



सत्यमेव जयते

**Report of the  
Comptroller and Auditor General of India  
Performance Audit on Outcomes in Surface  
Irrigation in Tamil Nadu  
for the year ended March 2020**



लोकहितार्थ सत्यनिष्ठा

Dedicated to Truth in Public Interest



**Government of Tamil Nadu  
Report No. 5 of the year 2022**





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## **P R E F A C E**

This Report of the Comptroller and Auditor General of India for the year ended March 2020 has been prepared for submission to the Hon'ble Governor of Tamil Nadu under Article 151 (2) of the Constitution of India to be tabled in the State Legislature.

This Report contains significant results of Performance Audit on Outcomes in Surface Irrigation in respect of the works executed by the Department of Public Works (Water Resources Department), Government of Tamil Nadu.

The instances mentioned in this Report are those, which came to notice in the course of test audit for the period 2015-20 as well as those which came to notice in earlier years, but could not be reported in the previous Audit Reports. The instances relating to the period subsequent to 2020-21 have also been included, wherever necessary.

The audit has been conducted in accordance with the Auditing Standards issued by the Comptroller and Auditor General of India.





# OVERVIEW



## OVERVIEW

This Report contains a Performance Audit on Outcomes in Surface Irrigation in Tamil Nadu.

### **Performance Audit on Outcomes in Surface Irrigation in Tamil Nadu**

Government of Tamil Nadu implemented Tamil Nadu Irrigated Agriculture Modernisation and Water-Bodies Restoration and Management Project, a multidisciplinary project with 85 *per cent* loan assistance from World Bank through Water Resources Department. The Performance Audit covered the major projects completed before 2015 and assessed the achievement during the period from 2015-16 to 2019-20 with measurable outcomes envisaged in the Detailed Project Reports. Performance Audit of the selected projects *viz.*, Amaravathy reservoir in Amaravathy sub-basin, Radhapuram channel in Hanumanadhi sub-basin and Kelavarapalli reservoir in Pennaiyar upto Krishnagiri sub-basin revealed the following:

- Absence of periodical capacity surveys by the Department led to non-ensuring adequate silt storage and retardation of sedimentation in the Reservoirs. Delay in sanction of desiltation works for removal of sedimentation resulted in non-harnessing of the realised surface water to an extent of 65.793 TMC in three reservoirs which affected the irrigation needs of the crop area of the sub-basins.
- The intended outcome envisaged for Amaravathi Reservoir *viz.*, increasing the conveyance efficiency of 20 *per cent* was only partially achieved even after incurring an expenditure of ₹ 74.99 crore on channel rehabilitation works. The conversion of gap area into fully irrigated area (22,095.17 ha) remained unachieved; and the actual irrigated area reduced during the period from 2015-16 to 2019-20 which was in the range of 12 to 57 *per cent* of the pre-project irrigated area. PWD failed to release water for irrigation from Amaravathi Reservoir either as per Regulations for release of water or on the basis of water requirement for the crops despite availability of sufficient water in years with good rainfall.
- The outcomes envisaged for Radhapuram Channel *viz.*, increased conveyance efficiency remained partially achieved during 2020 and for the balance years 2015-16 to 2018-19 it was not susceptible for verification due to absence of adequate documentation; and the outcome of conversion gap area of 2,183 ha into fully irrigated area remained unachieved. Inadequate assessment of availability of water in the source dams and delayed release of water from Radhapuram Channel due to non-receipt of Government orders also hindered the achievement of envisaged outcomes.

- The intended outcome of Kelavarapalli Reservoir *viz.*, conversion of gap area into fully irrigated area remained unachieved besides there was substantial reduction in the fully irrigated area after the implementation of the project. Failure of the department in framing the Rules of water regulations for the Kelavarapalli Reservoir even after 25 years of its completion resulted in release of water without assessing the irrigation requirements. Supply channel of Kelavarapalli Reservoir excavated to harness surface water to benefit 222 acres of agriculture land was not utilised for four years and the expenditure of ₹ 2.50 crore incurred remained unfruitful.
- There were gaps in maintenance of the rehabilitated water courses as the joint inspection conducted by the Audit along with Departmental official revealed encroachments, dumping of waste, weed formation on the water course, damages to the channel structures and illegal tapping of water using motors.
- Department failed to monitor the quality of irrigation water and there were instances of discharge of untreated sewage water into the water courses. There were gaps in undertaking Participatory Irrigation Management activities *viz.*, formation of Water Users Association, preparation of water budget and raising of crop for second season based on the water availability which hindered the achievement of envisaged outcomes of the project.

# **CHAPTER I**

## **INTRODUCTION**



# CHAPTER I INTRODUCTION

## 1.1 Introduction

Government of Tamil Nadu (GoTN) has been executing irrigation works with its own funds and funding assistance from Government of India (GOI), International Bank for Reconstruction and Development (World Bank), National Bank for Agriculture and Rural Development (NABARD), etc.

Tamil Nadu Irrigated Agriculture Modernisation and Water-Bodies Restoration and Management Project (TN-IAMWARM) is a multidisciplinary project with 85 *per cent* loan assistance from World Bank. Water Resources Department (WRD) of Public Works Department (PWD), Government of Tamil Nadu is the nodal agency for the implementation of the project. The project works were executed in the 63 selected sub-basins of the State to cover ayacut<sup>1</sup> area of 6.17 lakh ha from April 2007 onwards. The coordinating line Departments for TN-IAMWARM project are Agricultural Engineering Department, Tamil Nadu Agricultural University, Department of Agriculture, Department of Horticulture and Plantation Crops, Department of Agricultural Marketing and Agri-Business.

The project envisaged to measure the outcomes on the irrigation projects on the basis of following performance indicators:

- **Channel conveyance efficiency:** Conveyance efficiency is the ratio of quantity of water received in the tail end as compared to the quantum of water released from the canal. It is an important indicator to assess that the water released from the regulation point of the canal reaches the tail end of the supply channel *viz.*, fields.
- **Fully irrigated area:** Coverage of the pre-project non-irrigated areas (gap area) as irrigated area after implementation of the project.
- **Water regulation:** Comparison of water releases for irrigation with the actual demand based on requirements.
- **Water quality:** Quality of irrigation water with reference to the norms prescribed by the statutory organisations *viz.*, Central Pollution Control Board, Bureau of Indian Standards.
- **Participatory Irrigation:** Statutory obligation for farmers' participation in the management of irrigation systems and water regulations.
- **Storage loss:** The difference between designed capacity and capacity of utilisation due to accumulation of sediments in the reservoir over a period of time and it leads to underutilisation of the reservoir capacity.

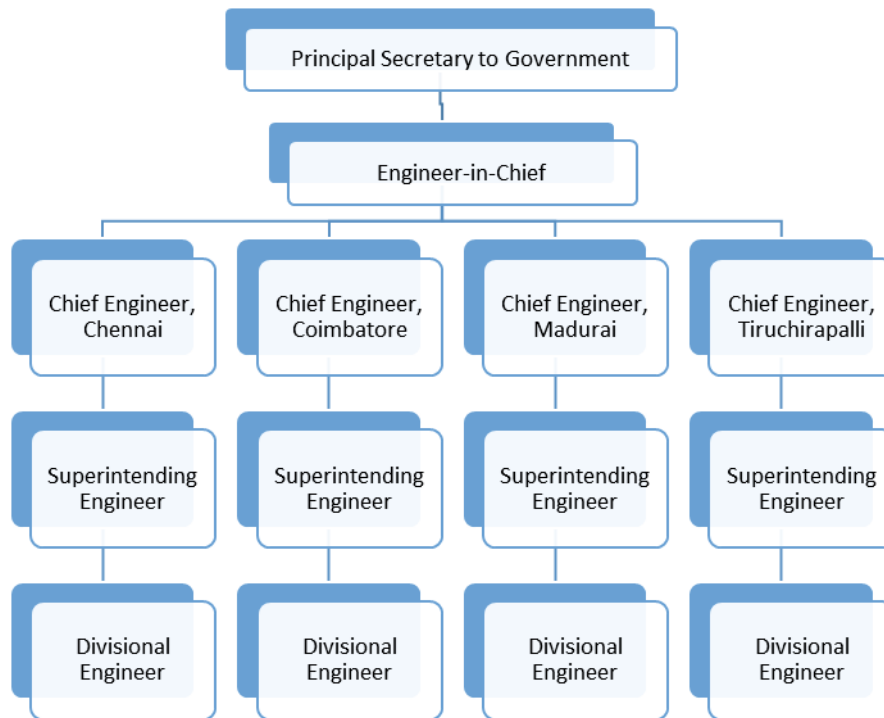
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<sup>1</sup> The area served by an irrigation project such as a canal, dam or a tank.

## 1.2. Organisational setup

Principal Secretary to Government is the administrative head of the PWD at Government level. WRD is divided into four<sup>2</sup> Regions based on river basin<sup>3</sup> framework. Engineer-in-Chief, WRD (EIC) is head of the Department who is assisted by Chief Engineers (CE) at Regional level, Superintending Engineers at Circle level and Executive Engineers at Divisional level. Organisational structure of Water Resources Department is depicted in **Chart 1**.

**Chart 1 – Organisation structure of Water Resources Department**



(Source: Details furnished by the Department)

## 1.3 Audit Objectives

Performance Audit was conducted to assess whether

- the Department harnessed the available surface water effectively and the outcomes *viz.*, improving the conveyance efficiency of channels and conversion of gap areas into irrigated areas as envisaged in the DPRs were achieved;
- the irrigation infrastructure was maintained effectively to ensure free flow of water for irrigation and adequate monitoring of the quality of water supplied for irrigation was undertaken in co-ordination with other departments; and
- the Water Users Associations were formed and functioning efficiently to benefit the farmers.

<sup>2</sup> Chennai, Coimbatore, Madurai and Tiruchirappalli.

<sup>3</sup> 34 rivers are grouped into 17 river basins and 127 sub-basins.



## 1.4 Audit Criteria

Audit criteria were sourced from

- Detailed Project Reports (DPRs) of TN-IAMWARM /Technical Sanctions of the work, Rules of Water Regulation, Government instructions/orders and Village G Returns<sup>4</sup> compiled by Economics and Statistics Department
- Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007, Indian Standard Guidelines for the Quality of Irrigation Water and Water Quality Criteria prescribed by Central Pollution Control Board
- Tamil Nadu Farmers Management of Irrigation System (TNFMIS) Act, 2000 and Rules 2002 thereunder

## 1.5 Scope and Methodology of Audit

In order to assess the actual achievement of the envisaged outcomes after implementation of the projects under TN-IAMWARM, the Performance Audit covered the major projects completed before 2015 and assessed the achievement during the period from 2015-16 to 2019-20 with measurable outcomes envisaged in the DPRs.

Audit selected the following six<sup>5</sup> out of 44 TN-IAMWARM projects completed before 2015 for assessment of outcomes envisaged in the DPRs based on surface water potential, gap area covered and expenditure incurred. In addition, two projects<sup>6</sup> with measurable outcomes which were completed in the same sub-basins with National Bank for Agriculture and Rural Development (NABARD) funding were also selected for detailed scrutiny.

The Department executed the works in the river channel, system tanks *viz.*, tanks which receive regulated supply of water from a river system and non-system tanks *viz.*, tanks which depend fully on the rainfall and these are not connected to any river system.

Audit noted that the non-system tanks of three<sup>7</sup> projects did not possess measuring devices to check and document the quantum of water received through rainfall, water utilisation through discharge, storage position, etc. by the field officials of WRD. In view of the above, the audit scrutiny was restricted to other three selected projects in sub-basins *viz.*, Amaravathi, Hanumanadhi and Pennaiyar upto Krishnagiri. The reservoir/channel selected in these three sub-basins and the basis of their selection are as follows:

- Out of 10 reservoirs in Amaravathi sub-basin, Amaravathi Reservoir alone had 42 *per cent* of total ayacuts of the sub-basin. Hence,

<sup>4</sup> G Returns are prepared for statistical purpose on village level data on land classifications, cropped area and source of irrigation. G Return comprises crop-wise extent of cultivated areas / irrigated areas with sources of irrigation in a village.

<sup>5</sup> Amaravathi, Kosathalayar, Girdhumal, Agniyar, Hanumanadhi and Pennaiyar upto Krishnagiri sub-basins.

<sup>6</sup> (i) Rehabilitation of Old Anicuts in Amaravathi River System and (ii) Excavation of a new supply channel to divert surplus water of Kelavarapalli Reservoir, with the NABARD loan assistance.

<sup>7</sup> Projects in sub-basins of Agniyar, Kosasthalaiyar and Girdhumal.

Amaravathi Reservoir was taken up for detailed audit in Amaravathi sub-basin.

- Out of four channel systems in Hanumanadhi sub-basin, Radhapuram channel system was taken up for detailed audit as it catered to 86 per cent of the ayacuts in the Hanumanadhi sub-basin.
- The Reservoir in Pennaiyar upto Krishnagiri sub-basin *i.e.*, Kelavarapalli Reservoir project which catered to 72 per cent of ayacuts of the sub-basin was taken up for detailed audit.

Due to Covid-19 pandemic, this Performance Audit was conducted in two spells during December 2019 to February 2020 and November 2020 to March 2021. Audit checked records at the Government Secretariat, Directorate of Agriculture, Office of Engineer-in-Chief, field offices of the Agriculture, WRD and Revenue Departments. Objectives of the selected projects were assessed through scrutiny of project documents, study reports, audit queries to the field officials.

Audit analysed the performance of the above selected projects on the basis of water regulations by the PWD, areas irrigated through surface irrigation<sup>8</sup> in their jurisdictions, crops cultivated as compiled in the G Returns of the Economics and Statistics Department. Audit also conducted the joint inspection of nine out of 19 channels in Amaravathi Reservoir system in Amaravathi sub-basin; the entire length of Radhapuram Channel in Hanumanadhi sub-basin; and 44 out of 48 km length of channels in Kelavarapalli Reservoir project in Pennaiyar upto Krishnagiri sub-basin with the officials of WRD to assess the effectiveness of water discharge through the reservoir/channels.

An Entry conference was held on 5 December 2019 with the Chief Secretary to Government and Principal Secretaries of the Public Works, Agriculture and Revenue departments wherein the audit scope, coverage, criteria and methodology were discussed. The Exit Conference was held on 2 July 2021 with the Additional Chief Secretary/Principal Secretary to Government, Public Works Department, Agriculture and Revenue departments wherein the observations were discussed. The views expressed at the meeting, the replies furnished by the Government were considered and duly incorporated in the relevant paragraphs of the Report.

## **1.6 Structure of the Report**

The Performance Audit Report has been structured on the basis of specific audit findings related to the three selected projects, *viz.*, Amaravathi Reservoir in Amaravathi sub-basin; Radhapuram Channel in Hanumanadhi sub-basin; and Kelavarapalli Reservoir in Pennaiyar upto Krishnagiri sub-basin as detailed below:

- Effectiveness of harnessing of surface water in three selected sub-basins (**Chapter II**);

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<sup>8</sup> Channels and tanks.

- Achievement of envisaged outcomes of
  - Amaravathi Reservoir in Amaravathi sub-basin (**Chapter III**);
  - Radhapuram Channel in Hanumanadhi sub-basin (**Chapter IV**);
  - Kelavarapalli Reservoir in Pennaiyar upto Krishnagiri sub-basin (**Chapter V**);
- Maintenance of the irrigation channels (**Chapter VI**); and
- Monitoring quality of irrigation water and functioning of Water Users Association (**Chapter VII**).

### **1.7 Acknowledgement**

We acknowledge the co-operation extended by WRD, Agriculture Department, Revenue Department, Economics and Statistics Department and other field officials in providing records and information for smooth conduct of Performance Audit.



## **CHAPTER II**

### **HARNESSING OF THE SURFACE WATER**





The department, prior to preparation of DPR for TN-IAMWARM project for Amaravathi Reservoir, conducted capacity survey during the years 2004 and 2009. The capacity survey (2009) of the Amaravathi Reservoir revealed that the current storage capacity as 94.54 Mcum as against 109.476 Mcum which was the original live storage capacity of the reservoir. The survey report highlighted that there was gross capacity loss of 13.64 *per cent* and annual loss of 0.27 *per cent* due to sediment deposition.

Based on the data on water utilisation for the period from 1996-97 to 2007-08 (till preparation of DPR of the project), it was noticed that the Department failed to store the water to the full original capacity of the reservoir for irrigation needs. DPR highlighted that there was surplus water in the range of 1.168 TMC to 10.434 TMC which was not harnessed for irrigation purpose in eight years<sup>9</sup> between 1996-97 to 2007-08. WRD failed to consider the guidelines of GOI in addressing the issues of sedimentation during the preparation of DPR. Audit noted that there was discharge of surplus water of 4.345 TMC for 31 days in 2015-16 and 8.852 TMC for 63 days in 2018-19 which was also not harnessed.

