years), it is evident- present irrigated area of U.B.C. in Rabi i.e. 5958 Hects. is more than proposed area of 4296 Hects. It is due to the private tube wells supplementing canal irrigation & other reasons as mentioned in item 6.4.1 on page-32.

18. Final Report of WUE study of the project sent to Principal Secretary (Land Development and Water Resources), Government of Uttar Pradesh vide TOL CWC/IPO/D-18/2010/366 dated 22/05/2012 for information and necessary action by the State Government on the recommendations made in the report.

BIHAR STATE

(31) KAMLA IRRIGATION PROJECT

1. NAME OF THE PROJECT - KAMLA IRRIGATION PROJECT
2. River / Main River / Basin - Kamla River - Ganga Basin
3. Type of Project - Major Irrigation Project
4. Type of Structure - Weir
5. Location
   (a) Weir: Latitude - 26^{o}-35'N
   Longitude - 86^{o}-10'E
   Town - Jaynagar
   District - Madhubani (Darbhanga)
   State - Bihar

   (b) Command Area
   Latitude - 26^{o}-17' to 26^{o}-45' N
   Longitude - 85^{o}-50'E to 86^{o}-16'E
6. Length / Period of data used for Study - 1995 to 2009

7. G.C.A. & C.C.A.

(i) Designed -	Western (Ha.)	Eastern (Ha.)	Total (Ha.)
G.C.A.	57744	8785	66529
C.C.A. (60% of GCA)	34648	5273	39921

   (ii) After transfer of a portion of command to Western Kosi canal command
   GCA = 47218
   CCA = 28331

8. Ultimate Irrigation Potential envisaged in the project.
   Kharif (70% of CCA) - 70% of 28331 Ha. = 19832 Ha.
   Rabi (20% of CCA) - 20% of 28331 Ha = 5665 Ha.

		Kharif	Rabi	Remarks
9. Potential Created	-	21070 Ha.	5665 Ha.	Based on area Irrigated between 1995 to 2009
10. Maximum Potential Utilized- In an year		19718 Ha.	653 Ha.	On sudkar basis

11. **Main Recommendation for overall improvement of the Project:**

Weir efficiency on an average works out to 0.4825. Main reasons of low efficiency are;

(a) The falling shutters when fall in kharif season get covered by siltation, which requires more time & labour in erecting it. So effective control on pond level is not maintained. It is therefore recommended that weir may also be made gated. It has 34 spans of 6.096 m (20 ft.) each. It will have effective control over pond level.

(b) There is a railway bridge at 1.28 Km. of Western main canal which has 2 spans of 6.92 metre each; which is capable of passing a discharge of 11.92 cumec only at FSD 1.524 & Bed slope 1:6667 and n = 0.0225.

As per the present GIR and Kharif potential of MWC (18770 Ha.) giving allowance of 10% for rush irrigation design discharge works out to 18.54 cumec so for passing rest (18.54 – 11.92) = 6.62 cumec additional waterway is required in Rly. Bridge. One vent of 8 m will be capable of passing 7.08 cumec.

Therefore one alternative is that one vent of 8 m be added in the Rly. Bridge at 1.28 Km. of M.W. canal.

A possibility of passing the design discharge through the existing two vents of 6.92 m of Rly. Bridge has also been examined by increasing. The F.S.D. At F.S.D 2.124 m (1.524 + 0.60) the discharge passed through existing water way (2 x 6.92 m) works out to 19.216 cumec against design requirement of 18.54 cumec.

This will require raising of weir crest and Pond level by 0.6 meter consequently floor of the weir will require strengthening and extension.In addition Main Canal will require rising of banks by 0.6 m.Adding additional vents in Rly. Bridge could not materialize despite efforts from beginning of the commissioning of the project.

Therefore it is recommended that the weir should be converted into a barrage with pond level raised by 0.6 m from present level of 68.276 m to 68.876 m.As GCA & CCA have changed the whole system of the project should be remodelled as per existing GCA & CCA with the above structural changes.This will ensure improvement in diversion efficiency of the head work, Improvement in utilization of created irrigation potential.Bringing more area under command on the right bank under Eastern Main Canal due to rise in FSL by 0.60 metre.

12. **Name of Consultant** :Water & Land Management Institute (WALMI), Bihar, Patna.

13. **Weir Efficiency**: In different years from 1996 to 2009 it varies from 0.2116 to 0.825. Mean efficiency comes to 0.4825.

14. **Conveyance Efficiency:**

(a)	Canals Conveyance Efficiency		
(i)	Main Western Kamla Canal	–	0.8902
(ii)	King's Canal	–	0.7799
(iii)	Korahia Distributary	–	0.7854
(b)	Delivery System Efficiency	=	0.6956

15. **Field Application Efficiency / On Farm Application Efficiency:**

(a) Kharif Paddy = 0.7438

16. Drainage Efficiency:

There is no specially planned drainage scheme. The data in Format VII have been provided.

