

Government of Kerala



**COMPLETION REPORT
OF
HYDROLOGY PROJECT- II**



Kerala Surface Water Component

Contents

	Title	Page No.
I	Introduction	2
2	Present Status of Development of Hydrological Data Base in Kerala	3
3	Output of Hydrology Project Phase I	3
4	Implementation of Hydrology Project- Phase II in Surface Water	4
	4.1 Aims/Objectives HP II	4
	4.2 Components	5
	4.3 Key Project Data	6
	4.4 Organisational Setup	6
	4.5 Structure of HIS in Kerala	8
5	Achievements/Activities in Hydrology Project Phase II	9
A	Institutional Strengthening	
	A.1 Conducting gauging operations	9
	A.2 Real Time HIS Upgradation	11
	A.3 Data Processing and Analysis.	12
	A.4 Data Storage and Dissemination	13
	A.5 Training Programmes	14
	A.6 Water Quality Monitoring	15
	A.7 Other Physical Achievements	18
B	Vertical extension	22
	B.1 Hydrological Design Aids	22
	B.2 Decision Support System (DSS)	22
	B.2.1 Components & Capabilities of DSS	23
	B.2.2 Technical Support	23
	B.2.3 Case study Basin – Bharathapuzha	23
	B.3 Purpose Driven Study	24
	B.3.1 Key Objectives	24
	B.3.2 Steps involved in the study.	25
	B.3.3 Awareness Programmes and Seminars	26
6	Financial Targets and Achievements	27
	Appenix	

Hydrology Project- Phase II (Loan No 4749 –IN) Kerala Surface Water Component Project Completion Report

Implementation Period: - April, 2006 to May, 2014.

1. Introduction

Scientific investigations on the development and management of water resources in a sustainable manner have gained importance in recent times, and salient issues pertaining to the subject are discussed in many international forums. The ‘Dublin Declaration’ of 1992 stipulates that water has an economic value, and should be recognized as an economic good, taking into account both affordability and equity criteria. The Mardel Plata UN Conference on drinking water and sanitation in 1977 proclaimed the right to drinking water in sufficient quantity and good quality as a basic human right. The Second World Water Forum (WWC, 2000) held in Hague, Netherlands recognized that, ‘Water is a basic human right’, and debated various steps required to ensure clean water in sufficient quantities for all in the future. International Conference on Freshwater (ICFW, 2001) held in Bonn focused on ‘water as key to sustainable development’ and recognized that ‘meeting the water security needs of the poor’ should be one of the important key policies for its sustainable development. Later, the United Nations declared the year 2003 as the International ‘Fresh Water Year’ with a mission, ‘Fresh Water for All’. Based on these, strategies were developed in India also for the conservation and protection of freshwater sources in a scientific manner. Governments and authorities at every level have to formulate and execute all required political, economic and technological measures that can ensure water security now and in the decades to come.

Readily accessible, reliable and adequate database on various hydrological parameters are the prerequisite for planning, design and development of water

resources in a sustainable manner. Moreover climate change will lead to an intensification of the global Hydrological Cycle and can have major impacts on regional water resources affecting both surface and ground water supply for various demands. Specific regional effects are also uncertain.

2. Present Status of Development of Hydrological Data Base in Kerala.

The state of Kerala, lies on the West coast of India at the Southern end of peninsular, has a land area of about 38,860 km². Most of the elongated state is formed by the Western Ghats with a narrow and discontinuous coastal plain fringing the Arabian Sea. Average Rainfall is about 3000mm/year. The rain fall occurs mainly during in the South-West Monsoon from June to September and North-East Monsoon from October to December, but short duration storms are fairly common during the relatively tri-months of January to May. Most of the state is drained westwards to the Arabian Sea by 41 relatively small river systems which originate on the upper most slopes of Western Ghats. A small part of the East ward draining Cauvery Basin (3 Sub basins) originates from Kerala.

Ninety percentage of rain fall is obtained during the months of June to October. During the other seasons there is scarcity of water in almost all parts of Kerala. This disparity can be solved to an extent by proper planning of the available water resources.

For developing and implementing a sustainable Hydrological Information System (HIS) through improvement and strengthening the infrastructure of Hydro-meteorological stations Hydrology Project Phase I was implemented during the year 1995-2003 in Kerala State and completed successfully.