It is pertinent to note that GoTN sanctioned (September 2014) ₹ 1.50 crore for preparation of DPR for removal of sedimentation in the reservoir. DPR was prepared (September 2016) by a consultant<sup>10</sup> and the detailed estimate was submitted (January 2017) to Government. Based on the directions (August 2018) of the Government to examine execution of the work under Revenue model, the estimates were revised (April 2019) and forwarded to Government for administrative sanction. However, Government returned (December 2019) the proposal with an instruction to submit a revised proposal at an appropriate time. Revision of estimates was pending finalisation by the Department. Thus, due to delay in finalisation of estimates by Department and according to sanction by Government for removal of sedimentation, the full capacity of the reservoir could not be utilised despite incurring ₹ 0.63 crore for preparation of DPR.

Audit also noted from the Environmental and Social Monitoring and Impact Assessment Report (2014) of WRD that many parts of the Amaravathi sub-basin were drought prone, face over-exploitation of ground water resources and decline in agriculture due to limitations in water resources. Due to non-harnessing of surplus water of 4.345 TMC for 31 days in 2015-16 and 8.852 TMC for 63 days in 2018-19, Department failed to provide sufficient irrigation facilities to the drought prone areas of the sub-basin.

Government replied (October 2021) that a revised proposal at an estimated cost of ₹ 10.30 crore which estimated revenue generation of ₹ 290.00 crore had been sent in June 2021 for obtaining administrative sanction of the Government.

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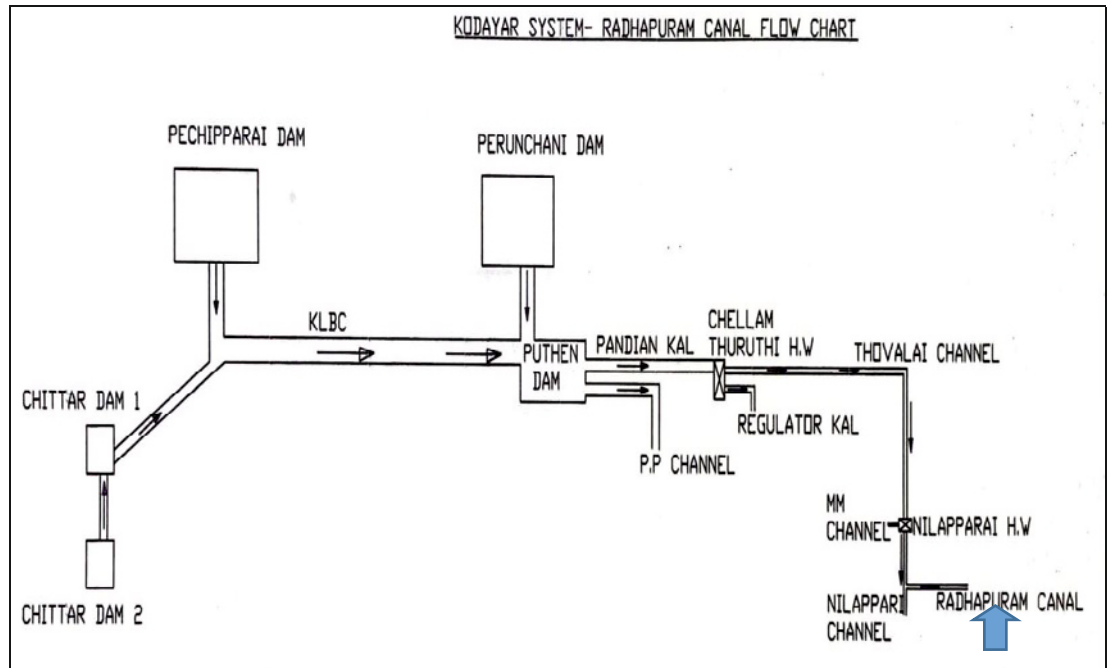
<sup>9</sup> 1996-97 to 2000-01; 2004-05, 2005-06 and 2007-08.

<sup>10</sup> M/s. Water and Power Consultancy Services (WAPCOS) Limited - A Government of India Undertaking, Ministry of Water Resources, River Development and Ganga Rejuvenation.



### 2.3 Radhapuram channel in Hanumanadhi sub-basin

#### RADHAPURAM CHANNEL



(Source: Details furnished by the Department)

The department conducted capacity survey during the years 2009 and 2013 in Pechiparai Reservoir which is the water source for Radhapuram channel in Hanumanadhi sub-basin. As per the capacity survey (2013) of Pechiparai Reservoir, the original capacity of 150.27 Mcum was reduced to 106.775 Mcum, (28.95 *per cent*) due to sedimentation. The survey report stipulates that the annual capacity loss at 0.69 *per cent*, which is graded as serious<sup>11</sup> as per the provisions of IS 12182 – 1987 and requires special care in estimating the sediment yields from the catchment.

Government sanctioned (September 2014) ₹ 1.45 crore for preparation of DPR to address the issues relating to sedimentation in the reservoir. After three years, DPR was prepared (August 2017) incurring an expenditure of ₹ 0.63 crore. Based on the DPR, PWD sought (April 2018) sanction for the work of desilting the Pechiparai Reservoir with an expenditure of ₹ 132.60 crore and the desilting work would also generate a revenue of ₹ 63.19 crore towards sale of desilted earth. Government returned (June 2018) the proposal with instructions to revise the proposal in revenue model without any expense to the State exchequer. Accordingly, WRD submitted (April 2019) revised proposal for ₹ 5.12 crore with a revenue generation of ₹ 95.60 crore. The clarifications sought for by the Government (June 2019) on statutory clearances, payment of compensation to Forest Department, etc., were yet to be furnished by WRD. Thus, despite sanction of funds for preparation of DPR, no decision had been taken in this regard, even after a lapse of seven years from sanction.

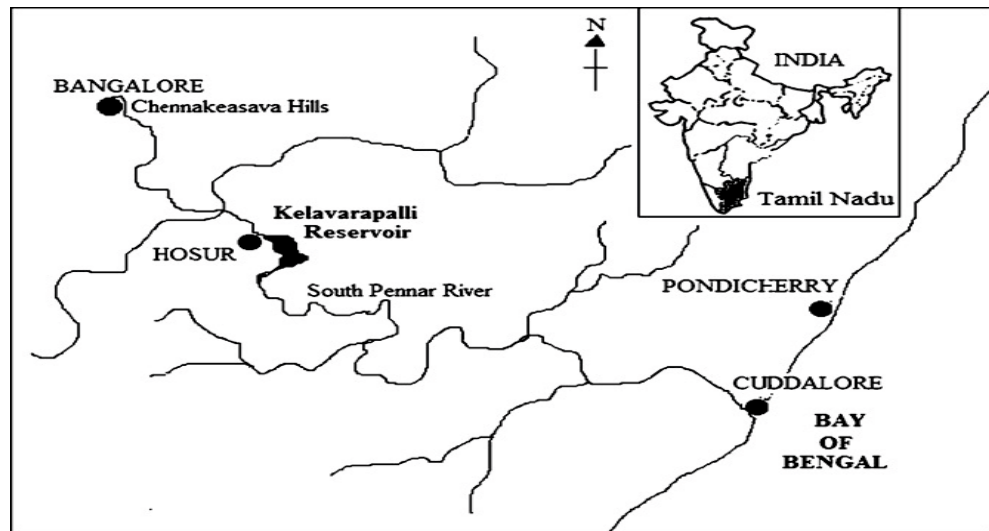
<sup>11</sup> Indian Standard IS: 12182-1987 – Guidelines for determination of effects of sedimentation in planning and performance of reservoirs.

Despite the Survey Report highlighting accumulation of sedimentation which resulted in reduction of the original capacity of reservoir by 29 per cent till 2013 and an additional 0.69 per cent every year, no fruitful initiative had been taken to fully harness the available surface water in the Pechiparai reservoir. Failure to consider the guidelines of GOI in addressing the issues of sedimentation during the preparation of DPR resulted in non-harnessing of surplus water of 9.336 TMC<sup>12</sup> for irrigation needs in three out of the five year period of 2015-20 and the surplus water was let into sea.

Thus, inadequate planning in preparation of DPR for the two projects viz., Amaravathi Reservoir in Amaravathi sub-basin and Radhapuram channel in Hanumanadhi sub-basin led to non-harnessing of the surface water for the benefits of the ayacuts despite incurring the expenditure of ₹ 1.26 crore towards preparation of DPR for desilting works.

#### 2.4 Kelavarapalli Reservoir in Pennaiyar upto Krishnagiri sub-basin

##### KELAVARAPALLI RESERVOIR



The Kelavarapalli Reservoir was constructed between 1993 and 1995. The Department did not conduct any capacity survey to assess the quantum of sedimentation in the Reservoir prior to the preparation of DPR for TN-IAMWARM project. DPR for the project prepared in 2008 stipulated that Kelavarapalli Reservoir was the only major reservoir located in Pennaiyar upto Krishnagiri sub-basin and there was huge sediment deposition in the reservoir due to which capacity of water flow had been considerably reduced. Despite the same, the first Capacity Survey Report was prepared in 2019 by the Institute of Hydraulic and Hydrology of WRD after a delay of 10 years from the preparation of DPR (2008). The Capacity Survey Report stated that the original capacity of 13.61 Mcum was reduced to 10.75 Mcum with a capacity loss of 21 per cent (2.86 Mcum) in the reservoir and an average annual capacity loss of one per cent. Scrutiny of departmental records also

<sup>12</sup> 2015-16 – 3,208 TMC; 2018-19 – 5,869 TMC and 2019-20 – 259 TMC. Total 9.336 TMC.

revealed that the surplus water was not harnessed for all the five years (2015-20) and the quantum of water which was not harnessed was 43.26 TMC<sup>13</sup>.

Thus, absence of periodical capacity surveys to assess and to address the sediment deposition issues in the reservoir and non-restoration of original capacity of the reservoir led to non-harnessing of surplus water and deprival of benefits to the extended ayacuts.

**Conclusion:**

Absence of periodical capacity surveys by the Department led to non-ensuring adequate silt storage and retardation of sedimentation in the Reservoirs. Delay in sanction of desiltation works for removal of sedimentation resulted in non-harnessing of the realised surface water to an extent of 65.793 TMC in three reservoirs which affected the irrigation needs of the crop area of the sub-basins.

**Recommendations:**

The Government may:

- Conduct periodical capacity surveys to assess the extent of sedimentation in the reservoirs to ensure adequate silt storage.
- Prioritise sanction of desiltation works for removal of sedimentation to retain the original capacity of the reservoir and to utilise the available water without wastage.

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<sup>13</sup> 2015-16 - 8.817 TMC; 2016-17 – 0.979 TMC; 2017-18 – 13.204 TMC; 2018-19 – 10.119 TMC; and 2019-20 – 10.141 TMC. Total 43.26 TMC.



## CHAPTER III

### AMARAVATHI RESERVOIR







## CHAPTER III

### MEASURABLE OUTCOMES OF AMARAVATHI RESERVOIR

#### 3.1 Introduction

The river Amaravathi which originates in the western slopes of Munnar hills of Kerala and traverses a length of about 220 Km. Amaravathi Reservoir was constructed (1958) across the Amaravathi River with the capacity of 4,047 Mcft. Amaravathi Reservoir has two irrigation systems viz., (i) Amaravathi Old Channels (AOC) with 18<sup>14</sup> irrigation earthen channels<sup>15</sup> which originated from 16 anicuts<sup>16</sup>, with a total length of 263 km; (ii) Amaravathi Main Channel (AMC), which is a lined channel with impervious layer at the bed and sides, on the left bank of Amaravathi River with 22 distributaries, traverses to a length of 63 km and water regulated through sluices at various reaches.

#### 3.2 Outcomes envisaged in Amaravathi Reservoir

Detailed Project Report of Amaravathi reservoir in Amaravathi sub-basin (2010-11) envisaged the following measurable outcomes of the project:

- To increase conveyance efficiency by about 20 per cent
- Conversion of the partially irrigated/gap area as fully irrigated area
- Increase in additional cultivation area during second crop season by about 2,520 ha.

#### 3.3 Achievement of conveyance efficiency

As per Guidelines (2010) for Preparation of Detailed Project Reports of Irrigation and Multipurpose Projects<sup>17</sup> of GOI, value of conveyance efficiency had to be indicated with the basis thereof, in the DPR.

DPR for Amaravathi Reservoir in Amaravathi sub-basin prepared (2010-11) by WRD did not specify the existing conveyance efficiency of the channels. DPR envisaged an increase in conveyance efficiency of about 20 per cent after the completion of project.

Department incurred an expenditure of ₹ 74.99 crore during 2013-15 on channel rehabilitation works under TN-IAMWARM for increasing the conveyance efficiency and increasing the irrigated area as contemplated in the DPR. In addition, Department incurred an expenditure of ₹ 9.72 crore towards maintenance of these channels during 2015-19.

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<sup>14</sup> 1. Ramakulam channel; 2. Kallapuram channel; 3. Komaralingam channel; 4. Sarkar Kannadiputhur channel; 5. Sholamadevi channel; 6. Kadathur channel; 7. Kaniyur channel; 8. Karatholuvu channel; 9. Alangium channel; 10. Dhalavaipattinam channel; 11. Dharapuram channel; 12. Kolinjivadi channel; 13. Nanjaithalayur channel; 14. Chinna Dharapuram channel; 15. Sundakkampalayam channel; 16. Nanjakkalakurichi channel; 17. Left Bank channel and 18. Right Bank channel.

<sup>15</sup> An artificial irrigation structure which is dug in the ground and the banks are formed from the removed earth to carry water.

<sup>16</sup> An anicut is a masonry check dam that is constructed across a stream to impound water for maintaining and regulating irrigation.

<sup>17</sup> Part III –Section – 1 – Sl. No. 5, 19.

Audit obtained the conveyance efficiency at the time of preparation of DPR from the Department and compared it with the actual conveyance efficiency after the completion of the project viz., for the four year period from 2015-19 as the Department did not furnish these details for 2019-20. The channel-wise percentage of increase in conveyance efficiency during the period from 2015-16 to 2018-19 is detailed in **Annexure I**.

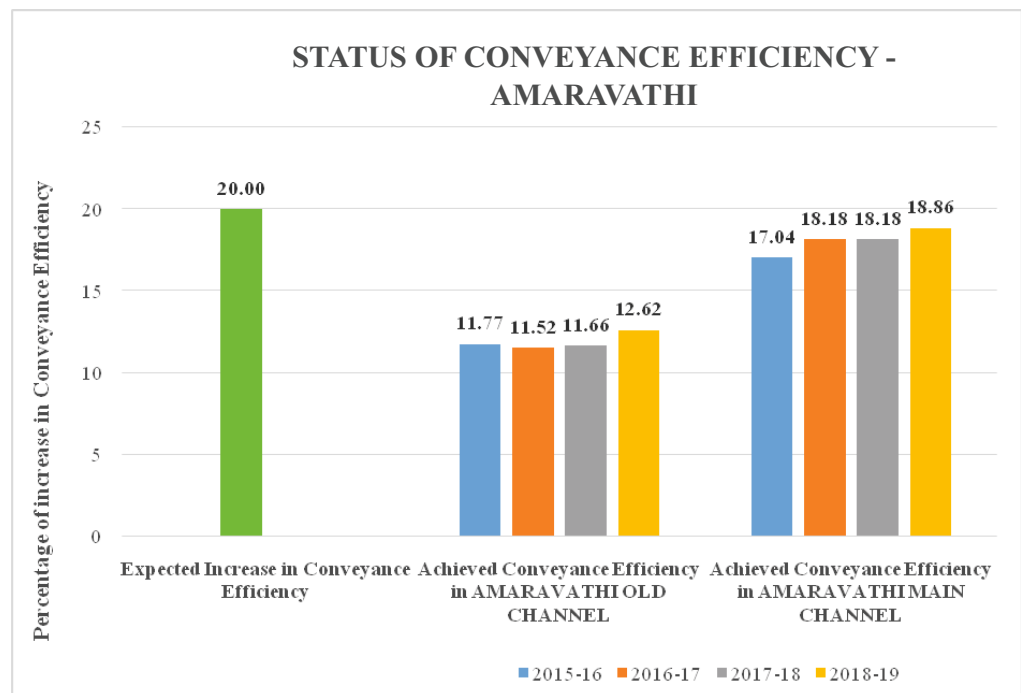
It is seen from the **Annexure - I** that:

- The conveyance efficiency was not achieved in 18 out of 19 channels during the four year period of 2015-19.
- As against the target of 20 *per cent* increase in conveyance efficiency, the increase in conveyance efficiency ranged between 6.34 and 18.75 *per cent* in the earthen channels. However, Sundakkampalayam channel achieved conveyance efficiency of 20.83, 20 and 23.33 during 2015-16, 2017-18 and 2018-19 respectively.
- The conveyance efficiency was less than 10 *per cent* in eight out of 19 channels atleast in three out of four years.
- The achievement in the lined channel of AMC ranged between 17.04 to 18.86 *per cent* during 2015 to 2019.