17. Overall efficiency of irrigation system = 0.6956 X 0.7438 = 0.5174

18. Data source and Data base collected:

- Directorate of Statistics, Bihar, Patna.

Monthly rainfall data of R.G. stations (i) Jaynagar (ii) Basopati (iii) Madhopur (iv) Benipati (v) Bisfi (vi) Ladania for the years 1995 to 2009.

- I M D Publications.

Climatological data of Darbhanga IMD observatory Average of year 1931 to 1960

- Water Resources Department, Bihar.

(i) WALMI, Khagaul, Phulwari Sharif, Patna ;- Project Details

(ii) Executive Engineer, Water Resource Department, Jaynagar

(Kamla Canal Division, Jaynagar)

(a) Discharge released in Main Western & Main Eastern canals at head work for the years 1996 to 2009 from June to October with quantity & duration

(b) Discharges released at head in King's canal and Korahia distributary form June to October for the years 1996 to 2009 with quantity and duration

(c) CCA and design irrigation potential for Kharif and Rabi and area irrigated every year for 1995 -1996 to 2009-2010

(d) Reach wise section details of Main Western canal, Kings canal and Korahia distributary and there design discharges at head.

- Bihar State ground Water Board: Pre-monsoon and post-monsoon W. L. in surface wells in the command for 1993 to 2008.
- Report of Post Facto Study of Kamla Irrigation Project by Meta Planners and Management Consultants (1990)

19. Final Report of WUE study of the project sent to Principal Secretary (Water Resources Department), Government of Bihar vide TOL CWC/IPO/D-17/2010/433-447 dated 09/08/2012 for information and necessary action by the State Government on the recommendations made in the report.

(32) UPPER MORHAR IRRIGATION PROJECT

1 NAME OF THE PROJECT - UPPER MORHAR IRRIGATION PROJECT

2 Basin /Sub Basin / Main River - Ganga Basin, Punpun sub basin, Morhar river

3 Type of Project - Major Irrigation Project

4 Type of Structure - Weir

5 Location

(a) Weir : Latitude - 24^0 31' - 23" N.
Longitude - 84^0 42' – 48" E
Village - Sugidih
P.S. - Sherghati
Town - Sherghati
District - Gaya
State - Bihar

(b) Command Area -
Latitude - 24^0 32' to 24^o 39' N
Longitude - 84^0 42' to 84^0 55' 2" E
C.D. Blocks - Amas, Gurua, Paraiya, Konch & Rafiganj.

6 Length / Period of data used for Study

- 1995 to 2009 – Monthly Rainfall
- 1998 to 2009 – Irrigated area .
- 2002 to 2009 – (i) Weir diversion from June to Oct.
  (ii) Discharge at head of sample Canals from June to Oct.

7 C**ulturable Command Area:**

(i) Original – GCA = 28336 Ha.; Kharif = 12954 Ha;Rabi = 1619 Ha.

(ii) After amalgamation of a portion of command to North Koel Canal command

GCA = 7322 Ha' CCA = 5725 Ha.

Irrigation Potential :- Kharif = 5725 Ha.
Rabi = 573 Ha.

8 **Ultimate Irrigation Potential:**

(i) Original

Kharif	-	12954 Ha
Rabi	-	1619 Ha
Total	-	14573 Ha

(ii) After amalgamation of a portion of command to North Koel Canal Command

Kharif = 5725 Ha.

Rabi = 573 Ha.
Total = 6298 Ha.

9. **Potential Created:**

Kharif - 5725 Ha; Rabi - 573 Ha

10. **Potential Utilized:**

Kharif - 5725 Ha; Rabi - 405 Ha

11. **Main Recommendation for overall improvement of the Project:**

(i) River Morhar is a rainfed flashy river. The project is designed to fill up ahars besides providing direct irrigation through its canal network. As such it becomes incumbent to draw as much water as practicable, when there is adequate flow in the river. But raising of the crest shutters immediately after recession of floods presents difficulties. This job is done manually and there is reluctance on the part of the workmen to enter the river in which current is rather swift even during low floods. And by the time the shutters are raised in position the river flow drops down substantially. On an average shutters fall 12 to 14 times during kharif season. This is the main reason of low diversion efficiency of the weir.

It is therefore recommended that the weir be converted into a barrage with vertical lifting gates. Total length of the weir portion is 157 m (515 ft.) The conversion will involve construction of piers, lift gates, road bridge across the river through piers and RCC raft for capping of the existing floor etc.

(ii) In Dariaura Distributary command. Water is supplied in Dariaura distributary by putting obstruction in fall at Km 9.27 of Main Canal. It requires construction of a cross regulator upstream of this fall. This will ensure Improvement in diversion efficiency of the Head work and Improvement in irrigation potential utilization.

12. **Name of Consultant** :Water & Land Management Institute (WALMI), Phulwarisharif, Patna, Bihar.