3. Output of Hydrology Project Phase I in Kerala

- Data observation network was developed using advanced techniques and modern equipments – 44 River gauging sites, 140 meteorological sites including 9 full climatic stations and 19 Reservoir locations.

- Data entry and validation of hydro meteorological & water quality data have been digitalised. Advanced softwares are installed for data processing and analysis. Historical hydro meteorological data were computerised.
- Infrastructure developed - State Data Centre Building at Thiruvananthapuram, Level II lab building at Thrissur, Level I labs (10Nos), Office and Quarters – 14 Nos., Site Equipment Store and building -34Nos, Hydrological, Meteorological and Water Quality lab Equipments, Data Processing computer package and data storage computer package and Vehicles for data collection activities.
- Hydrological Data User’s Group, representing current and potential users of data, has been formed in State & District level. This group comprised of Government Institutions, Voluntary Organizations, and Other establishments like all professional bodies, universities and individuals engaged with operational, research & development and/or consulting responsibilities.
- Data disseminated to HDUG as per HIS protocol and Government norms.
- Integrated Bathymetric System for Sedimentation Survey in Reservoirs procured and surveyed all Reservoirs and Vembanadu Lake.
- Imparted training to the officers and relevant staff regarding softwares of data entry and validation.

4. Implementation of Hydrology Project- Phase II in Surface Water component of Kerala.

4.1 Aims/Objectives HP II

To extend and promote the sustained and effective use of the hydrological information system (HIS) by all potential users concerned with water resources planning and management, both public and private, thereby contributing to improved productivity and cost-effectiveness of water-related investments, a follow on **Hydrology Project Phase -II** has been taken up with the assistance of

International Bank for Reconstruction and Development (World Bank). The project has been implemented in 13 States including Kerala and 8 Central Agencies.

Agreement for Hydrology Project Phase –II between International Bank for Reconstruction and Development (World Bank) and Government of India has been signed on 19.01.2006. The project has become effective from 05.04.2006. The Project period is up to 31.05.2014.

Administrative Sanction to the project was issued vide G.O (MS) No. 53/2007/WRD dated 20.08.2007 by Government of Kerala for Rs. ₹75.536 million. Then the estimated project cost enhanced to ₹14.04 Crore as per Revised Cost Table 2013.

4.2 Components

Hydrology project-II has two components in Kerala State, institutional strengthening and vertical extension.

Institutional strengthening includes

- Consolidation of HP- I.
- Implementation support.
- Awareness raising & knowledge sharing.
- Data dissemination.
- Strengthening capacities to use existing software/equipment.

Vertical extension includes the following activities.

- Creation or development of hydrological design aids.
- Water quality studies, using well-established internationally acceptable methodologies
- Planning Decision Support System.
- Purpose driven studies.