Audit noted that the channels which had been rehabilitated utilising the TN-IAMWARM funds were not maintained properly leading to non-achievement of the targeted conveyance efficiency as discussed in **Paragraph 6.2.1**.

Average increase of conveyance efficiency in Amaravathi old channel (earthen channel) and Amaravathi Main Channel (lined channel) against the expected outcome during 2015-16 to 2018-19 is represented in **Chart 2**.

**Chart 2: Status of conveyance efficiency**



(Source: Details furnished by the Department)



Thus, the intended outcome of increasing the conveyance efficiency of 20 *per cent* was only partially achieved even after incurring an expenditure of ₹ 74.99 crore on channel rehabilitation works under TN-IAMWARM and ₹ 9.72 crore under maintenance works during 2015-16 to 2018-19.

When pointed out (October 2020), Department did not furnish the reason for the shortfall in achievement, although during Exit Conference (July 2021), Departmental officials stated that the conveyance efficiency was achieved without any documentation in support of the claim. However, ACS, in the Exit Meeting accepted the importance of adequate documentation and assured of immediate corrective action.

Government replied (October 2021) that the conveyance efficiency has increased considerably after implementation of the project. The reply is not tenable as the increase of 20 *per cent* conveyance efficiency was achieved only in one out of 19 channel (five *per cent*) and the increase was less than 10 *per cent* in 42 *per cent* of channels.

### 3.4 Non-conversion of gap area as fully irrigated area

Section 3 of TNFMIS Act, 2000 and Rule 3 of TNFMIS Rules, 2002 stipulate that Water Users Association (WUA) shall be formed for a specified area. WUAs shall regulate water supply among farmers and prepare water budget<sup>18</sup> based on the cropping pattern. In all, 45 WUAs were functioning to regulate water supply among farmers in the Amaravathi irrigation system. Rules of water regulation (1982) for Amaravathi Reservoir determined the total annual water requirement for the Amaravathi River system as 19.919<sup>19</sup> TMC.

The total ayacuts of Amaravathi River system (Amaravathi Main Channel and Amaravathi Old Channel) was not fully irrigated due to structural and operation deficiencies *viz.*, damages in bed and linings, sluices etc., due to this, the Department could not effectively regulate the water in a systematic manner. Hence, rehabilitation works were undertaken through TN-IAMWARM project to increase the irrigated area. **Table 2** shows the details of fully irrigated, partially irrigated and gap areas before implementation of TN-IAMWARM and the proposed irrigated area after implementation of the project for the ayacuts of Amaravathi River system (AMC and AOC).

**Table 2: Ayacuts in Amaravathi River system**

Sl. No.	System	Ayacuts prior to the implementation of the project (percentage with respect to total)				Proposed irrigated area after implementation of the project
		Fully irrigated	Partially irrigated	Gap area	Total	
1	AMC	7,048.32 (69)	2,181.03 (21)	988.93 (10)	10,218.28	10,218.28
2	AOC	9,156.35 (77)	1,642.39 (13)	1,078.15 (10)	11,876.89	11,876.89
<b>TOTAL</b>		<b>16,204.67</b>	<b>3,823.42</b>	<b>2,067.08</b>	<b>22,095.17</b>	<b>22,095.17</b>

(Source: Details available in the DPR)

<sup>18</sup> Working out the water allocation to the farmers on the basis of existing water availability in the reservoir and the anticipated inflows.

<sup>19</sup> 15.307 TMC to AOC and 4.612 TMC to AMC.

Audit noted that the conversion of gap area / partially irrigated area into fully irrigated area would depend on the effective regulation of water in the channels by the field officials of the Department.

Audit obtained the actual area irrigated through the two channels of the Amaravathi River system from the Department of Economics and Statistics of GoTN. **Table 3** depicts the actual area irrigated through AOC and AMC channels during the period from 2015-16 to 2019-20.

**Table 3: Area irrigated through channel**

Registered Ayacut (In ha)	Actual irrigated area after implementation (In ha)				
	2015-16	2016-17	2017-18	2018-19	2019-20
22,095.17	14,222.54	6,922.33	10,385.24	10,628.51	12,765.80
Percentage to the registered Ayacut	64	31	46	48	58
Percentage of shortfall in irrigated area	36	69	54	52	42

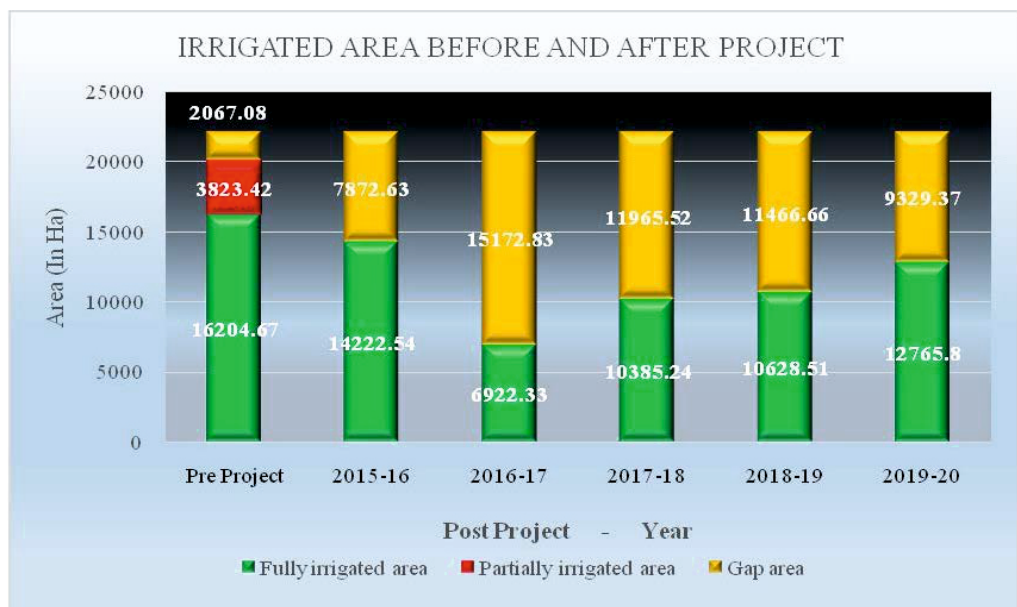
(Details furnished by the Department of Economics and Statistics)

The details in **Table 3**, shows that the achievement of fully irrigated area ranged between 31 and 64 *per cent* of the total registered ayacut of Amaravathi river system.

The envisaged outcome of conversion of gap area / partially irrigated area into fully irrigated area remained unachieved even after five years from the implementation of the project.

Futher, the **Chart 3** exhibits the status of irrigated area and gap area in the Amaravathy irrigation system prior to the implementation of the TN-IAMWARM project and the actual achievement after the implementation of the project.

**Chart 3: Pre implementation Vs Post implementation**



(Source : Details furnished by WRD)

Audit noted that the actual irrigated area reduced during the period from 2015-16 to 2019-20 which was in the range of 12 to 57 *per cent* of the pre-project irrigated area.

Thus, the conversion of gap area into fully irrigated area (22,095.17 ha) remained unachieved.

There were gaps in release and regulation of water by the field officials of the Department from the Amaravathi reservoir which were detailed in the subsequent paragraphs:

### 3.4.1 Regulation of water in Reservoir

The details of total water requirement as per the Rules for regulation of water for Amaravathi river system, the actual availability of water for irrigation in the reservoir, actual release of water for irrigation and water requirement for the cropping pattern for the period from 2015-16 to 2019-20 are given in **Table 4**.

**Table 4: Non-release of water despite availability** (in Mcft)

Year	Water requirement as per Regulation	Water available for irrigation <sup>20</sup>	Water actually released (percentage to water availability)	Crop Water Requirements*	Actual requirement of water for the crops cultivated based on net realisation** ( <i>Per cent</i> over actually released)
2015-16	19,919	19,835	8,475 (43)	11,580	21,849 (39)
2016-17	19,919	5,906	2,141 (36)	9,532	17,985 (12)
2017-18	19,919	10,620	5,384 (51)	9,406	17,747 (30)
2018-19	19,919	21,236	8,602 (41)	10,484	19,781 (43)
2019-20	19,919	13,239	7,898 (60)	9,701	18,304 (43)

\*Crop water requirement of the year was consolidated from G returns prepared by Economics and Statistics Department.

\*\*DPR envisaged realisation of water in the field at 53 *per cent* of the water released from the reservoir

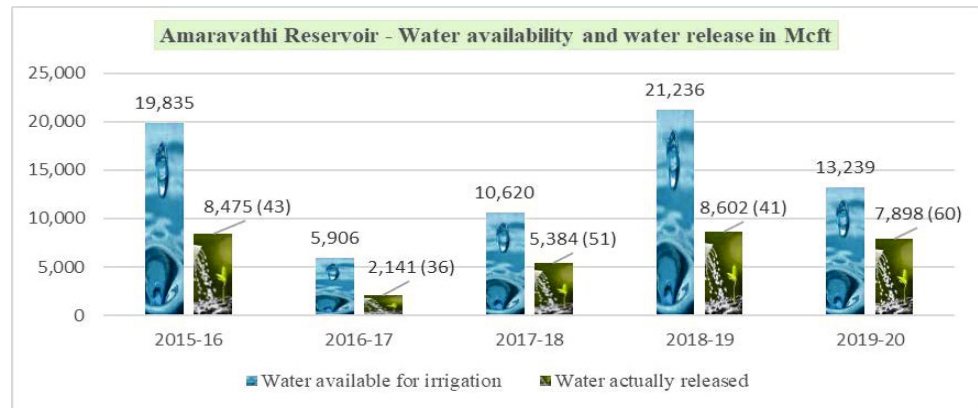
(Source: Details furnished by WRD)

It may be seen from the above that:

- Despite availability of water in the reservoir, the actual percentage of water released for irrigation ranged between 36 and 60 *per cent* and the actual realisation of water for the irrigated crops (after considering loss of water through seepage, evaporation etc.) was between 12 and 43 *per cent* of the water requirement.
- Though the water availability in the reservoir during the years 2015-16 and 2018-19 was almost equal to the total requirement of water as stipulated in the Regulations for release of water, Department released only 43 and 41 *per cent* of the available water for irrigation during these two years as shown in **Chart 4**.

<sup>20</sup> Water available at the beginning of the month was consolidated, after adjusting the dead storage, for the purpose of comparison.

**Chart 4: Water availability and water release**



(Source: Details furnished by WRD)

Thus, PWD failed to release water for irrigation either as per Regulations for release of water or on the basis of water requirement for the actually cultivated crops despite availability of sufficient water (2015-16 and 2018-19) in years with good rainfall.

Government stated (October 2021) that the water release to the ayacuts were reduced during the period of rainfall (2015-16 and 2018-19) and sufficient quantity of water has been released to the crops during the entire period of crop season. The reply is not tenable as the irrigation to the gap areas during these two years ranged between 48 and 64 *per cent* of the target.

### 3.4.2 Short release of water from the reservoir

WRD is responsible for regulation of water to the ayacuts of the Reservoir based on the water budget prepared by the WUAs. WRD is also the competent authority to assist the WUAs for preparation of water budget as per Section 26 of TNFMIS Act, 2000 and Rule 23 of TNFMIS Rules, 2002 made thereunder. The quantum and periodicity of water released from the reservoirs was determined by the Government based on the proposals from the field officials of WRD.

Audit noted that the proposals for release of water from the reservoir were finalised by the field offices based on storage position and anticipatory water inflow to the reservoir. The water requirement for the ayacut area was not considered by the Department while finalising the proposals. The proposals also did not highlight the actual water requirement for the ayacuts based on the water budget prepared by the WUAs.

A comparison of the actual water release with the total water requirement as envisaged in the Rules II (1,2) and III (1) of Rules for regulation of water for the Amaravathi river system during the audit period is detailed in the **Table 5**.

**Table 5: Water requirement and water release in Amaravathi Reservoir**

Year	AOC (water requirement 15.307 TMC)		AMC (water requirement 4.612 TMC)		TOTAL (water requirement 19.919 TMC)	
	Water released (TMC)	Percentage	Water released (TMC)	Percentage	Water released (TMC)	Percentage
2015-16	5.425	35	3.050	66	8.475	43
2016-17	1.574	10	0.567	12	2.141	11
2017-18	4.172	27	1.212	26	5.384	27
2018-19	6.023	39	2.579	56	8.602	43
2019-20	5.866	38	2.032	44	7.898	40

(Source: Details furnished by WRD)

It may be seen that the Department could release 11 to 43 *per cent* of the total water requirement for irrigating the ayacuts as envisaged in the Rules for regulation of water for Amaravathi river system during the period from 2015-16 to 2019-20. This resulted in non-achievement of the envisaged outcome of conversion of gap area into irrigated area as already discussed in **Paragraph 3.4**.

On being pointed out, WRD replied (February 2021) that during years with good rainfall, the water had been effectively regulated in accordance with the requirements of crops sown in the ayacuts and during the drought period the water was released to safeguard the standing crops. The reply is not tenable for the reason that, despite having good rainfall during the years 2015-16 and 2018-19, the Department did not regulate water in accordance with the Rules for Water Regulation even during these two years with good rainfall. The ineffective regulation of water in Reservoir is already discussed in **Paragraph 3.4.1**.

ACS in the Exit conference (July 2021) stated that development of integrated Water Resources Management System is in progress and assured that the system would be in place in two to three years.

Government accepted (October 2021) that the Compendium of Rules for Water Regulation was last revised in 1984 and the same was required to be revised.

### 3.4.3 Inequitable distribution of water

Rule 24 of TNFMIS Rules, 2002 envisages that equitable distribution of water amongst all users shall be the main principle in water regulation. Regulation of water from the reservoir through anicuts to the supply channels for irrigation is the responsibility of the field officials of WRD.

Audit observed that the Department rehabilitated damaged 13<sup>21</sup> out of 18 anicuts including leading channels in Amaravathi River system to ensure equitable distribution of available water upto the tail end during the year 2013 by incurring an expenditure of ₹ 19.48 crore with NABARD loan assistance.

<sup>21</sup> 1. Kumaralingam 2. Sarkarkannadipudur, 3. Solamadevi, 4. Kaniyur 5. Kadathur, 6. Karatholuvu 7. Alangium 8. Dhalavaipattinam 9. Dharapuram 10. Kolinjivadi 11. Chinnadharapuram 12. Nanjaikalaikurichi 13. Pallalalayam anicuts.

The release of water from the 18 anicuts of the Amaravathi river system for the four year period<sup>22</sup> is detailed in **Annexure II**.