13 **Weir Efficiency:** 39.86%

14 **Conveyance Efficiency:**

(i)	(a) Main Canal	–	0.9474
	(b) Branch Canal	–	No Branch Canal
	(c) Dariaura Distributary	–	0.7439
	(d) Supai Distributary	–	0.9260
	(e) Weighted average efficiency of disty.	–	0.8104
(ii)	Delivery System Efficiency	=	76.78%

15 **On Farm Application Efficiency of Kharif Paddy:**

(i)	Supai Distributary command	–	0.3959
(ii)	Overall Irrigation Efficiency	–	0.7678x0.3959=0.304

16 Drainage Efficiency: There is no specially designed drainage system. But the command is well drained. Ground Water Table is well below ground level. So there is no problem of water logging.

17.**Data Base Collected:**

(i) Meteorological data of Gaya IMD observatory month wise daily average data (1931 to 1960) from IMD publication.

(ii) Weekly average discharge diverted in main canal by weir for the years 2002 to 2006 and daily average discharge from 2007 to 2009.

(iii) Weekly average discharge released at head of sample canals for the years 2002 to 2006 and daily average discharge from 2007 to 2009.

(iv) Yearly sudkar area of Kharif and Rabi for the years 2002 to 2009 in the command as a whole and in command of sample canals

(v) Reach wise section details of sample canals & their design discharge

(vi) Conveyance loss rate determined in sample canals.

(vii) Monthly rainfall of R.G. Stations Paraiya, Konch, Amas and Rafiganj procured from Directorate of Statistics, Bihar, Patna for the years 1995 to 2009.

(viii) Data of Ground water rise in command for the years 1993 to 2007 procured from Bihar State Ground Water Board.

Data source Sl. (ii) to (v) project authorities.

18. Final Report of WUE study of the project sent to Principal Secretary (Water Resources Department), Government of Bihar vide TOL CWC/IPO/D-17/2010/433-447 dated 09/08/2012 for information and necessary action by the State Government on the recommendations made in the report**.**

(33) DURGAWATI IRRIGATION PROJECT

1. NAME OF THE PROJECT : DURGAWATI IRRIGATION PROJECT

2. Basin, Sub Basin, River : Ganga Basin, Karmnasa Sub Basin, Durgawati River

3. Type of Project : Major Irrigation Project

4. Type of Structure : Weir

5. Location:

a. (a) Weir : Latitude - 25^0 2' N
Longitude - 83^0 48' E

i. Town - Kudra (Sakri Village)
ii. District - Kaimoor
iii. State - Bihar

b. (b) Command Area:

1. Latitude - 25^0 6.46' to 25^o16.868' N
2. Longitude - $83^0$31.312' to $83^0$48' E

6. Length / Period of data used for Study- 2002 to 2009 – Project data
- 1995 to 2009 – Monthly Rainfall Data

7. Culturable Command Area : 21110 Ha.,G.C.A = 24220 Ha

8. Ultimate Irrigation Potential (UIP), Kharif-19558 Ha.,Rabi- 8983 Ha.Total; 28541 Ha.

9. Potential Created (PC), Before Remodelling, kharif;13,783Ha, Rabi;1,619 Ha After Remodelling Kharif;18,400, Rabi8,983.

10. Potential Utilized (PU), Before Remodeling, kharif;18,400 Ha, Rabi;1,619 Ha After Remodelling Kharif;13,589 Ha, Rabi 8,983 Ha.

11. Main Recommendation for overall improvement of the Project:

The Weir efficiency is satisfactory (Average value 0.8784) and the conveyance efficiency & delivery system efficiencies of canals (0.8116) are satisfactory. Remodeling work has recently been done. The work of proposed Jitapur Minor only has not been started. The work in Main Canal, Usri Distributary and Chhata Minor are in progress.

12. On farm Application Efficiency (0.651) The canals have recently been remodelled. New outlets & village channels and field channels have been constructed. The efficiency may improve by better water management.

13. Overall irrigation Efficiency (0.5283) is satisfactory.

Drainage – Drainage scheme for waterlogged area at Ghagia and Dadar villages should be planned and executed.

14. Name of Consultant : Water & Land Management Institute (WALMI), Phulwarisharif, Patna, Bihar

15. **Storage Efficiency/ Weir Efficiency**: The project under study has its head work a weir across river Durgawati at village Sakri (in Kudra Block) District Kaimoor. It has no provision for storage. Weir Efficiency = 0.8784

16. **Conveyance Efficiency**:

(a) Main Canals – 0.9603

(b) Branch Canals – There is no Branch Canal

(c) Distributaries – Weighted Average 0.8452

(d) Minors – These also take off from Main Canal

Delivery system Efficiency = 0.8116

17. **On-Farm Application Efficiency:** for all major crops for Kharif (Paddy) – 0.6510 when water supply is abundant & the Overall Efficiency of Irrigation system = 0.5283

18. **Drainage Efficiency**: There is no planned drainage system in the command.