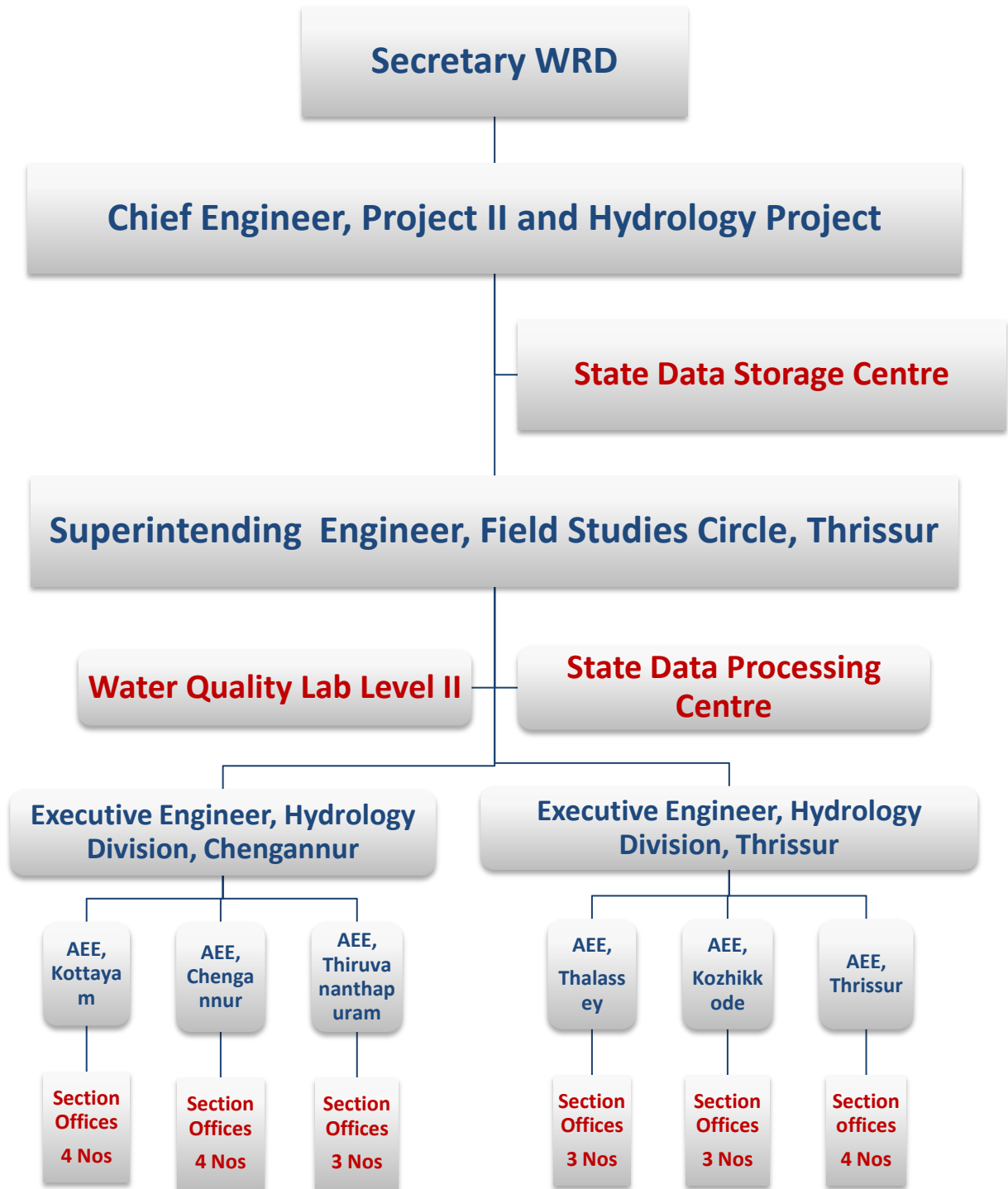
4.3 The key project data

Loan No.	4749-IN
Signing of agreement	January 19, 2006
Effectiveness	April 5, 2006
Closing date	June 30, 2012 (six years) extended to May31, 2014.
Total Project outlay as per Original Project Implementation Programme	Rs.7.55 Crores
Total Project outlay as per Revised Cost Table 2013	Rs. 14.04 Crores
Total expenditure up to March 2014	Rs. 10.43 crores
Committed expenditure by May31, 2014	Rs.0.63 Crore