From the details in the Annexure, audit noted that the release of water was not proportionate to the irrigated area as detailed below:

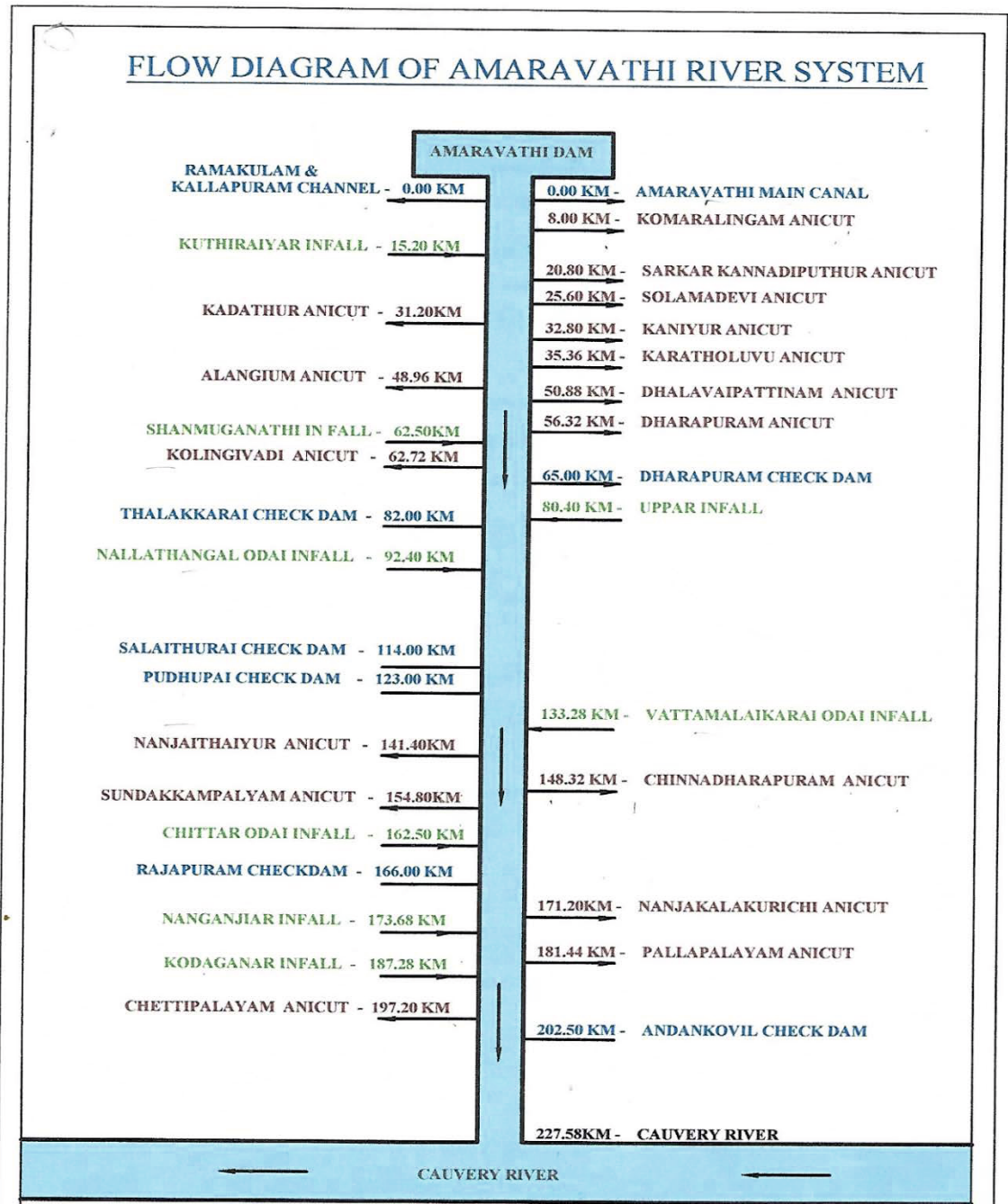
- The water released in Ramakulam channel was 0.125 TMC to irrigate 560.32 ha whereas, 0.465 TMC was released to irrigate 474.08 ha in Kadathur channel during 2014-15. The release of water was ranged between 30 and 133 *per cent* during 2014-15. Similarly, the water released in Ramakulam channel was 0.111 TMC for the irrigated area of 560.32 ha but, 0.144 TMC was released to irrigate 160.30 ha in Nanjaikalakurichi channel during 2018-19. The release of water was disproportionate to the ayacut area in these 18 channels as it ranged from 29 to 132 *per cent* during 2018-19.
- The water is released through regulated mechanism by the Department into the channels/ Anicuts for irrigation. The quantum of water released during 2014-15 to 2018-19 was lesser in the head channels *viz.*, Ramakulam and Kallapuram Anicuts (ranged between 29 and 67 *per cent*) as compared to water released in the central portions of the channel (ranged between 68 and 225 *per cent*) and tail end channels *viz.*, Chettipalayam and Pallapalayam (ranged between 84 and 113 *per cent*). The flow diagram of the Amaravathi River system is shown in **Figure 1**.

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<sup>22</sup> During 2016-17 the Department did not release water in 10 channels and hence the same was not considered. Four year period from 2014-15 to 2018-19 (except 2016-17)



Figure 1 Flow diagram of the Amaravathi River system



- Despite execution of rehabilitation works after incurring an expenditure of ₹ 19.48 crore, due to non-release of water proportionately to the irrigated area by the field officials, the equitable distribution of water was not achieved.

Thus, Department failed to adhere to the provisions of the TNFMIS Rules and to ensure equitable distribution of water in all reaches of the channel despite rehabilitating the damaged anicuts incurring an expenditure of ₹ 19.48 crore.

Government replied (October 2021) that the distribution of water in the Amaravathi River system was made on the basis of ayacut of the respective channel, local rainfall and crop water requirement. The reply is not tenable as

the release of water was disproportionate to the ayacut area. Further, the restoration of 13 out of 18 anicuts were undertaken to ensure equitable distribution which remained unachieved.

### 3.5 Non-achievement of additional cultivation during second crop season

DPR for the project envisaged a measurable outcome of increase in additional cultivation area during second crop season by about 2,520 ha. Rules for regulation of water for Amaravathi Reservoir (1982) detailed the month-wise water requirement for irrigation of additional crops in the registered ayacuts catered by the Reservoir.

As per Government instructions<sup>23</sup> (April 1985), section officer of WRD should maintain an ayacut register of the irrigation system in their jurisdiction. The Section officers are required to ascertain and record the details of fields which have not been irrigated in a particular crop period. The officer is also authorised to cross verify the cultivation records with the village records and to bring the discrepancies to the notice of the Revenue authorities for rectification.

Economics and Statistics Department of GoTN compiles the village G-returns every year based on the inputs received from the Revenue Department, Agriculture Department and Public Works Department. The G-returns provide the villagewise-data relating to the irrigated area in the first and second crop seasons.

Analysis of the data pertaining to water requirement as per Regulations, actual water available, actual water released for irrigation during the second season (October to March) and irrigated area in the second season as compiled in the G-returns for the period 2015-16 to 2019-20 revealed the following:

**Table 6: Details regarding release of water against the storage**

(In Mcft)

Year	Water requirement as per Regulations	Water available for irrigation for second season	Actually released (Percentage with respect to requirement)	Irrigated area in the second season (ha)
2015-16	11,434	12,443	4,152 (36)	1,215
2016-17	11,434	2,152	370 (3)	5
2017-18	11,434	7,567	5,339 (47)	7
2018-19	11,434	12,190	6,105 (53)	29
2019-20	11,434	9,566	6,504 (57)	0

(Source: Details furnished by WRD and data available in G>Returns)

It is seen from the above that:

- As against the envisaged outcome of additional cultivation area of 2,520 ha during the second crop season, the actual achievement was about 50 per cent (1,215 ha) during 2015-16 and thereafter the

<sup>23</sup> G.O.Ms.No. 593 of Revenue Department, dated 16.4.1985.



irrigated area in the second season was negligible *i.e.*, less than one *per cent* of planned additional cultivation area.

- Despite release of 11,814 Mcft by WRD, the actual irrigated area during second season for the three year period of 2016-17 to 2018-19 ranged between 05 ha and 29 ha, as against the envisaged target area of 2,520 ha every year. In respect of the year 2019-20, the G>Returns compiled by Economics and Statistics Department indicated that no area was irrigated during second season. Thus, 6,504 Mcft of water released by WRD during 2019-20, was not put to any effective use. There was huge variation in the quantum of water released and area irrigated during the second season during 2016-17 to 2019-20.
- The field officials failed to share the status on water availability with the farmers to encourage raising of crops during the second season indicating systemic lapses in management of release of water for irrigation activities.

Thus, the quantum of water released and the cultivation of second crop revealed that the released quantum of water was not effectively utilised during the years 2016-17 to 2019-20. The envisaged outcome of increasing the additional cultivation area during the second season was not achieved despite availability and release of water.

The Additional Chief Secretary, in the Exit Conference (July 2021), accepting the audit observation also instructed the WRD officials for maintaining parallel data about the irrigated area in the first and second crop season.

Government replied (October 2021) that the water had been released from reservoir for second crop season as per the crop water requirements during the five years covered in the audit. The reply is not tenable as the field officials failed to encourage the farmers to cultivate their crops during second season based on the water availability and release.

### **3.6 Agriculture productivity**

TN-IAMWARM Project Appraisal Document emphasised to increase the irrigated agriculture productivity in a sustainable water resources management framework. In pursuit of this objective, the project supported investments in improving irrigation service delivery.

DPR of Agriculture Department pertaining to Amaravathi sub-basin was prepared in 2011 for the project at a cost of ₹ 7.67 crore which aimed at increasing income of the farmers per unit of irrigation water and land. DPR envisaged diversification of low profit high water crops to high profit, low water crops, especially to commercial crops by gap area coverage with irrigated crop especially commercial crops besides adoption of latest production technologies through demonstration. The increase in productivity was aimed for six major crops *viz.*, paddy, maize, cholam, pulses, groundnut and sugarcane.

The details regarding the targeted increase and actual achievement of productivity of the six major crops during the period 2015-16 to 2019-20 are shown in **Table 7**.

**Table 7: Target and Achievement of productivity of major crops**

(in MT/Ha)

Crop	Actuals before implementation of project in 2010-11	Target after implementation of project	Actuals after implementation of the project				
			2015-16	2016-17	2017-18	2018-19	2019-20
Paddy	4.690	6.370	5.254 (-18)	3.502 (-45)	5.425 (-15)	5.153 (-19)	6.019 (-6)
Maize	2.450	4.100	7.664 (87)	6.732 (64)	6.993 (71)	8.254 (101)	8.377 (104)
Cholam	1.250	2.000	0.481 (-76)	0.378 (-81)	0.509 (-75)	0.837 (-58)	0.776 (-61)
Pulses	0.510	0.650	0.449 (-31)	0.143 (-78)	0.479 (-26)	0.589 (-9)	0.401 (-38)
Groundnut	1.570	2.000	2.773 (39)	2.700 (35)	3.303 (65)	2.257 (13)	2.708 (35)
Sugarcane	105	120	114 (-5)	95 (-21)	96 (-20)	117 (-3)	98 (-18)

(figures in bracket indicate the percentage of achievement)

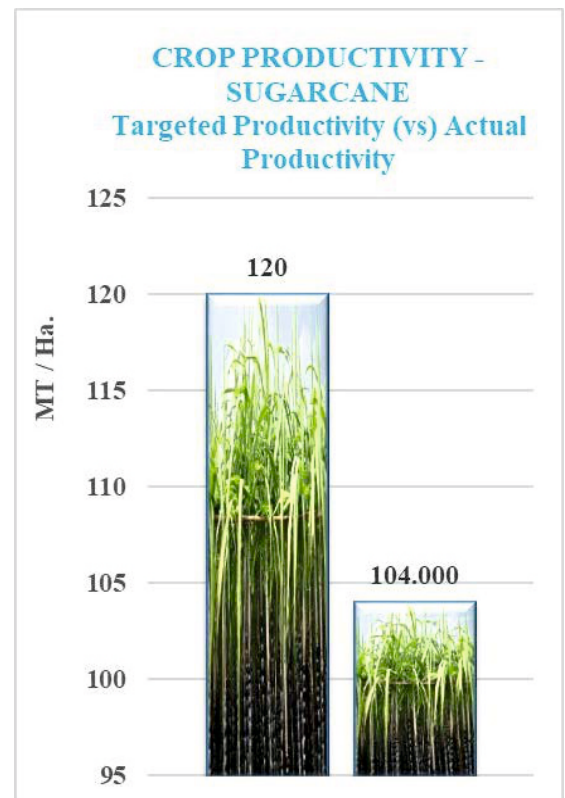
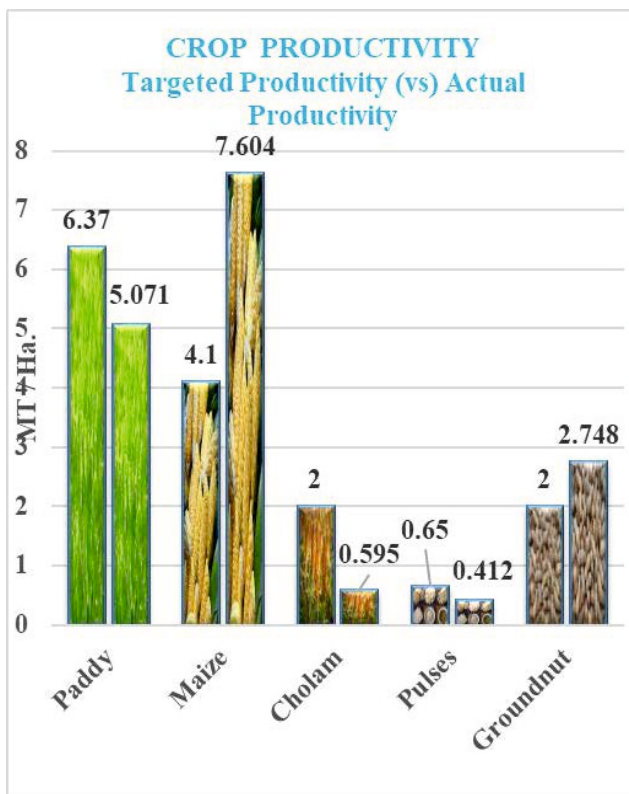
(Source: Details furnished by WRD)

It could be seen from the table that:

- After the implementation of the project, the increase in the productivity was partially achieved in two crops viz., maize and groundnut and not achieved in four out of six major crops during the period from 2015-16 to 2019-20.
- In fact, the productivity after the implementation of the project was less than that of the actuals prior to implementation of project in two crops viz., cholam (during the five-year period) and pulses (during 2015-16 to 2017-18 and 2019-20).

The average of achievement of productivity as against the targets of six major crops during the period from 2015-16 to 2019-20 is shown in **Chart 5**.

**Chart 5: Achievement of productivity**



(Source: Details furnished by the Agriculture Department)

Audit noted that non-achievement of the proposed gap area conversion as discussed in **Paragraph 3.4**, due to inadequate release of water was one of the reasons for non-achievement of the envisaged productivity for the identified commercial crops.

Government accepted the shortfall in productivity (October 2021) and stated that the non-achievement of additional cultivation during second crop season as the reason for shortfall.

Thus, inefficient water management despite rehabilitation works to ensure irrigation service delivery, as discussed in previous paragraphs, resulted in non-achievement of the envisaged outcome of increased agriculture productivity thereby increasing the income of farmers as envisaged in the DPR of the project.

**Conclusion:**

The intended outcome envisaged for Amaravathi Reservoir viz., increasing the conveyance efficiency of 20 *per cent* was only partially achieved even after incurring an expenditure of ₹ 74.99 crore on channel rehabilitation works. The conversion of gap area into fully irrigated area (22,095.17 ha) remained unachieved; and the actual irrigated area reduced during the period from 2015-16 to 2019-20 which was in the range of 12 to 57 *per cent* of the pre-project irrigated area. PWD failed to release water for irrigation from Amaravathi Reservoir either as per Regulations for release of water or on the basis of water requirement for the crops despite availability of sufficient water in years with good rainfall.

**Recommendations:**

The Government may:

- Formulate and update the Rules for regulation of water for irrigation systems to ensure release of water based on the availability and crop area cultivation.
- Development of integrated Water Resources Management System may be completed promptly to ensure effective utilisation of available water for irrigation needs.
- Take efforts to bridge the gap between the irrigation potential created and actually utilised by focusing on conversion of gap areas and partially irrigated areas into fully irrigated areas.





## CHAPTER IV

### RADHAPURAM CHANNEL

#### PECHIPARAI DAM



#### PERUNCHANI DAM





## CHAPTER IV MEASURABLE OUTCOMES OF RADHAPURAM CHANNEL

### 4.1 Introduction

The Chittar Pattanamkal scheme was devised<sup>24</sup> to harness surplus water in the Kodayar system to irrigate the ayacuts and to cover 6,882.6 ha in the Radhapuram area of Tirunelveli district. For this purpose, the reservoir levels of Pechiparai and Perunchani reservoirs were raised to increase their storage capacity. The existing channels were strengthened and lined to lead to a new channel (Radhapuram Channel) into the drought prone Radhapuram area.

Radhapuram channel of 28/800 Km length, excavated during 1970 in Tirunelveli district is an extension of old Thoivalai channel under Kodayar system in Kanyakumari district. The Radhapuram channel starts from Pechiparai reservoir (Kodayar left bank channel) in Kanyakumari district. Thoivalai channel from Perunchani dam joins the Kodayar left bank channel in Tirunelveli district, is called Radhapuram Channel. Thus, the source for the Radhapuram channel is both from Pechiparai and Perunchani dams.

### 4.2 Outcome envisaged in Radhapuram channel

Detailed Project Report (DPR) was prepared during 2008-09. DPR envisaged that the total water potential of the sub-basin covered by Radhapuram channel as 96.58<sup>25</sup> Mcum. It was also stated that the conveyor system of the channel was sub-standard due to the damaged condition of the anicuts, diversion head works, supply channels, etc. Hence, it was proposed to improve and modernise the irrigation infrastructures through TN-IAMWARM project thereby increasing the irrigation water demand under WRD sources from 53.93 Mcum to 69.56 Mcum.