19. **Data source and data base collected:**

(i) Directorate of Statistics, Bihar, Patna.-Monthly Rainfall data at Ramgarh, Kudra, Durgawati and Mohania for 1995 to 2009

(ii) IMD Publication -Climatological data of Dehri IMD observatory. Average of 1951 to 1960.

(iii) WALMI, Khagaul, Phulwari Sharif, Patna-Project Details

(iv) Water Resources Department Bihar.Executive Engineer Water Resource Department Mohania:

(a) Daily discharge data released at project head in Main Canal with duration from June to October for the year 2002 to 2009.

(b) Daily discharge data with duration of flow of Kaithia distributary, Mohania distributary, Maricha distributary and Sawath Distributary for the year 2004 to 2009 from June to October.

(c) Kharif and Rabi irrigation area of the project for the years 2002 to 2009.

(d) Details of distribution system of the project.

(e) Details of Weir and head regulator.

- Bihar State Ground Water Board: Pre-Monsoon and Post Monsoon W.L. in surface wells in the Blocks covered in the command for the years 1993 to 2007.
- Report on Post Facto Study of Durgawati Irrigation Project by Metaplanners & Consultants Patna-1991

20. Final Report of WUE study of the project sent to Principal Secretary (Water Resources Department), Government of Bihar vide TOL CWC/IPO/D-17/2010/433-447 dated 09/08/2012 for information and necessary action by the State Government on the recommendations made in the report.

(34) EASTERN SONE CANAL SYSTEM

1	NAME OF THE PROJECT	-	EASTERN SONE CANAL SYSTEM
2	Basin / Main River	-	Ganga Basin - Sone River
3	Type of Project	-	Part of Major Irrigation Project
4	Type of Structure	-	Barrage
5	Location		
	(a) Barrage: Latitude	-	24^{o}-49.68' N
	Longitude	-	84^{o}-8.793'E
	Town	-	Indrapuri
	District	-	Rohtas
	State	-	Bihar
	(b) Command Area		
	Latitude	-	24^{o}-53.043' to 25^{o}-38.654' N
	Longitude	-	84^{o}-13.043' to 85^{o}-12.391' E
6	Length / Period of data used for Study	-	1995 to 2009

7 Culturable Command Area- 1,26,055 Ha.; G. C. A = 2,25,532 Ha.

8 Ultimate Irrigation Potential envisaged in the project.

Kharif	75 % of C.C.A
Rabi	45 % of C.C.A
Others	5 % of C.C.A
Total	125% of C.C.A

9

- Potential Created -

(i)	Crop	Kharif	Rabi	Irrigation Intensity
(ii)	Area	110581 Ha.	52920 Ha.	
(iii)	% of C.C.A	87.72%	41.98%	129.70%

- Potential Utilized (Maximum in one year)

(iv)	Area	100107 Ha (2007–08)	45421 Ha. (2003–04)	
(v)	% of C.C.A	79.42 %	36.03 %	115.45 %

10. Main Recommendation for overall improvement of the Project:

(i) The distributaries of the Eastern Sone Canal System viz Paliganj Distributary, Manjhauli distributary, R.P. Channel-5 and Tangraila distributary, R.P. Channel III, Adampur distributary, Khajuri distributary, Fatehpur distributary, Dorwan distributary are in bad shape and need special repair.

(ii) Pucca road on right bank of Patna Canal is badly damaged and requires special repair. This will facilitate frequent inspection of all locks and improve water management. Thereby will increase potential utilization.

11. Name of Consultant - Water & Land Management Institute (WALMI), Phulwarisharif, Patna (Bihar)

12. Storage Efficiency:

(a) **Reservoir Filling Efficiency:**

The project under study has its head work, a barrage across river Sone at Indrapuri, District Rohtas. It has no provision for storage. However, barrage efficiency to divert water in its off taking canals has been computed.

(b) **Inflow Pattern:** It has been studied by comparing the mean monthly flows and statistics of flow series 1944 to 1961, 1962-1973, 1974 to 1991 and 1995 to 2009. In these time spans 1944 to 1961 is pre-Rihand and pre-Bansagar and 1974 to 1991 and 1995 to 2009 are post-Rihand and post–Bansagar. In comparing these it has been identified that non-monsoon flow has increased and monsoon flows have reduced with respect to total annual flow.

12.1 Barrage Efficiency: Kharif -0.9866:Rabi -0.9566

12.2 Patna Canal H.R. efficiency:

Kharif - 0.8891

13. Conveyance Efficiency:

(a) Canals conveyance efficiency

i. Main Eastern Canal – 0.8777

ii. Distributaries

- MEC & Manora Distributary – 0.9037
- Mali Distributary – 0.7904
- Paliganj Distributary – 0.8401
- Rewa Distributary – 0.7924

iii. Weighted average conveyance efficiency – 0.8302

(b) Delivery System Efficiency – 0.7286

14. Field Application Efficiency:

(a) On Farm Application Efficiency in Sample commands.