4.4 Organisational Setup

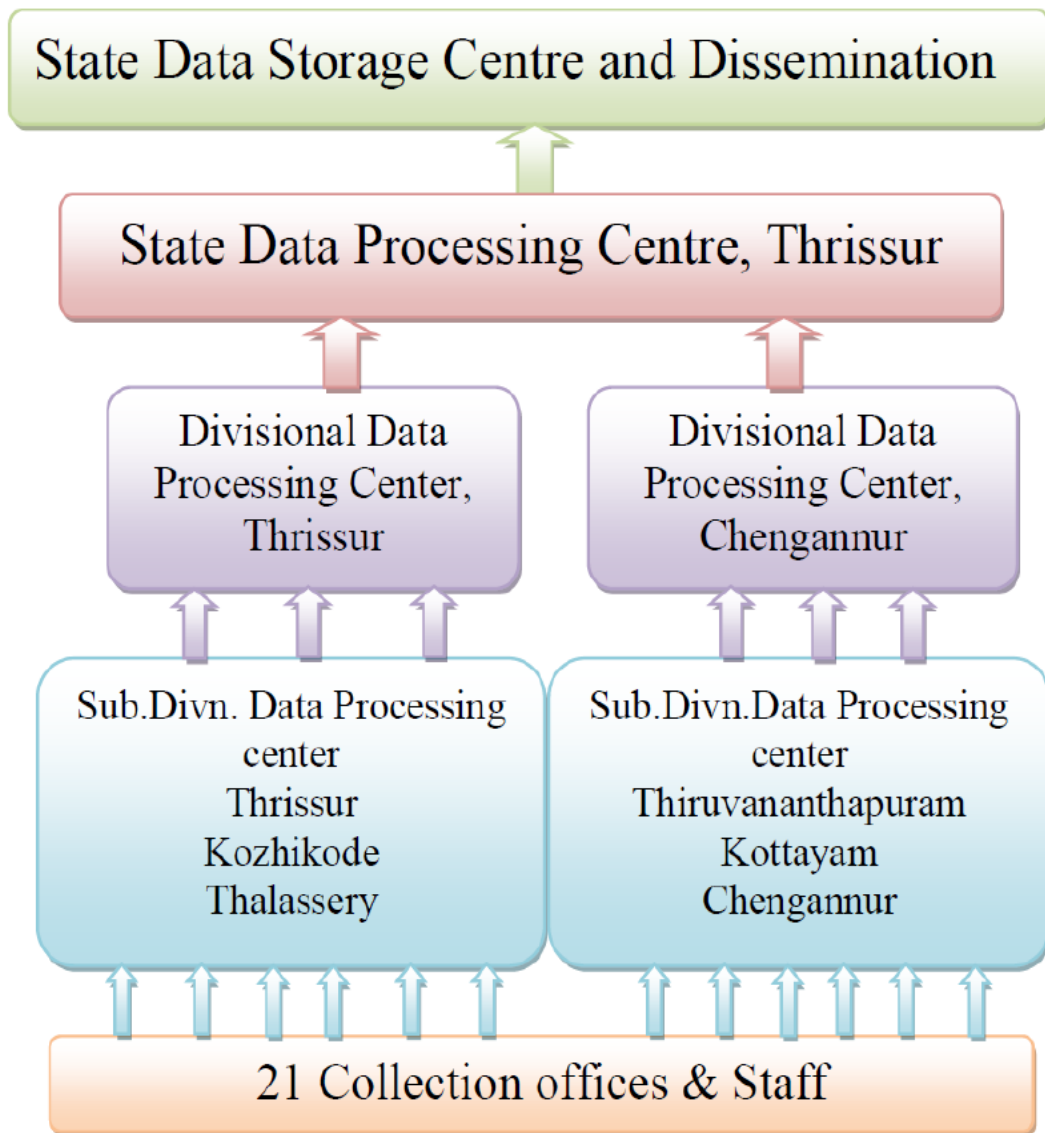
Surface water hydrological data collection and management is carried out by a circle office, within the jurisdiction of Chief Engineer, Project II and Hydrology Project in the Kerala State Irrigation Department, who reports to the Secretary to the Minister of Water Resources. This Circle office headed by Superintending Engineer controls two division offices, headed by Executive Engineers. Three Sub Division offices are there under each Division offices. 21 section offices are under these Sub Divisions. The sub divisions are headed by Assistant Executive Engineers and Sections are controlled by Assistant Engineers. In addition to this, Level-II (Water Quality) lab and State Data Processing Centre are directly attached to the office of Superintending Engineer, Field Studies Circle, Thrissur. State Data Storage Centre is attached to the office of Chief Engineer.

Organisational Chart



4.5 Structure of HIS in Kerala

The Hydrological Information system in Kerala, emphasising the distributed data Processing, exchange, and dissemination structure, as illustrated below.



4.5.1 Methodology

The observed field data are submitted to the Sub-divisional data Processing Centre at the end of the month of observation. These are entered and preliminary validation is being carried out within 10 days. The data are then passed on to the Divisional Data Processing centres. The WQ samples are also regularly sent to designate water quality labs. Samples are analysed within the prescribed time frame. The results are entered in the computer and subjected to primary validation. The data are then transferred to State Data Processing Centre, Thrissur for validation, completion, analysis, and reporting. The processed data are then transferred to State Data Storage Centre, Thiruvananthapuram for dissemination and maintenance of finalised databases for all future reference and use.