DPR envisaged the following measurable outcomes:

- To increase conveyance efficiency from 42 to 53 *per cent*
- Conversion of the partially irrigated/gap area as fully irrigated area

### 4.3 Non-achievement of expected conveyance efficiency

The DPR of the project contemplated that the improvement and modernisation of irrigation infrastructures would improve the conveyance efficiency from 42 to 53 *per cent*. The DPR was incomplete since, it did not include the basis for calculation of the existing conveyance efficiency of 42 *per cent* with details of water flow from the head works to tail end, etc.

WRD did not furnish either the details of calculation of conveyance efficiency or the records relating to the calculation of conveyance efficiency after the completion of the project. WRD stated (March 2021) that conveyance efficiency had increased from 42 to 48 *per cent* during 2020 and no data relating to the period from 2015-16 to 2018-19 was furnished to audit.

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<sup>24</sup> During third five year plan period 1961-62 to 1965-66.

<sup>25</sup> Surface water – 58.81 Mcum and ground water – 37.77 Mcum.

As against the envisaged outcome on the targeted increase in conveyance efficiency by 11 per cent, the achievement was 06 per cent during 2020. The achievement for the period 2015-16 to 2018-19 could not be ascertained due to absence of documentation on conveyance efficiency. Thus, the intended outcome of the project remained partially achieved during 2020 and for the balance years 2015-16 to 2018-19 it was not susceptible for verification, despite incurring an expenditure of ₹ three crore towards improvement and modernization of irrigation infrastructures besides maintenance cost of ₹ 0.40 crore during 2015-16 to 2019-20.

A joint inspection conducted (March 2021) in entire length of Radhapuram channel by the Audit along with the officials of the WRD also revealed water seepages, unauthorised stacking of sand bags, accumulation of plastic waste in the channels which affected the free flow of water thereby reducing the conveyance efficiency of the channel and reduced irrigation water to the ayacuts in the tail end as discussed in **Paragraph 6.2.2**.

Government replied (October 2021) that the conveyance efficiency of 53 per cent was achieved during 2021-22. The fact however, remained that the envisaged outcome was not achieved during 2020 and no data was furnished for the period from 2015-16 to 2018-19.

#### 4.4 Non-conversion of gap area as fully irrigated area

As per the DPR (2008-09) of TN-IAMWARM, for rehabilitation of the project, the details regarding fully irrigated, partially irrigated and gap areas for the total ayacuts of Radhapuram channel was 4,596.54 ha as detailed below:

**Table 8: Ayacuts in Radhapuram channel system**

System	Registered Ayacut as per DPR (2008-09)	Status of irrigated area as per DPR (in ha)		
		Fully irrigated	Partially irrigated	Gap area
Radhapuram channel	4,596.54	1,705.93	707.50	2,183.11*

\*After adjusting the permanent gap area of 2,288.15 ha due to erection of windmill.  
(Source: Details furnished by WRD)

A cross verification of data furnished by the Department of Economics and Statistics revealed that the actual area irrigated through channel during the period 2015-16 to 2019-20 is as follows:

**Table 9: Actual irrigated area**

Registered Ayacut	Actual irrigated area (in Ha)				
	2015-16	2016-17	2017-18	2018-19	2019-20
4,596.54	489	290	529	362	375
Percentage to the registered Ayacut	11	6	11	8	8

(Source: Details furnished by WRD)

From the above tables, it is evident that



- Department was not in a position to retain the fully irrigated area prior to the commencement of the rehabilitation works to the channel, as the actual irrigated area was reduced from 11 *per cent* to 8 *per cent* during the period from 2015-16 to 2019-20 which was lesser than the fully irrigated area as stipulated in the DPR.
- There was significant reduction of more than 70 *per cent* in fully irrigated area during the five year period (2015-16 to 2019-20) after completion of the project when compared with the extent of fully irrigated area prior to the implementation of the project (2008-09).

Thus, the intended outcome of the project of conversion of gap area of 2,183 ha into fully irrigated area remained unachieved. Therefore, the expenditure of ₹ three crore on the project became unfruitful due to non-provision of irrigation to entire area of 4,596.54 ha as envisaged in the project.

Audit noted that there were shortcomings in regulation of water by the field offices of the Department. Ineffective regulation of water also contributed to the non-achievement of the outcome of conversion of gap area as discussed in the subsequent paragraphs:

#### **4.4.1 Absence of Rules for regulation of water**

Water Resources Department (WRD) is responsible for regulation of water to the ayacuts of Reservoir. Though, Radhapuram channel was excavated in 1970 to cater additional area of cultivation from the water released from the Pechiparai and Perunchani Dams after raising level of these dams, the Rule of regulation of water from these reservoirs (1968) was not amended. However, GoTN issued instructions (1970) to release the water in the Radhapuram Channel for irrigation, when the combined storage water of dams is more than 1,300 Mcft. Water Resources Department brought out (October 1984) the Compendium of Rules of Water Regulations for the reservoirs which were constructed upto 1983, for better water management in the systems. Despite the same, the regulation of water in Radhapuram Channel was not considered in the said Compendium.

Audit noted that WUA was not functioning in the sub-basin area of Radhapuram channel during the audit period. As the WUA was not formed, its activities *viz.*, preparation of water budget for release of water based on the cropping pattern, etc. as envisaged in the Section 22 of TNFMIS Act, 2000 were not undertaken.

#### **4.4.2 Non-release of water proportionate to the area of cultivation**

The water requirement to achieve the targeted irrigated area, as per DPR, was 69.56 Mcum (2,456.16 Mcft or 2.5 TMC). Based on the Rules for regulation (1968), the water requirement for irrigation for the two channels (Pandian kal and Padmanabhapuram puthan) flowing from these two Dams was 16.4 TMC. Considering the water requirement for irrigating the target area of Radhapuram channel in the DPR (2.5 TMC), the total water release requirement from these two Dams for irrigation worked out to 18.9 TMC.

As against the total requirement of 18.9 TMC for irrigating the area covered by the three channels, the actual water released from Pechiparai and

Perunchani dams, the proportionate<sup>26</sup> release of water in Radhapuram channel (13.23 per cent) as per water requirement and actuals thereon for the period 2015-16 and 2019-20 are shown in **Table 10**.

**Table 10: Water release from Pechiparai and Perunchani Dams**

(in Mcuft)

Year	Pechipari dam	Perunchani dam	Total water released	Proportionate share for Radhapuram Channel (col 4 x 13.23 per cent)	Actual water release in Radhapuram channel	Short release
2015-16	10,264.65	5,821.44	16,086.09	2,128.19	884.41 (42)	1,243.78 (58)
2016-17	7,020.14	4,400.62	11,420.76	1,510.97	126.09 (8)	1,384.88 (92)
2017-18	10,185.73	4,467.74	14,653.47	1,938.65	674.23 (35)	1,264.42 (65)
2018-19	13,903.91	8,469.67	22,373.58	2,960.02	383.43 (13)	2,576.59 (87)
2019-20	9,557.54	6,755.15	16,312.69	2,158.17	400.13 (19)	1,758.04 (81)

(Source: Details furnished by WRD)  
(Figures in brackets indicate the percentage)

It may be seen from the above that:

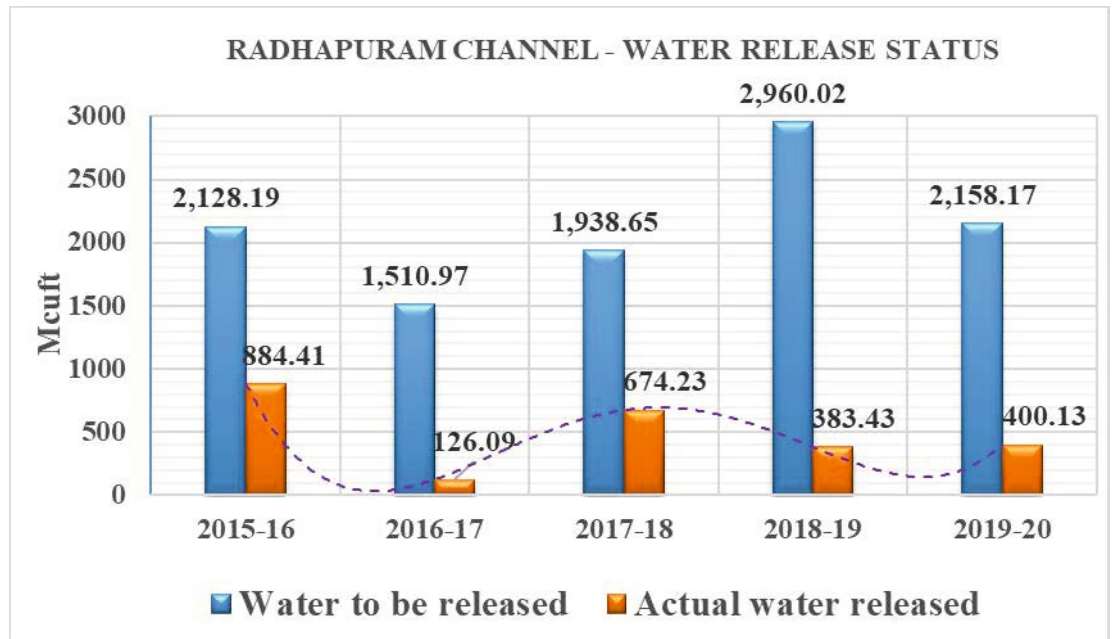
- WRD released only 08 to 42 per cent of the required water for irrigating the target area in the Radhapuram channel during 2015-16 to 2019-20. The short release of water in Radhapuram channel ranged between 58 and 92 per cent. Audit noted that the initial proposal for release of water in the Radhapuram channel submitted by the field officials of the Department to Government ranged between 130 Mcft and 194 Mcft as against the water requirement of 2.5 TMC (as envisaged in the DPR) during the years 2016-17 to 2019-20.
- During 2018-19 the water released from the two dams for the three channels was 22.4 TMC. Of this, the water requirement for the two channels<sup>27</sup> was 16.4 TMC and there was an excess water release of 5.9 TMC. But, WRD released only 0.38 TMC as against the requirement of 2.5 TMC for Radhapuram channel and the balance water was diverted to the other two channels.

The short release of water in Radhapuram channel during the period 2015-16 to 2019-20 is exhibited in **Chart 6**.

<sup>26</sup> Total requirement 18.9 TMC. Requirement for Radhapuram area 2.5 TMC; Proportionate requirement  $2.5/18.9$  per cent = 13.23 per cent.

<sup>27</sup> Pandian kal and Padmanabhapuram puthan channels

Chart 6: Short release of water



(Source: Data furnished by WRD)

Thus, the field officials of WRD failed to propose to release 2.5 TMC of water as envisaged in the DPR required for conversion of gap area. This led to short release of water to the drought prone Radhapuram area and non-achievement of envisaged outcome on conversion of gap area as discussed in **Paragraph 4.4.**

Government accepted (October 2021) the short release of water and stated that the actual release of water has been increased to 926 Mcuft during 2020-21. The fact, however, remains that there was short release of water during 2015-16 to 2019-20.

#### 4.4.3 Delay in release of water despite availability

GoTN instructed (1970) to release water in the Radhapuram channel on 16 June of every year for irrigation when the combined storage of water in dams is more than 1,300 Mcft. An analysis of the combined water storage in dams and actual release of water are detailed in **Table 11.**

**Table 11: Release of water**

Year	Date	Combined water level in the dams (Mcft)	GO No. / date and quantum of release	Remarks
2015-16	16.06.2015	6,669.21	The date and quantum of water released was not furnished to audit.	--
2016-17	16.06.2016	6,165.91	415/20.09.2016 - from 21.09.2016 for 20 days @ 75 cusec Maximum 130 Mcft	Despite availability of water on 16 June itself, WRD initiated the proposal only in August 2016 i.e., after a delay of two months and the order was issued only in September 2016
	22.08.2016	4,024.70		
	02.09.2016	3,265.46		
2017-18	28.06.2017	1,426.81	562/03.11.2017 - from 06.11.2017 to 25.11.2017 for 20 days @ 75 cusec Maximum 129.60 Mcft	Scrutiny of WRD records revealed that the proposal was initiated in October 2017 and issued orders for release of water after the delay of about four months. Actual release of water was made in November 2017.
	29.06.2017	1,487.99		
	30.06.2017	1,520.48		
	11.10.2017	2,264.58		
	20.10.2017	2,343.69		
2018-19	16.06.2018	4,039.29	312/07.07.2018 - from 03.07.2018 for 30 days @ 75 cusec Maximum 194.4 Mcft	Delay less than a month.
2019-20	16.06.2019	1,392.16	449/25.09.2019 - 27.09.2019 to 26.10.2019 for 30 days @ 75 cusec Maximum 194.4 Mcft	Delay more than three months.
	07.09.2019	3,817.13		

(Source: Details furnished by WRD)

It may be seen from the above that:

- WRD failed to initiate proposals for release the water as soon as the combined storage position of the dam reached the mandated levels of 1,300 Mcft. Non-submission of proposal in time led to delay in issue of Government instructions for release of water in Radhapuram channel despite availability of water. The delay in release of water ranged between 25 days and four months.

Thus, failure of the WRD to assess availability of water in the source dams and propose for release of water requirement in time led to non-achievement of the outcome of conversion of gap area into fully irrigated area as discussed in **Paragraph 4.4**.

#### **4.5 Non-achievement of the targeted productivity**

DPR of Agriculture Department (2008-09) aimed at increasing income of the farmers by increasing the productivity in four major crops viz., paddy, groundnut, pulses and cotton.

The details regarding the targeted increase and actual achievement of productivity of the four major crops during the period 2015-16 to 2019-20 are shown in **Table 12**.

**Table 12 Achievement of productivity**

Crop	Actuals before implementation of project	Target after implementation of project	Actuals after implementation of the project				
			2015-16	2016-17	2017-18	2018-19	2019-20
Paddy	4.000	4.500	5.980 (33)	3.875 (-14)	5.960 (32)	6.023 (34)	5.945 (32)
Groundnut	2.000	2.500	1.340 (-46)	1.314 (-47)	1.355 (-46)	1.452 (-42)	1.430 (-43)
Pulses	0.500	0.700	0.590 (-16)	0.540 (-23)	0.673 (-4)	0.731 (4)	0.740 (6)
Cotton	1.200	1.400	0.430 (-69)	0.420 (-70)	0.470 (-66)	0.428 (-69)	0.470 (-66)

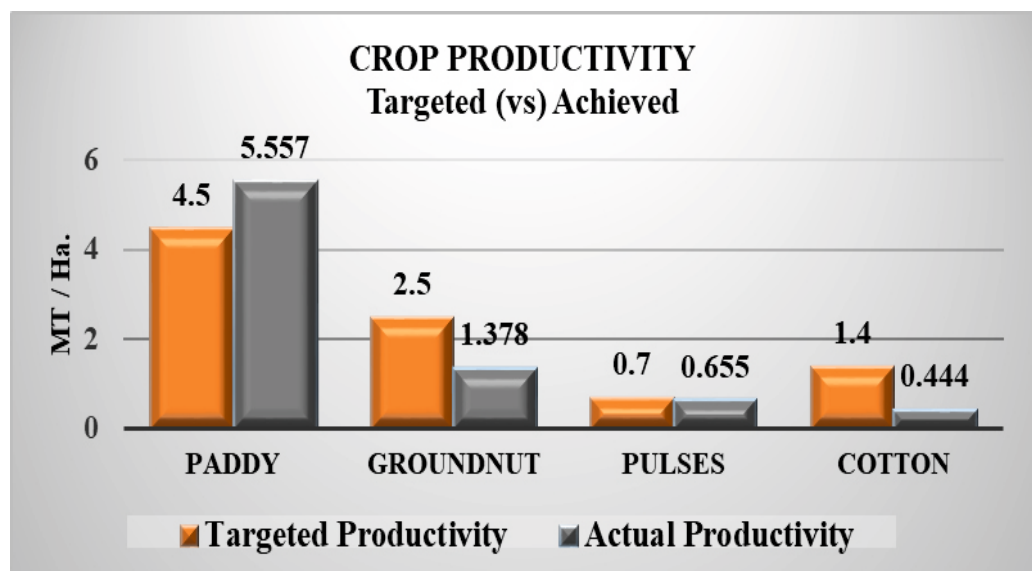
(Figures in bracket indicate the percentage of achievement)

(Source: Details furnished by WRD and Agriculture Department)

It could be seen from the table that:

- After the implementation of the project, the productivity was achieved in two crops viz., paddy and pulses, however, was not achieved in case of groundnut and cotton crops during the period from 2015-16 to 2019-20.
- The productivity in crops viz., groundnut and cotton after the implementation of the project was less than that of the actuals prior to implementation of project.