(i) Command of MEC & Manora Distributary – 0.5895

(ii) Command of Mali Distributary – 0.7582

(iii) Command of Paliganj Distributary – 0.8315

(iv) Command of Rewa Distributary – 0.6790

(b) Weighted average OFAE – 0.7306

(c) Overall Irrigation Efficiency of the system – 0.5323

15. Drainage Efficiency: There is no specially planned drainage scheme. So, the data of water drained out is not available.

16. Data base Collected:

A. From Project Authorities:

(a) GCA, CCA, Potential Created and Utilized, Cropping Pattern, (Planned and actual).

(b) Inflow of river Sone at Indrauri barrage diversion in Western and Eastern Link Canal and spillage downstream of barrage.

(c) Releases in Main Canal and in Sample Canals at head.

(d) Hydraulic details of Sample Canals reach wise.

(e) Area irrigated by sample distributary and system as a whole.

B. Other Sources:

- Climatological data of Patna and Dehri from IMD publication for working out ETo for the command are of Patna Canal. (From IMD Publication)
- Monthly Rainfall data of raingauge stations in and around the command. (From Directorate of Statistics, Bihar)
- Data of Ground Water rise in the command Block-wise from State Ground Water Organisation.
- Feasibility Report of Sone Modernisation Project – By WAPCOS
- History of Irrigation in Bihar (Ancient British and upto pre plan period) – By Gagan Prasad, Director Bihar State Hydrology Cell, W.R.D., Patna – Published by :- WALMI, Phulwarisharif, Patna, Bihar–1995 (September)

17. Final Report of WUE study of the project sent to Principal Secretary (Water Resources Department), Government of Bihar vide TOL CWC/IPO/D-17/2010/161-175 dated 08/05/2013 for information and necessary action by the State Government on the recommendations made in the report.

(35) SARAN CANAL SYSTEM

1.	Name of the Project	:	Saran Canal System
2.	River/Main River/Basin	:	Gandak River/ Gangabasin
3.	Type of Project	:	Major Irrigation Project
4.	Type of Structure	:	Barrage
5.	Location	:	Lat. 25^0.40'N to 26^0 40'N & Long 83^0 50' to $85^0$5'E
6.	Length/Period of Data used for study	:	1999 to 2006
7. a)	Culturable Command Area	:	3.60 Lac Ha.(As per Gandak Project Report).
b)	CCA (As per Agriculture Dept.)	:	5.61 Lac Ha (Other SMC- Tube well, MI, Pump etc also included in addition to Gandak canal CCA).
8.	Ultimate irrigation Potential	:	4.60 Lac Ha
9.	Potential Created	:	2.82 Lac Ha
10.	Potential Utilized	:	Kharif 1.52 Lac Ha Rabi 0.60 Lac Ha

11. **Main Recommendations for overall improvement of the project:**

i. Completion of the project up to OFD works
ii. Completion of the proper drainage scheme in three phases.
iii. Improvement of outlet with controlled gate
iv. Development of selected chaurs (depressed land) for storing the excess water and using this for summer crop. These chaurs can also be used for aqua culture.
v. Scheme for conjunctive use of G.W. with canal (Surface) water should be planned & executed.

12. **Name of the consultant:**
Water and Land Management Institute, Phulwarisharif Patna, Bihar

13. **Storage Efficiency:**

(a) Reservoir filling efficiency-does not concern us.

(b) Inflow Pattern-does not concern

14. **Conveyance Efficiency:**

(a). Main Canal : 90.61%
(b). Branch Canal and Disty taking off from

Main Canal. : 86.90%

(c). Distributaries and sub-disty
Taking off from Branch Canal : 78.67%

(d) .Sub distributaries : 84.81%

(e). Delivery System Efficiency : 52.54%

15. (i) **Field application Efficiency for all major crops:**

(a) Kharif - 69.33 %

(b) Rabi - 38.5 %

(ii) **Over all irrigation system Efficiency:**

(a) Kharif crop-36.42%

(b) Rabi (wheat)-19.97%

16. **Drainage Efficiency:** No drainage system is existing in the project area and hence ratio of the actual delivery to the designed capacity has not been evaluated.

17. Database used in the study:

i. Project details with salient features have been supplied by WALMI Phulwarisharif, Patna.

ii. Data regarding section details and discharges released at head of the canals have been supplied by project authorities.

iii. Data of command rainfall has been collected from District Agriculture Office Siwan, Chapra and Gopalganj District.

18. Final Report of WUE study of the project sent to Principal Secretary (Water Resources Department), Government of Bihar vide TOL CWC/IPO/D-17/2010/161-175 dated 08/05/2013 for information and necessary action by the State Government on the recommendations made in the report.