The average of achievement of productivity as against the targets of four major crops during the period from 2015-16 to 2019-20 is shown in **Chart 7**.

**Chart 7: Achievement in Crop Productivity**

(Source: Details furnished by WRD)

Thus, absence of adequate water management, as discussed in previous paragraphs, resulted in non-achievement of the envisaged outcome of increase in the agriculture productivity thereby increasing the income of farmers as envisaged in the DPR of the project.

Government replied (October 2021) that the ayacut area of Radhapuram channel has been converted to seasonal crops as farmers were interested in cultivating the short-term crops. The reply is not tenable as the targeted productivity of the short-term crops viz., groundnut and cotton remained unachieved after the implementation of the project.

**Conclusion:**

The outcomes envisaged for Radhapuram Channel viz., increased conveyance efficiency remained partially achieved during 2020 and for the balance years 2015-16 to 2018-19 it was not susceptible for verification due to absence of adequate documentation; and the outcome of conversion of gap area of 2,183 ha into fully irrigated area remained unachieved. Inadequate assessment of availability of water in the source dams and delayed release of water from Radhapuram Channel due to non-receipt of Government orders also hindered the achievement of envisaged outcomes.

**Recommendations:**

The Government may:

- Maintain adequate documentation for recording the actual conveyance efficiency of Radhapuram Channel to ensure supply of adequate water to all the farmers.
- Take efforts to assess the requirement of water based on the availability in the source dams and avoid delayed issue of Government orders for release of water for irrigation from Radhapuram channel.



## CHAPTER V

### KELAVARAPALLI RESERVOIR







## CHAPTER V MEASURABLE OUTCOMES OF KELAVARAPALLI RESERVOIR

### 5.1 Introduction of Kelavarapalli Reservoir

The Pennaiyar River has its origin in the South Eastern slopes of Chennakesava hills in Nandhidurg in Karnataka state. After traversing about 112 km in Karnataka state, it enters in Tamil Nadu in Hosur Taluk. The river flows through five<sup>28</sup> districts in Tamil Nadu for a total length of 320 km and finally flows into the Bay of Bengal near Cuddalore.

Kelavarapalli Reservoir was constructed between 1993 and 1995. It has two lined channels viz., (i) Right Main Channel (RMC) with the length of 22.99 km to cater 1,041.24 ha; (ii) Left Main Channel (LMC) with five branch / distributaries channel to a length of 49.58 km to cater 2,197.95 ha.

The details of fully irrigated, partially irrigated and gap areas before implementation of the project and the irrigated area anticipated after implementation of the project in the ayacuts of Kelavarapalli Reservoir system, as specified in the DPR (2007-08), are given in **Table 13**.

**Table 13: Ayacuts of the channels under Kelavarapalli Reservoir system**

Sl. No.	System	Ayacut area before implementation of the project			Irrigated area anticipated after implementation of the project in DPR
		Fully irrigated	Partially irrigated	Gap area	
1	RMC	264.18	205.54	571.92	1,041.24
2	LMC	569.20	431.65	1,197.10	2,197.95
<b>TOTAL</b>		<b>833.38</b>	<b>637.19</b>	<b>1,768.62</b>	<b>3,239.19</b>

(Source: Details furnished by WRD)

### 5.2 Outcomes envisaged

The DPR of TN-IAMWARM (2007-08) stipulated that total water potential of the sub-basin as 121.12<sup>29</sup> Mcum. It was also elaborated that the conveyer system of the channel was sub-standard due to the damaged condition of the anicuts, diversion head works, supply channels, etc. Hence, it was proposed to improve and modernise the irrigation infrastructures through TN-IAMWARM project thereby increasing the irrigation water demand under WRD sources from 23.36 Mcum to 45.23 Mcum.

DPR envisaged the following measurable outcomes:

- Increase in conveyance efficiency from 53 to 56 *per cent*.
- Conversion of 1,769 ha of gap area as fully irrigated area.

<sup>28</sup> Krishnagiri, Dharmapuri, Thiruvannamalai, Villupuram, Cuddalore.  
<sup>29</sup> Surface water – 58.88 Mcum and Ground water – 62.24 Mcum.

### 5.3 Inadequate documentation on conveyance efficiency

The DPR of the project contemplated that the improvement and modernisation of irrigation infrastructures would improve the conveyance efficiency from 53 to 56 *per cent*. DPR did not include the basis for calculation of the existing conveyance efficiency of 53 *per cent* with details of water flow from the head works to tail end, etc.

WRD did not furnish either the details of calculation of conveyance efficiency or the records relating to the calculation of conveyance efficiency after the completion of the project. However, WRD replied (January 2021) that conveyance efficiency was actually increased upto 58 *per cent*. It was further stated that records pertaining to channel-wise conveyance efficiencies at different reaches and irrigated areas including water distribution in tail end command areas were not maintained.

It is also pertinent to note that the conveyance efficiency in a similar lined channel of Amaravathi Reservoir ranged between 96.36 and 98.18 *per cent* during the period 2015-16 to 2018-19 after implementation of the project. However, the conveyance efficiency of the lined Kelavarapalli reservoir was stated to be 58 *per cent* only.

Hence, Audit could not assess the achievement of the outcome of the project due to failure of the Department to maintain adequate documentation in this regard.

Government replied (October 2021) that the conveyance efficiency of channel was ascertained by conventional methods. It was assured that the proposal would be initiated for installation of the devices at the appropriate location for calculating the discharge.

### 5.4 Non-conversion of the gap area as fully irrigated area

As per Government instructions<sup>30</sup> (April 1985), Section Officer of WRD should maintain an ayacut register of the irrigation system in their jurisdiction. The Section Officers are required to ascertain and record the details of fields which have not been irrigated in a particular crop period. The officer is also authorised to cross verify the cultivation records with the village records and to bring the discrepancies to the notice of the Revenue authorities for rectification.

The DPR envisaged that structural and operational deficiencies of the existing channel resulted in partial irrigation and gaps in irrigation area. Hence, it was proposed to rehabilitate the channel with the objective to convert the entire ayacut area of 3,239.19 ha of Kelavarapalli Reservoir as fully irrigated area, as detailed in **Table 14**.

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<sup>30</sup> G.O.Ms.No. 593, Revenue Department, dated 16.4.1985.

**Table 14: Details of area irrigated with and without project**

Total Registered Ayacut	Ayacut area before implementation of the project				Irrigated area after implementation of the project (A+B+C)
	Fully irrigated (A)	Partially irrigated (B)	Total (A+B)	Gap area (C)	
3,239.19	833.38	637.19	1,470.57	1,768.62	3,239.19

(Source: Details furnished by WRD)

The actual irrigated area through the Kelavarapalli Reservoir after the implementation of the project (2015-16 to 2019-20) was very meagre (three *per cent*) and the envisaged outcome of conversion of gap area and partially irrigated area into fully irrigated area remained unachieved, as detailed in **Table 15**.

**Table 15: Actual irrigated area**

Registered Ayacut	Actual irrigated area (in ha)				
	2015-16	2016-17	2017-18	2018-19	2019-20
3,081.59 Ha <sup>31</sup>	106.70	106.70	106.70	106.70	102.40
Percentage to the registered Ayacut	3	3	3	3	3

(Source: Details furnished by WRD and from the G Returns)

It may also be seen that:

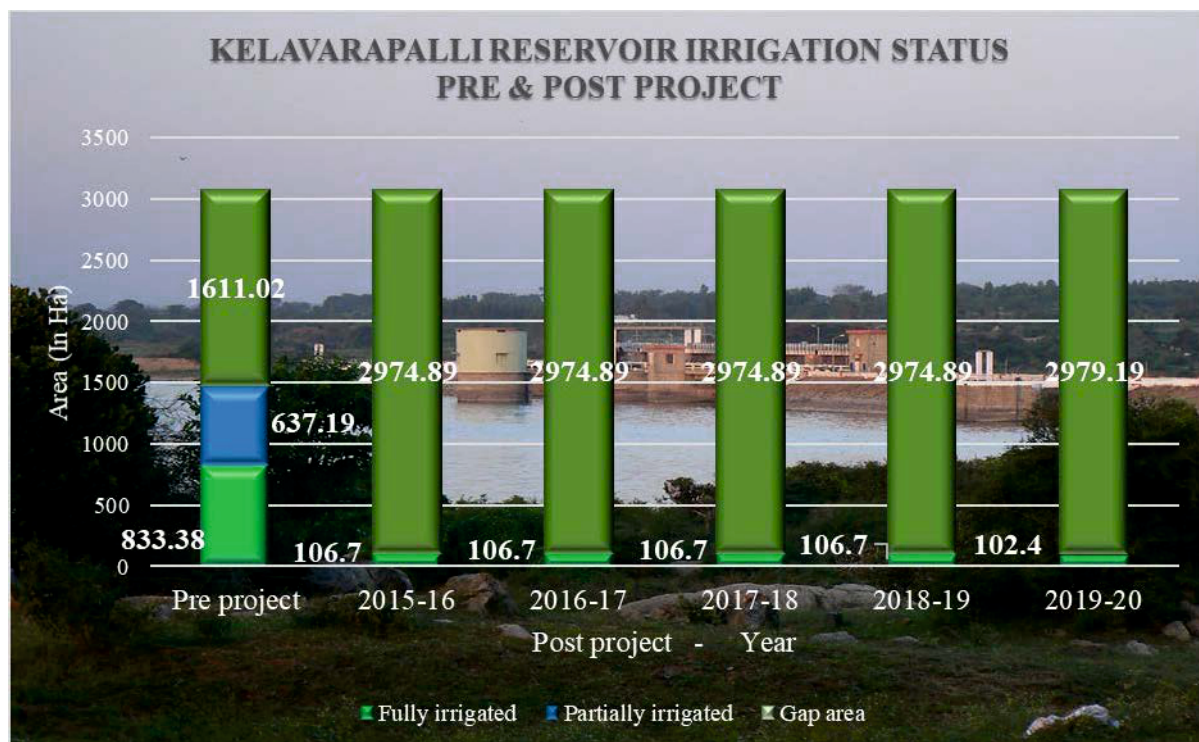
- Despite the release of 67 to 98 *per cent* of crop water requirement, as discussed in **Paragraph 5.4.2**, to cover registered ayacut, there was shortfall to an extent of 88 *per cent* after the implementation of the project, for which Department incurred an expenditure of ₹ 6.60 crore. Besides, the envisaged outcome of conversion of partially irrigated area and gap area as fully irrigated area was not achieved in any of the five years.
- Field officials of WRD, however, did not adhere to the instructions of the Government with regard to irrigation of fields in a particular crop period. The field officials failed to share the status on water availability with the farmers to encourage raising of crops. This had resulted in underutilisation of the released water to the benefit of farmers besides the intended objective of conversion of gap area into irrigated area remained unachieved. Failure of the Department had resulted in underutilisation of water potential by the farmers, despite release of water as discussed in **Paragraph 5.4.2**.

<sup>31</sup> Of the total registered ayacuts of 3,239.19 ha in Kelavarapalli channel, details pertaining to six villages having a total ayacut of 157.60 ha were not made available by the Department of Economics and Statistics and hence the comparison was restricted to 3,081.59 ha.

Thus, not only the intended outcome of the project on conversion of gap area into fully irrigated area remained unachieved but also there was substantial reduction in the fully irrigated area after the implementation of the project.

The irrigation status in Kelavarapalli Reservoir during the pre and post project implementation (2015-16 to 2019-20) is shown in **Chart 8**.

**Chart 8: Pre and Post project implementation status**



(Source: Details furnished by WRD)

The gaps in regulation of water by the Department from the Kelavarapalli Reservoir are discussed in the subsequent paragraph:

#### 5.4.1 Absence of Rules of water regulation

The WRD brought out (October 1984) the Compendium of Rules of water regulations for the reservoirs which were constructed upto 1983, for better water management in the systems. Rules for water regulations for the Kelavarapalli Reservoir were not incorporated in the compendium as the reservoir works were completed in 1995.

However, WRD reported (September 2016) to Government that compendium of Rules for Water Regulation would be updated covering all the reservoirs in the State within a period of six months and sent to Government. However, the same was not released even after a lapse of about five years (April 2021). Though WRD forwarded the draft Rules to the Government, the same was pending approval (May 2021).

Thus, failure of the department in framing the Rules of water regulations for the reservoir even after 25 years of its completion resulted in release of water without assessing the irrigation requirements, as discussed in the subsequent paragraph:

Government replied (October 2021) that Rules for water regulation for Kelavarapalli Reservoir is under formation.

#### 5.4.2 Short release of water

Scrutiny of records revealed that WUA was not functioning in the sub-basin area of Kelavarapalli Reservoir during the Audit period. As the WUA were not formed, its activities *viz.*, preparation of water budget for release of water based on the cropping pattern, etc. as envisaged in the section 22 of TNFMIS Act, 2000 were not undertaken.

The orders issued by the Government for release of water in these channels, actual release of water and crop water requirement after completion of the project as envisaged in the DPR were as detailed below:

**Table 16: Actual release of water against the crop water requirement**

Year	Water to be released as per GO (Mcft)	Crop required water with project as per DPR <sup>32</sup> (Mcft)	Actual release of water (Mcft)	Short release (percentage)
2015-16	Not Available	1,149.89	766.800 (67)	383.09 (33)
2016-17	4,421.34*	1,149.89	950.918 (83)	198.972 (17)
2017-18		1,149.89	909.705 (79)	240.185 (21)
2018-19		1,149.89	1,123.372 (98)	26.518 (2)
2019-20		1,149.89	948.672 (83)	201.218 (17)

\*GO for release of water for the year 2015-16 was not made available to Audit. Further, in respect of the remaining period the orders were issued spreading over two financial years. Hence, total for four years was included in the table.  
(Source: Details furnished by WRD)

It is seen from the above that:

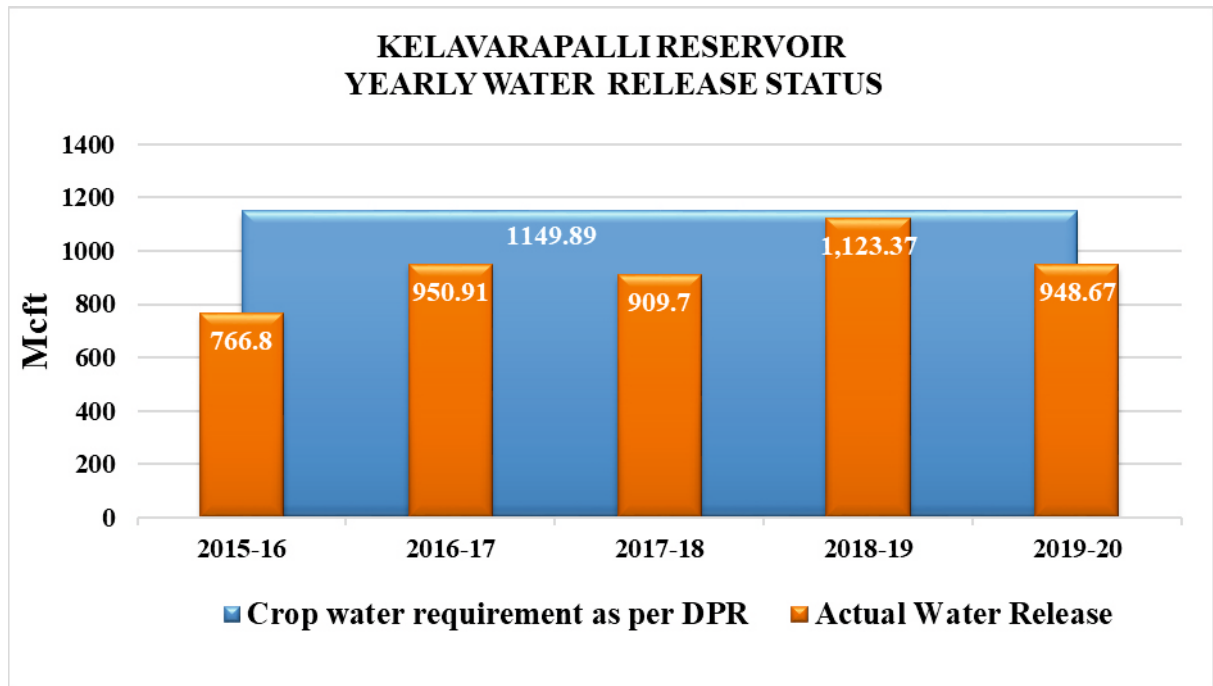
- As against the orders of the Government for release of 4,421.31 Mcft during the period from 2016-17 to 2019-20, WRD released 3,932.667 Mcft (89 *per cent*) only.
- Despite the release of water from 67 to 98 *per cent* of water required for crops, the actual irrigation was only about 110 ha (04 *per cent*), as against the targeted area of about 3,000 ha. Such a large scale reduction in actual irrigated area indicated inadequate co-ordination of the field officials of WRD with the Revenue authorities and farmers as already discussed in the **Paragraph 5.4**.

The quantum of water released as against the crop water requirement in respect of Kelavarapalli Reservoir for the period from 2015-16 to 2019-20 is exhibited in **Chart 9**.

<sup>32</sup> The crop water requirement of sub-basin is 1,597.07 Mcft. Since, percentage of the ayacuts covered under Kelavarapalli Reservoir to the total ayacuts in the sub-basin works out 72 *per cent*, the same percentage was adopted to arrive the water requirement for the ayacuts covered under the reservoir.



**Chart 9: Water release against crop water requirement**



(Source: Details furnished by WRD)

Thus, absence of adequate water management, as discussed in previous paragraphs, resulted in non-achievement of the envisaged outcomes of conversion of gap area into fully irrigated area as envisaged in the DPR of the project even after incurring of ₹ 6.60 crore and maintenance cost of ₹ 1.50 crore.

### **5.5 Formation of extension supply channel in Kelavarapalli Reservoir**

Based on the proposal (September 2015) of WRD, GoTN sanctioned (February 2016) ₹ 2.50 crore with the NABARD loan assistance, for excavation of a new supply channel to divert the flood surplus of Kelavarapalli Reservoir through its Left Main Channel to feed Marudandapalli Eri and Durai Eri in Hosur taluk. The scheme would have direct benefit for 222 acre from the water from these two tanks and indirect benefit for 50 acre for irrigation by recharge of wells aligned adjacent to diversion channel.

The work was commenced in March 2016 and completed in August 2016 with the expenditure of ₹ 2.50 crore. It is evident from the **Table 16 of Paragraph 5.4.2**, that even after completion of four years of formation of new channel work, WRD did not take efforts to regulate the water in the new channel due to objection raised by other farmers. However, WRD failed to convince the benefit to farmers about the availability of surplus water in the reservoir so as to fulfil the objectives of the project.

Thus, despite having surplus water in the Kelavarapalli Reservoir continuously for the period of four years since excavation of supply channel, surface water was not harnessed to the benefit of the 222 acre and the expenditure of ₹ 2.50 crore incurred remained unfruitful.

**Conclusion:**

The intended outcome of Kelavarapalli Reservoir viz., conversion of gap area into fully irrigated area remained unachieved besides there was substantial reduction in the fully irrigated area after the implementation of the project. Failure of the department in framing the Rules of water regulations for the Kelavarapalli Reservoir even after 25 years of its completion resulted in release of water without assessing the irrigation requirements. Supply channel of Kelavarapalli Reservoir excavated to harness surface water to benefit 222 acres of agriculture land was not utilised for four years and the expenditure of ₹ 2.50 crore incurred remained unfruitful.

**Recommendations:**

The Government may:

- Frame Rules for regulation of water for irrigation systems in Kelavarapalli Reservoir to ensure release of water based on irrigation requirements.
- Take efforts to utilise the supply channel to benefit the agriculture lands by harnessing surface water.





## CHAPTER VI

### MAINTENANCE OF IRRIGATION CHANNELS





## CHAPTER VI MAINTENANCE OF IRRIGATION CHANNELS

### 6.1 Introduction

Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007 (Section 6 and Section 8) (Act) envisages that the act of damaging the irrigation structures; interfering with the flow in the supply channels and encroaching upon the adjoining areas of canals is punishable by the Officers of the Public Works Department. GoTN issued orders (December 2014 read with March 2016) fixing the responsibilities for eviction of encroachments in respect of water bodies, from the level of Assistant Engineer to the Executive Engineer of WRD.

### 6.2 Condition of channels observed during joint inspection

#### 6.2.1. Amaravathi Reservoir

Rules of water regulation (Para 2.1) for Amaravathi reservoir stipulated that the closure period for undertaking maintenance works of the earthen channel of Amaravathi Reservoir as April and May of every year.

Department incurred an expenditure of ₹9.72 crore towards executing 254 maintenance works for the channels in Amaravathi Reservoir during 2015-19. Audit observed that the maintenance works were commenced in the last week of May during 2017-18 and 2018-19 and for the other three years the works were commenced between June and August. The works were completed between July and February during 2015-19.

A joint inspection was conducted (March 2021) in nine out of 18 channels by the Audit along with the officials of the WRD to ascertain the condition of the channels. The joint inspection revealed the following gaps in maintenance of the infrastructure created through the project.

- There were obstructions affecting the flow of water, such as debris and garbage accumulation and huge growth of vegetation in six channels<sup>33</sup>.

Department replied that necessary action would be taken for clearing the debris before the next release of water for irrigation.

- In Pallapalayam Left bank channel, audit noticed erection of a pump set at the upstream of the channel paving way for illegal drawal of water from the channel and it was also noticed that a sluice was in damaged condition.

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<sup>33</sup> Amaravathi Main Channel, Kadathur, Kolinjivadi, Pallapalayam, Chettipalayam and Ramakulam.

**Figure 2: Illegal drawal of water in Pallapalayam Left bank channel**



Department stated that the illegal drawal of water as well as the damaged condition of the sluice was noticed only during joint inspection and action would be initiated for the removal of pump set / rectification of damaged sluice.

- In addition to the above, audit noticed encroachments *viz.*, growth of coconut trees, constructed structures, etc., on the lands adjoining to the banks of four Channels<sup>34</sup>.

Department stated that these encroachments were not affecting the free flow of water and action would be taken to evict the encroachment. However, the fact remains that the WRD failed to protect their assets from illegal encroachments like constructions in Government lands.

- Audit also noticed direct letting of drainage / sewage water from Karur municipality area and instances of letting of industrial waste as discussed in **Paragraph 7.2.2**.

Thus, Joint Inspection revealed that the field officials of the WRD failed to adhere to the provisions of the Act and Government orders and prevent/remove encroachments and other activities which were prohibited under the Act.

The Additional Chief Secretary, in the Exit Conference (July 2021), accepting the condition of the irrigation infrastructure highlighted by audit, instructed the departmental officers to ensure efficient irrigation infrastructure.

### **6.2.2 Radhapuram Channel**

A joint inspection conducted (March 2021) in entire length of Radhapuram channel by the Audit along with the officials of the WRD also revealed the following gaps in maintenance of the infrastructure created through the project.

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<sup>34</sup> AMC, Kolinjivadi, Chinnadharapuram and Pallapalayam.



- Water seepages of five cusecs due to uneven seating of both the shutters of the Head Regulator at LS 0 KM of the Radhapuram channel was noticed and the water was unauthorisedly blocked by stacking sandbags across the channel in the LS 645 and diverted to the corresponding ayacuts.

**Figure 3: Water seepages due to damaged shutter**



It was noticed that there were damages in the wall of the main channel which resulted in seepages. It was also observed that there were damages in the out-let channels and used plastic bottles obstructed the free flow of water.

**Figure 4: Damages in the outlet channel**

**Plastic waste obstructing free flow of water**



Field officials of the Department confirmed that unauthorised activities were done by the farmers and that action for removal of blockages and rectification of damages would be initiated before subsequent water regulations.

Government replied (October 2021) that the obstructions causing seepage of water would be removed before the next water release.

### **6.2.3. Kelavarapalli Reservoir**

A joint inspection was conducted (March 2021) in Left Main Channel upto tail end (i.e., 25 KM) and Right Main Channel (RMC) upto LS 19 out of 22 KM,

by the Audit along with the officials of the WRD to ascertain the condition of the channels. The joint inspection revealed the following:

- It was observed that the carrying capacity of RMC channel was not maintained uniformly to ensure free flow of water in the channel. The carrying capacity was 84 *per cent* in LS 755 m, it reduced to 72 *per cent* in LS 1,215m and it increased to about 100 *per cent* in LS 2,908 m. The carrying capacity of the channel reduced flow of water due to obstruction by siltation and seepage of water by damages from the channel.
- Audit noticed illegal tapping of water by the farmers utilising private pumpsets from the main channel (in three places LS 2,908 m, 6,925 m and 6,940 m), siltation with bushes (in three places LS 3,015 m, 8,122 m and 11,600 m), seepages in the closed sluices (in six places, with siltation in three and vegetation in two places), defective shutters in the regulators (one place), breaches due to erosion of body wall (one place).

**Figure 5: Breaches in the Channel**



**Figure 6: Siltation with bushes in the lined channel**



- On account of illegal tapping of water, siltation, improper maintenance of channel, the realisation of water at the tail end was very meagre depriving water to the farmers in the tail end. It was noticed during Joint Inspection (17 March 2021) that the released water reached only



upto LS 19 km out of 22 km of RMC after 23 days of release of water (22 February 2021) by the Department for irrigation.

On this being pointed out, it was stated that the deficiencies were observed by the Department only during joint inspection and hence necessary corrective measures would be initiated.

In addition to above, audit also noticed two encroachments *viz.*, structures on the lands adjoining to the banks of RMC. Department stated that the matter had been taken up with the Revenue authorities for surveying the PWD lands for eviction of the encroachments and the same was pending. The fact, however, remains that WRD failed to protect their assets from encroachments.

**Conclusion:** There were gaps in maintenance of the rehabilitated water courses as the joint inspection conducted by the Audit along with Departmental official revealed encroachments, dumping of waste, weed formation on the water course, damages to the channel structures and illegal tapping of water using motors.

**Recommendations:**

The Government may:

- Ensure timely repairs and maintenance of irrigation channels as envisaged in the Rules for regulation of water in Reservoirs.
- Protect the assets created for enhancing the conveyance efficiency of the irrigation systems from encroachments and illegal drawal of water to fulfil equitable distribution of water.





## CHAPTER VII

### MONITORING THE QUALITY OF IRRIGATION WATER





## CHAPTER VII

### MONITORING THE QUALITY OF IRRIGATION WATER

#### 7.1 Absence of action plan for improving the water quality

Guidelines for Preparation of DPRs of Irrigation and Multipurpose Projects of GOI stipulated that, while preparing DPR, assessment of water quality parameters<sup>35</sup> in locations *viz.*, upstream, reservoir and downstream areas should be made and measures for improving the water quality be described.

IS: 11624-1986 – Indian Standard Guidelines for the quality of irrigation water and Food Agriculture Organisation Guidelines for interpretations of water quality for irrigation stipulated that water with total salt concentration in terms of electrical conductivity exceeding three deciSiemens per metre (3,000 milliSiemens (mS)/cm) or total dissolved solids<sup>36</sup> exceeding 2,000 mg/l caused hazardous effects on soil properties and crop growth.

Scrutiny of records revealed that the DPR prepared for Amaravathi sub basin of TN-IAMWARM project did not assess the water quality parameters as envisaged. Audit noticed from the scrutiny of a study report of the Department prepared in March 2012, that untreated domestic sewage was being discharged into the Amaravathi river system which affected the water quality. In addition, there were instances of discharge of semi treated industrial effluent directly into the river which increased the total dissolved solids in the water body.

Despite the above instances, Department did not assess the water quality of the river at the time of preparation of DPR or during the execution of the project so as to suggest measures for improving the water quality.

#### 7.2 Water quality in Amaravathi Reservoir

##### 7.2.1 Status of Pollution in Amaravathi river

Audit obtained the data relating to the pollution monitoring tests conducted by the Tamil Nadu Pollution Control Board (TNPCB) during July 2019 to March 2020 from two<sup>37</sup> locations *viz.*, Sellandipalayam and N Colony on the banks of Amaravathi river. It was seen that the water quality was not within the permissible limits which had hazardous effects on soil properties and crop growth as detailed below:

- The Electrical Conductivity at Sellandipalayam ranged from 3,170 to 3,590 and at N Colony it was between 7,690 and 8,390 as against the permissible limits of 3,000 mS/cm.

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<sup>35</sup> Salinity, pH value, presence of anions like boron, phosphate, fluoride which pose toxic risk and environmental problems.

<sup>36</sup> Total dissolved solids is a measure of the dissolved combined content of inorganic and organic substances present in water.

<sup>37</sup> (i) Southern bank of River Amaravathi and downstream side of Karur Dyeing Cluster in Sellandipalayam near Kalaingar Tea Stall and (ii) Adjacent to Karur Municipal Solid Waste (MSW) dumpsite and on the northern bank of River Amaravathi and downstream side of Karur Dyeing Cluster in Vangal Road near Narikuravar Colony.

- The total dissolved solids at Sellandipalayam ranged from 2,032 to 2,168 and at N Colony it was between 4,928 and 6,344 as against the permissible limits of 2,000 mg/l.

However, the Department had not carried out any corrective measures to improve water quality.

### **7.2.2 Discharge of untreated sewage**

Implementation Completion Report of the project (June 2015) noted that sewage was not being treated by the Municipalities or Town Panchayats and that the effluents generated by the major industries *viz.*, textile dyeing and bleaching units were let out directly into the nearby drains which ultimately reached the Amaravathi River or its supply channels.

Scrutiny of records and Joint inspection with the field officials of the Department revealed the following:

Karur Municipality established (April 2007) a Sewage Treatment Plant (STP) with a processing capacity of 15 Million Litres per Day (MLD) for treatment of sewage generated from the municipal areas of 32 out of 48 wards. Despite having a treatment plant, it was observed by TNPCB (July 2016) that the Municipality discharged sewage without treatment into nearby channels of Amaravathy river. It is pertinent to mention that Hon'ble Madurai Bench of Madras High Court directed (September 2016) Karur Municipality to stop draining the untreated sewage water into Amaravathi River before October 2016. However, no fruitful action was initiated by the Municipality. TNPCB, based on the complaint of farmers that the water discharged from STP affected the crop growth, inspected (July 2019) the STP and confirmed that discharged sewage water was not clean and had traces of colour. TNPCB directed (July 2019) the Karur Municipal Commissioner to ensure that treated sewage should comply with the prescribed standards for irrigation. However, during joint inspection (March 2021), audit noticed that the sewage directly flowed into Left and Right Bank Irrigation Channel of Amaravathi river. The field officials had also admitted in the joint inspection that the irrigation in these reaches was undertaken with the contaminated water. It was also ascertained from TNPCB (March 2020) that water samples were not tested and monitored regularly.

It was also observed from the scrutiny of G returns that this polluted water was used in six villages for irrigation purpose for an area of 61 ha (channel irrigated) to 307 ha (channel irrigated) during 2015-16 to 2019-20.

To an audit query, TNPCB replied (March 2020) that Karur Municipal authority was directed to formulate a proposal to cover entire municipal area through underground drainage system. The Commissioner, Karur Municipality, to an audit query, replied (January 2021) that DPR to cover entire municipal area was under preparation.

The Additional Chief Secretary, in the Exit Conference (July 2021), accepting the audit observation instructed the departmental officials to ensure that the irrigation water is free from pollution by co-ordinating with other Government agencies.

Government accepted and replied (October 2021) that a Joint Committee had been constituted by the National Green Tribunal (South Zone) to suggest measures for controlling direct letting of drainage/ sewage into irrigation channels in Karur municipality areas.

### **7.3 Water quality in Kelavarapalli Reservoir**

#### **7.3.1 Absence of water quality testing**

During the preparation of DPR (2007-08), Department identified that there was flow of drainage water from Bangaluru city into the Kelavarapalli reservoir throughout the year. DPR also highlighted about the existence of industrial pollution in this sub-basin caused by 34 Major and Medium industries due to discharge of effluents from these industries through drains and into the river or supply channels of tanks. Scrutiny of records revealed that WRD did not conduct periodical test for assessing the quality of irrigation water. During joint inspection (March 2021), the field officials of the Department confirmed that no action had been initiated for testing the quality of irrigation water and assured that necessary action would be initiated in this regard.

Thus, environmental issues in the irrigation areas of Kelavarapalli reservoir was not addressed by the Department for more than 12 years, despite being highlighted in the DPR of the project.

### **7.4 Participatory Irrigation Management**

Operations and Maintenance (O&M) of the tanks and irrigation systems rehabilitated under the project was the main responsibility of the WRD. State budgets contain an allocation for maintenance of water structures being managed by WRD and will be used for the O&M of project irrigation assets. In addition, as per section 25 of the Tamil Nadu Farmers Management of Irrigation System (TNFMIS) Act 2000 and Rule 25 of TNFIMS Rules 2002, WUAs may levy a fee for management of irrigation systems and regulation of water. GoTN in the Project Appraisal Document of World Bank committed to sustain the participatory irrigation management (PIM) programme in the State and to provide continued support to the WUAs through the permanent institutionalisation of the PIM cell in the office of the Engineer-in-Chief.