SUMMARY

OF

THE FINDINGS

SUMMARY OF THE FINDINGS

Sl. No.	Name of project/Agency	Dam/ Reservoir efficiency	System efficiency (%)	Hydrological Parameters	
				IPC(ha)	IPU(ha)
ANDHRA PRADESH					
1	BHAIRAVANITHIPPA PROJECT WALMI, HBD	Reservoir filing efficiency Gross storage – 53.47 Mcum live storage – 51.59 Mcum Actual storage = 27 Mcum during Nov 2002	Conveyance efficiency of right main canal = 86.51% On farm application efficiency = 66.87% overall efficiency= 57.85%	4856	3083
2	GAJULADINNE (SANJEEVAIAH SAGAR PROJECT). WALMI, HBD	Reservoir filing efficiency gross storage = 148.68 Mcum Live storage = 121.21 Mcum Actual storage = 26.22 Mcum during Oct 2004	conveyance efficiency Main Canal = 56.76 % on farm application efficiency = 45.37% overall efficiency=25.75%	10246 TO 10310	6928
3	GANDIPALEM PROJECT WALMI, HBD	Reservoir filing efficiency Storage Capacity = 53.24 Mcum Live storage=45.88 Mcum Actual storage = 3.68 Mcum during Oct 2004	Conveyance efficiency of RMC= 85.36% LMC= 80.36% Distributary D3 of RMC=86.44% on farm application efficiency = 38.40% overall efficiency=28.03%	6478	4155
4	GODAVARI DELTA SYSTEM (SIR ARTHUR COTTON BARRAGE) WALMI, HBD	Reservoir filing efficiency Storage Capacity = 83 Mcum Live storage=60.06 Mcum Actual storage = 67.48 Mcum during Apr 2005	Conveyance efficiency combined canal system=83.21% on farm application efficiency = 54.15% overall efficiency=45.05%	410108	313295 to 410108
5	KRISHNA DELTA SYSTEM (PRAKASAM BARRAGE) WALMI, HBD	Reservoir filling efficiency = 100%	Conveyance efficiency Main Canal 88 to 99.4 % (K.E. Delta) 92.24 to 99.15% (K.W. Delta) on farm application efficiency =Not observed but Evaluated 35.0 to 45.03 %	5.29 lakh	7.23 lakh

6	KURNOOL -CUDDAPAH CANAL SYSTEM WALMI, HBD	Diversion scheme	Conveyance efficiency canal=62.25% on farm application efficiency = 45.15% overall efficiency=28.10%	65465	34321
7	NARAYANAPURAM PROJECT	diversion scheme	Conveyance efficiency of right canal system=46.57% on farm application efficiency =31.18% overall efficiency=14.52%	15855	15855
8	SOMASILA PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 2221 Mcum Live storage=1994 Mcum Actual storage = 1438.97 Mcum during Nov 2005	Conveyance efficiency of canal system=67.86% on farm application efficiency =31.84% overall efficiency=18%	54650	22663
9	SRISAILAM (NEELAM SANJEEVA REDDY SAGAR) PROJECT / SRBC WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 308.06 TMC Live storage=253.05TMC Actual storage = 263.16 TMC during Oct 2005	Conveyance efficiency of canal system=50% on farm application efficiency =33.94% overall efficiency=17%	59900	26300
10	TUNGABHADRA HIGH LEVEL CANAL	Reservoir filling efficiency- Gross Storage Capacity = 146.4 Mcum Live storage=135.07 Mcum Actual storage = 68.75 Mcum during Sept 2004	Conveyance efficiency of canal system=80.8% on farm application efficiency =75.8%(for wet crops) 68.57% (for ID crops) overall efficiency=58.32%	45800	56766
11	TUNGABHADRA PROJECTB - LOW LEVEL CANAL (TBP-LLC) WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 3157.497 Mcum Live storage=3157.497 Mcum Actual storage = 3157.497 Mcum during Aug 2004	Conveyance efficiency of canal system=72.18% on farm application efficiency =44.80% overall efficiency=32.33%	61163	37745
12	VAMSADHARA PROJECT	Reservoir filling efficiency- Gross Storage	Conveyance efficiency of canal	82087	82087

	(STAGE – I) WALMI, HBD	Capacity = 17.33 Mcum Live storage=17.33 Mcum Actual storage = 17.33 Mcum	system=90.50% η_{dr} = not found on farm application efficiency =58.47% overall efficiency=52.91%		
13	YELERU PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 682.85 Mcum Live storage=506.30 Mcum Actual storage = 316.58 Mcum during Dec 2004	Conveyance efficiency of canal system=50%(assumed) η_{OFA} =28.42% overall efficiency=14.21%	27240	27240
ANDHRA PRADESH & TELANGANA					
14	NAGARJUNA SAGAR PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 408.24 TMC Live storage=202.47 TMC Actual storage = 307.52 TMC during Oct 2004	Conveyance efficiency of canal system=55.96% on farm application efficiency =38.93% overall efficiency=21.80%	8.89 lakh	0.3 to 0.8 lakh
TELANGANA					
15	KADDAM PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 215.3 Mcum Live storage=136.55 Mcum Actual storage = 198.67 Mcum during Sept 2005	Conveyance efficiency of project=51.25% on farm application efficiency =36.13% overall efficiency=18.52%	27519	4047 to 21482
16	KOIL SAGAR PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 64.46 Mcum Live storage=59.89 Mcum Actual storage = 1.19 Mcum during Sept 2004	Min irrigation done= 10.4% Conveyance efficiency of project=82.62% on farm application efficiency =75% overall efficiency=61.96%	11700 acre	9200 acre
17	NIZAMSAGAR PROJECT WALMI, HBD	Reservoir filling efficiency Gross Storage Capacity 504 Mcum Live storage=504Mcum Actual storage = 382.8 Mcum during Nov 2005	Conveyance efficiency of canal system=87% on farm application efficiency =45.32% overall efficiency=39.43%	93659	93659