Rule 23 of TNFMIS Rules, 2002 envisaged that a Managing Committee with the assistance of Competent Authority<sup>38</sup>, shall prepare water budget one month before the onset of the irrigation season after considering the anticipated inflows and existing water availability in the reservoir. Further, for the second crop season, the Project Committee would determine the quantum of area to be irrigated based on the availability of water at the beginning of the second season.

Rule 24 of TNFMIS Rules, 2002 stipulated that after the preparation of water budget, the Farmers' Organisation shall draw up a plan of water regulation

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<sup>38</sup> As per section 26 (1) of the Tamil Nadu Farmers' Management of Irrigation Systems Act 2000 the Government may, by notification, appoint such officer of the Water Resources Organisation, as they consider necessary, to be the competent authority to every farmers organisation, for the purposes of this Act.



viz., the dates of release and closure based on the principle of equitable distribution of water amongst all users.

Scrutiny of records in the three selected sub-basins revealed the following:

- PIM cell of WRD failed to adhere to the statutory requirements on the participatory Irrigation management by ensuring the existence of WUAs.
- The term of WUAs had expired in June and December 2014 in respect of Pennaiyar upto Krishnagiri and Hanumanadhi sub-basins respectively and they were not formed thereafter.
- In Amaravathi sub-basin, elections were conducted between July 2014 and February 2015 and WUA was functional upto February 2020. Thereafter, no election was conducted and WUA was not formed.
- Even when WUA was functional till February 2020 in Amaravathi sub-basin, Department failed to consider the water budget prepared by WUA in the proposal forwarded to Government for release of water for irrigation purposes.
- Similarly, the second crop season was also not determined by WUA based upon the actual availability of water during the second season.

Thus, non-adherence to the provisions of the TNFMIS Rules by the Department led to non-release of water based on crop water requirement despite availability of water as discussed in **Paragraphs No. 3.4.1.**

## **7.5 Monitoring**

### **7.5.1. Non-maintenance of ayacut register**

GoTN instructed (April 1985) that the field officials of WRD should have an approved ayacut register of the irrigation system in their jurisdiction with the data on fields which have not been irrigated in a particular crop period. This should be compared with the records of Revenue Department for every month. The instructions also stipulated that the section officer should attend the monthly meetings along with the Revenue, statistical and agricultural staff and variations and discrepancies noticed, if any, should be rectified then and there before recording in the Revenue records. The section officer is also authorised to check the cultivation details in the records of Village Administrative Officer and any shortcoming should be rectified through joint inspection with Revenue officials.

As against the above, the officials of the three<sup>39</sup> WRD divisions did not maintain ayacut register of their jurisdiction with the irrigation details for the respective crop periods. The higher officials of the Department had also failed to monitor the lapses on the part of field officials. Hence, WRD was not in a position to ascertain water requirement for the actual irrigated area within their jurisdiction.

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<sup>39</sup> Amaravathi Basin Division/Dharapuram; Kodayar Basin Division/Nagercoil and Upper Pennaiyar Basin Division/Dharmapuri.

Thus, WRD failed to adhere to the Government instruction in assessing the actual irrigated area which led to non-release of water based on the crop water requirement as discussed in the **Paragraphs 3.4.1 and 5.4.2.**

The department furnished ayacut register for Amaravathi basin. It was replied (October 2021) that ayacut register was not maintained for Kodayar basin (Radhapuram channel) and records of Upper Pennaiyar basin (Kelavarapalli reservoir) were damaged due to seepage of water and necessary action initiated to maintain the register in future. The fact however remains that the Department failed to maintain new register immediately after the damage of old register.

### 7.5.2. Absence of monitoring the quantum of water discharged from non-system tanks

The irrigation infrastructure in respect of the following three selected projects depended mainly on system tanks and non-system tanks as detailed in the **Table 17.**

**Table 17: Tank irrigation infrastructure in three sub-basins**

Sl. No.	Sub-basin	Total ayacuts (ha)	Total ayacuts depending on tanks (ha)	System tanks		Non-system tanks		Percentage of non-system ayacut to total ayacuts
				No.	Ayacuts (ha)	No.	Ayacuts (ha)	
1	Agniyar	12,016.90	12,016.90	0	0.00	190	12,016.90	100
2	Kosasthalaiyar	35,256.26	34,918.17*	91	10,449.97	203	24,468.20	69
3	Girdhumal	17,057.81	17,057.81	31	6,886.56	85	10,171.25	60

**\*Balance 338.09 ha covered under Anicuts**

**(Source: Details furnished by the Department)**

Audit noted that the non-system tanks maintained by the PWD in the ayacut area of these three projects did not possess measuring devices to check and document the quantum of water received through rainfall, water utilisation through discharge, storage position, etc. In the absence of these devices, the quantum of water received through rainfall, its utilisation etc., were not measured and the field officials of WRD could not monitor the release of water for irrigation of ayacuts from these non-system tanks.

### **Conclusion:**

Department failed to monitor the quality of irrigation water and there were instances of discharge of untreated sewage water into the water courses. There were gaps in undertaking Participatory Irrigation Management activities viz., formation of Water Users Association, preparation of water budget and raising of crop for second season based on the water availability which hindered the achievement of envisaged outcomes of the project.

**Recommendations:**

The Government may:

- Strengthen monitoring mechanism to retain the quality of irrigation water by arresting the discharge of untreated water into the irrigation channels.
- Ensure effective functioning of Water Users Association and preparation of water budget to strengthen the Participatory Irrigation Management activities.



## **CHAPTER VIII**

### **CONCLUSION AND RECOMMENDATIONS**



## CHAPTER VIII CONCLUSION AND RECOMMENDATIONS

### 8.1 Summary of Conclusion

Performance Audit of Outcomes in Surface Irrigation in respect of the works executed under TN-IAMWARM project in the Amaravathy reservoir, Radhapuram channel and Kalavarapalli reservoir revealed the following:

- Absence of periodical capacity surveys by the Department led to non-ensuring adequate silt storage and retardation of sedimentation in the Reservoirs. Delay in sanction of desiltation works for removal of sedimentation resulted in non-harnessing of the realised surface water to an extent of 65.793 TMC in three reservoirs which affected the irrigation needs of the crop area of the sub-basins.
- The intended outcome of envisaged for Amaravathi Reservoir *viz.*, increasing the conveyance efficiency of 20 *per cent* was only partially achieved even after incurring an expenditure of ₹ 74.99 crore on channel rehabilitation works. The conversion of gap area into fully irrigated area (22,095.17 ha) remained unachieved; and the actual irrigated area reduced during the period from 2015-16 to 2019-20 which was in the range of 12 to 57 *per cent* of the pre-project irrigated area. PWD failed to release water for irrigation from Amaravathi Reservoir either as per Regulations for release of water or on the basis of water requirement for the crops despite availability of sufficient water in years with good rainfall.
- The outcomes envisaged for Radhapuram Channel *viz.*, increased conveyance efficiency remained partially achieved during 2020 and for the balance years 2015-16 to 2018-19 it was not susceptible for verification due to absence of adequate documentation; and the outcome of conversion gap area of 2,183 ha into fully irrigated area remained unachieved. Inadequate assessment of availability of water in the source dams and delayed release of water from Radhapuram Channel due to non-receipt of Government orders also hindered the achievement of envisaged outcomes.
- The intended outcome of Kelavarapalli Reservoir *viz.*, conversion of gap area into fully irrigated area remained unachieved besides there was substantial reduction in the fully irrigated area after the implementation of the project. Failure of the department in framing the Rules of water regulations for the Kelavarapalli Reservoir even after 25 years of its completion resulted in release of water without assessing the irrigation requirements. Supply channel of Kelavarapalli Reservoir excavated to harness surface water to benefit 222 acres of agriculture land was not utilised for four years and the expenditure of ₹ 2.50 crore incurred remained unfruitful.
- There were gaps in maintenance of the rehabilitated water courses as the joint inspection conducted by the Audit along with Departmental official revealed encroachments, dumping of waste, weed formation on

the water course, damages to the channel structures and illegal tapping of water using motors.

- Department failed to monitor the quality of irrigation water and there were instances of discharge of untreated sewage water into the water courses. There were gaps in undertaking Participatory Irrigation Management activities *viz.*, formation of Water Users Association, preparation of water budget and raising of crop for second season based on the water availability which hindered the achievement of envisaged outcomes of the project.

## **8.2 Summary of Recommendations**

The Government may:

- Conduct periodical capacity surveys to assess the extent of sedimentation in the reservoirs to ensure adequate silt storage.
- Prioritise sanction of desiltation works for removal of sedimentation to retain the original capacity of the reservoir and to utilise the available water without wastage.
- Formulate and update the Rules for regulation of water for irrigation systems to ensure release of water based on the availability and crop area cultivation.
- Development of integrated Water Resources Management System may be completed promptly to ensure effective utilisation of available water for irrigation needs.
- Take efforts to bridge the gap between the irrigation potential created and actually utilised by focusing on conversion of gap areas and partially irrigated areas into fully irrigated areas
- Maintain adequate documentation for recording the actual conveyance efficiency of Radhapuram Channel to ensure supply of adequate water to all the farmers.
- Take efforts to assess the requirement of water based on the availability in the source dams and avoid delayed issue of Government orders for release of water for irrigation from Radhapuram channel.
- Frame Rules for regulation of water for irrigation systems in Kelavarapalli Reservoir to ensure release of water based on irrigation requirements.
- Take efforts to utilise the supply channel to benefit the agriculture lands by harnessing surface water.
- Ensure timely repairs and maintenance of irrigation channels as envisaged in the Rules for regulation of water in Reservoirs.
- Protect the assets created for enhancing the conveyance efficiency of the irrigation systems from encroachments and illegal drawal of water to fulfil equitable distribution of water.

- Strengthen monitoring mechanism to retain the quality of irrigation water by arresting the discharge of untreated water into the irrigation channels.
- Ensure effective functioning of Water Users Association and preparation of water budget to strengthen the Participatory Irrigation Management activities

**Chennai**  
**The 05 JUL 2022**



**(K.P. ANAND)**  
**Principal Accountant General (Audit-II)**  
**Tamil Nadu and Puducherry**

**Countersigned**

**New Delhi**  
**The 12 JUL 2022**



**(GIRISH CHANDRA MURMU)**  
**Comptroller and Auditor General of India**



# ANNEXURES





## Annexure I

(Refer to the Paragraph No. 3.3)

### Channel-wise increase in conveyance efficiency

(in percentage)

Sl. No.	Channel	At the time of preparation of DPR (2010-11)	2015-16	2016-17	2017-18	2018-19
	<b>EARTHEN CHANNELS</b>					
1	Ramakulam	20	36.67 (16.67)	35.83 (15.83)	37.33 (17.33)	37.67 (17.67)
2	Kallapuram	16.67	31.67 (15.00)	32.08 (15.41)	32.92 (16.25)	33.17 (16.50)
3	Kumaralingam	17.50	27.50 (10.00)	30 (12.50)	27.13 (9.63)	28 (10.50)
4	Sarkarkannadiputhur	20	32.50 (12.50)	31.75 (11.75)	31.75 (11.75)	33 (13.00)
5	Sholamadevi	18.52	27.78 (9.26)	26.67 (8.15)	27.59 (9.07)	28.15 (9.63)
6	Kadathur	14.55	26.64 (9.09)	22.73 (8.18)	23.27 (8.72)	23.55 (9.00)
7	Kaniyur	23.53	38.24 (14.71)	36.76 (13.23)	37.65 (14.12)	38.53 (15.00)
8	Karatholuvu	11.11	22.22 (11.11)	21.30 (10.19)	22.59 (11.48)	23.15 (12.04)
9	Alangium	15.48	23.75 (8.27)	24.50 (9.02)	24 (8.52)	25.75 (10.27)
10	Dhalavaipattinam	6.91	17.14 (10.23)	18.57 (11.66)	17.71 (10.80)	19.71 (12.80)
11	Dharapuram	14.28	20.95 (6.67)	21.90 (7.62)	20.62 (6.34)	21.05 (6.77)
12	Kolinjivadi	16.92	25.38 (8.46)	26.92 (10.00)	25.38 (8.46)	26.38 (9.46)
13	Nanjaithalaiyur	25	42.50 (17.50)	40 (15.00)	42 (17.00)	43.5 (18.50)
14	Sundakkampalayam	25	45.83 (20.83)	43.75 (18.75)	45 (20.00)	48.33 (23.33)
15	Chinnadharapuram	15.79	25 (9.21)	25.66 (9.87)	24.87 (9.08)	25.46 (9.67)
16	Nanjaikkalakurichi	25	37.50 (12.50)	35 (10.00)	37.5 (12.50)	38.5 (13.50)
17	Left Bank Channel	13.76	23.81 (10.05)	23.54 (9.78)	23.28 (9.52)	23.73 (9.97)
18	Right Bank Channel	13.40	23.20 (9.80)	23.71 (10.31)	22.63 (9.23)	22.86 (9.46)
	<b>Average of AOC</b>		(11.77)	(11.52)	(11.66)	(12.62)
	<b>LINED CHANNEL</b>					
19	AMC	79.32	96.36 (17.04)	97.50 (18.18)	97.5 (18.18)	98.18 (18.86)

\*Figures in bracket represent increase in percentage.

## Annexure II

(Refer to the Paragraph No. 3.4.3)

### Regulation of water in the channel: The disproportionate release of water

Sl. No	Channel	Ayacuts (Ha)	2014-15		2015-16		2017-18		2018-19	
			Water released from Anicuts (TMC)	Percentage of water released with respect to ayacuts	Water released from Anicuts (TMC)	Percentage of water released with respect to ayacuts	Water released from Anicuts (TMC)	Percentage of water released with respect to ayacuts	Water released from Anicuts (TMC)	Percentage of water released with respect to ayacuts
	<b>Head channel</b>									
1	Ramakulam	560.320	0.125	30	0.154	64	0.155	67	0.111	29
2	Kallapuram	558.460	0.132	32	0.151	62	0.155	67	0.124	33
	<b>Central portion</b>									
3	Komaralingam	509.657	0.338	90	0.336	152	0.241	114	0.236	68
4	Sarkarkandiputhur	267.610	0.169	86	0.168	145	0.120	109	0.118	65
5	Solamadevi	253.030	0.228	123	0.227	207	0.163	156	0.159	93
6	Kadathur	474.080	0.465	133	0.462	225	0.331	169	0.324	101
7	Kaniur	157.890	0.144	124	0.143	209	0.102	157	0.100	94
8	Karatholuvu	253.015	0.228	123	0.227	207	0.163	156	0.159	93
9	Alangium	426.550	0.363	115	0.185	100	0.196	111	0.348	120
10	Dhalavapattinam	377.180	0.320	115	0.163	100	0.173	111	0.307	120
11	Dharapuram	978.150	0.874	121	0.435	103	0.490	121	0.871	131
12	Kolingivadi	1,304.690	1.123	117	0.573	101	0.607	113	1.078	122
13	Nanjaithalaiyur	199.020	0.116	79	0.086	100	0.078	95	0.166	123
14	Sundakkampalayam	118.200	0.103	119	0.053	103	0.056	115	0.100	124
15	Chinnadharapuram	759.990	0.604	108	0.296	90	0.327	104	0.581	113
16	Nanjaikalakurichi	160.300	0.116	99	0.086	124	0.079	120	0.144	132
	<b>Tail end channel</b>									
17	Chettipalayam (RBC)	2,240.000	1.676	102	0.872	90	0.905	98	1.609	106
18	Pallapalayam (LBC)	2,292.000	1.633	97	0.833	84	0.882	93	1.764	113
	<b>Channels</b>	<b>11,142.000</b>	<b>8.759</b>		<b>5.146</b>		<b>4.912</b>		<b>8.062</b>	

<b>Glossary of abbreviations</b>	
<b>Abbreviation</b>	<b>Full form</b>
AMC	Amaravathi Main Channel
AOC	Amaravathi Old Channel
CE	Chief Engineer
DPR	Detailed Project Report
EIC	Engineer- in-Chief
GO	Government Order
GOI	Government of India
GoTN	Government of Tamil Nadu
Ha	Hectare
LMC	Left Main Channel
Mcft	Million cubic feet
Mcum	Million cubic meter
NABARD	National Bank for Agriculture and Rural Development
O&M	Operations and Maintenance
PIM	Participatory Irrigation Management
PWD	Public Works Department
RMC	Right Main Channel
TMC	Thousand Million Cubic Feet
TN-IAMWARM	Tamil Nadu Irrigated Agriculture Modernisation and Water-Bodies Restoration
TNFMIS	Tamil Nadu farmer's Management of Irrigation System
TNPCB	Tamil Nadu Pollution Control Board
World Bank	International Bank for Reconstruction and Development
WRD	Water Resources Department
WUA	Water Users Association





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