18	SRI RAM SAGAR PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 3171 Mcum Live storage=2322 Mcum Actual storage = 3055.8 Mcum during Sept 2005	Conveyance efficiency of kakatiya canal above LMD =97.93 % below LMD = 90.77% on farm application efficiency =57.28% overall efficiency=44.66%	371054	306558
19	UPPER MANAIR PROJECT WALMI, HBD	Reservoir filling efficiency- Gross Storage Capacity = 62.30 Mcum Live storage=61.43 Mcum Actual storage = 2.57 Mcum during Jun 2003	Conveyance efficiency of canal system= not found on farm application efficiency = not found overall efficiency= not found	1215 TO 5296	4000
20	RAJOLIBANDA DIVERSION SCHEME (RDS) WALMI, HBD	Diversion scheme	Conveyance efficiency of canal system=82.83% on farm application efficiency =51.51% overall efficiency=42.65%	35410	4830 to 18741
HARYANA					
21	AUGMENTATION CANAL PROJECT HIRMI, KURUKSHETRA	No storage provision	Conveyance efficiency of canal system=79% on farm application efficiency =72%	85443	94778
22	NAGGAL LIFT IRRIGATION PROJECT HIRMI, KURUKSHETRA	No storage provision	Conveyance efficiency of canal system=47.82% on farm application efficiency =27% overall efficiency=13%	12074	9176
PUNJAB					
23	DHOLABAHA DAM IPRI, AMRITSAR	Reservoir filling efficiency= 61.50%	Conveyance efficiency of canal system=74.27% on farm application efficiency =71% overall efficiency=52.73%	2600	1782

24	RANJIT SAGAR DAM IPRI, AMRITSAR	Reservoir filling efficiency= 57.35%	Conveyance efficiency of canal system=97.57, 93.07, 77.17 % of UBDC main , MBU and MBL respectively water supply adequacy index = 9.89%(for rabi) and 12.565(for Kharif) overall efficiency=50.83%	–	361052
UTTAR PRADESH					
25	AHRAURA DAM IRRIGATION PROJECT WALMI, LUCKNOW	Reservoir filling efficiency= 91.3%	Canal Conveyance efficiency = 42 to 80 % overall efficiency=49.2%	14964	15351
26	EAST BAIGUL RESERVOIR PROJECT WALMI,LUCKNOW	Reservoir filling efficiency= 84.77%	Canal efficiency of UBC feeder system = 64 % Bara canal system= 63% overall efficiency of UBC feeder system =48%in kharif and 41.6 % in Rabi overall efficiency of Bara canal system =47.3%in kharif and 41.0 % in Rabi water supply adequacy index= 0.66 to 0.92	11230+2354	13439+2259
27	MATATILA DAM PROJECT. WALMI,LUCKNOW	Reservoir filling efficiency= 67.36%	Conveyance efficiency of canal system- Betwa canal system= 68.2% Gursarai canal system= 67.8% on farm application efficiency =80% overall efficiency=54.6 to 54.2%	179880+47213	213906+28337

28	NAUGARH DAM IRRIGATION PROJECT WALMI,LUCKNOW	Reservoir filling efficiency= 81.4%	Conveyance efficiency of canal system=70.7% overall efficiency=49.5%	64221	N/A
29	PILI DAM PROJECT. WALMI,LUCKNOW	Reservoir filling efficiency= 47.53%	Conveyance efficiency of main canal =58% overall efficiency=37.7 to 43.5% water supply adequacy index= 0.54 to 0.70	4044	4753
30	WALMIKI SAROVAR PROJECT WALMI,LUCKNOW	Reservoir filling efficiency= 61.15%	Conveyance efficiency of main canal =43% overall efficiency=37.7 to 43.5% on farm application efficiency =62% η_{dr} = not found	6271	2864
BIHAR					
31	KAMLA IRRIGATION PROJECT WALMI, PATNA (BIHAR)	Weir filing efficiency 48.25 %	Conveyance efficiency main western kamla canal = 89.02% King's Canal = 77.99% Korahia Distributary = 78.54% On farm application efficiency = 74.38% overall efficiency= 51.74%	Kharif 21070 Rabi 5665	Kharif 19718 Rabi 653
32	UPPER MORHAR IRRIGATION PROJECT WALMI, PATNA (BIHAR)	Weir filing efficiency 39.86%	Conveyance efficiency Main canal = 94.741% Av. Distributary canal = 81.04 On farm application efficiency = 39.59% overall efficiency= 30.4%	Kharif 5725 Rabi 573	Kharif 5725 Rabi 405
33	DURGAWATI IRRIGATION PROJECT WALMI, PATNA (BIHAR)	Weir filing efficiency = 87.84 %	Conveyance efficiency of canal = 81.16% On farm application efficiency = 65.1% overall efficiency= 52.83%	Kharif 18400 Rabi 8983 (after remodeling)	Kharif 18400 Rabi 8983

34	EASTERN SONE CANAL SYSTEM WALMI, PATNA (BIHAR)	Barrage efficiency Kharif 98.66 % Rabi 95.66 %	Weighted Conveyance efficiency = 83.02% On farm application efficiency = 73.0666.87% overall efficiency= 53.23%	Kharif 110581 Rabi 52920	Kharif 100107 Rabi 45421
35	SARAN CANAL SYSTEM WALMI, PATNA (BIHAR)		Conveyance efficiency Main canal = 90.61% Delivery System efficiency = 52.54 On farm application efficiency Kharif= 69.33 % Rabi = 38.5 % overall efficiency Kharif= 36.42 % Rabi = 19.97 %	282000	Kharif 152000 Rabi 60000

EFFICIENCY TABLE

OF

THE 35 PROJECTS

(in descending order)

EFFICIENCY TABLE OF THE 35 PROJECTS(IN DESCENDING ORDER)

Sl No	Name of Project	Major/Medium	State	Culturable Command Area	Conveyance Efficiency	On Farm Application Efficiency	Overall Project Water Use Efficiency
				(Hectare)	(%)	(%)	(%)
(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)
1	Koil Sagar Project	Medium	A.P	11,700	83	75	62
2	Bhairavanithippa Project	Medium	A.P	4,856	86	67	58
3	Augmentation Canal Project	Major	Haryana	85,443	79	72	57
4	Matatila Dam Project	Major	U.P	1,79,880	68	80	54
5	Eastern sone canal	Major	Bihar	1,26,055	73	73	53
6	Vamsadhara Project	Major	A.P	82,087	91	58	53
7	Durgawathi Irrigation Project	Major	Bihar	21,110	81	65	53
8	Dholabaha Dam Project	Medium	Punjab	2,600	74	71	53
9	Kamla Irrigation Project	Major	Bihar	28,331	70	74	52
10	Naugarh Dam Irrigation Project	Major	U.P	64,221	71	70	50
11	Ahraura Dam Irrigation Project	Medium	U.P	14,964	70	70	49
12	Tungabhadra High Level Canal	Major	A.P	45,800	81	58	47

13	Godavari Delta System (Sir Arthur Cotton Barrage)	Major	A.P	4,10,108	83	54	45
14	Sri Ram Sagar Project	Major	A.P	3,71,054	78	57	45
15	Rajolibanda Diversion Scheme	Major	A.P	35,410	82	51	42
16	East Baigul Reservoir Project	Medium	U.P	16,605	64	65	42
17	Krishna Delta System (Prakasam Barrage)	Major	A.P	5,29,000	87	46	40
18	Nizam sagar Project	Major	A.P	93,659	87	45	39
19	Walmiki Sarovar Project	Major	U.P	6,271	62	62	38
20	Pili Dam Project	Medium	U.P	4,044	58	65	38
21	Ranjit Sagar Dam Project	Major	Punjab	3,00,000	51	65	33
22	Tungabhadra Low Level Canal	Major	A.P	61,163	72	45	32
23	*Saran Canal Irrigation Project	Major	Bihar	3,60,000	53	69	30
24	Upper Morhar	Major	Bihar	5725	77	40	30
25	Kurnool –Cuddapah Canal System	Major	A.P	65,465	62	45	28
26	Gandipalem Project	Medium	A.P	6,478	73	38	28
27	Gajuladinne (Sanjeevaiah Sagar Project).	Medium	A.P	10,300	57	45	26
28	Nagarjuna Sagar Project	Major	A.P	8,89,000	56	39	22
29	Somasila Project	Major	A.P	54,650	56	32	18

30	Kaddam Project	Major	A.P	27,519	51	36	18
31	Srisailam Project	Major	A.P	59,900	50	34	17
32	Narayanapuram Project	Medium	A.P	15,855	47	32	15
33	Yeleru Project	Major	A.P	27,240	50	28	14
34	Nagal Lift Project	Major	Haryana	35,721	48	27	13
35	Upper Manair Project	Medium	A.P	6,984	-	-	-
	Weighted average value				69	55	36