5. Achievements/Activities in Hydrology Project Phase II

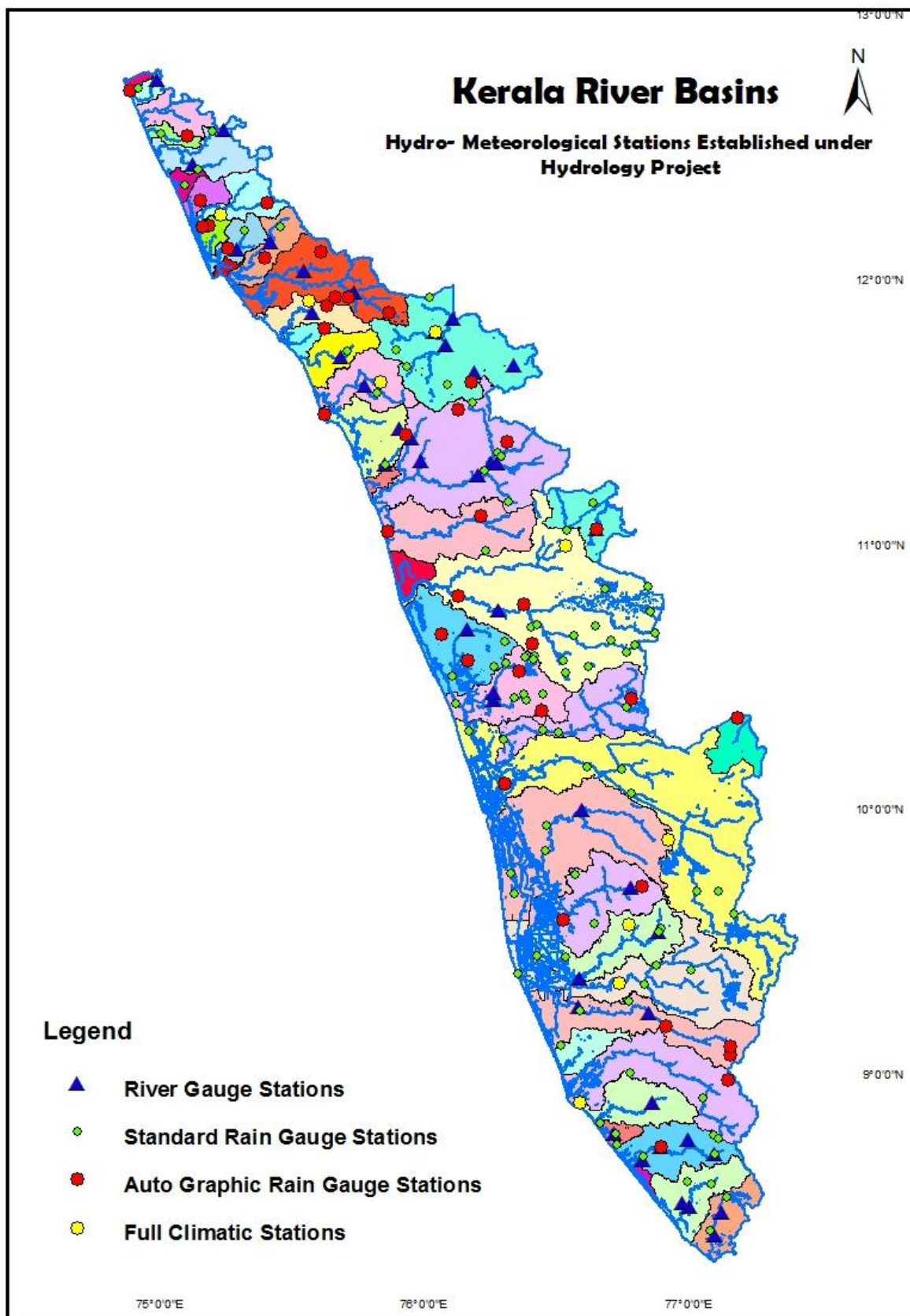
A: Institutional Strengthening

A.1 Conducting gauging operations

Gauging of Hydro- meteorological stations established under Hydrology Project Phase I was continued. In view of conducting gauging of all rivers of Kerala, new river gauge stations were also established in 10 more locations. Selection of river gauge locations and methods adopted for gauging were finalized based on the report obtained from CWC authorities. Data validated, processed, analysed and disseminated as per HIS protocol. Periodic inspections were conducted by IMD officials at existing FCS and rain gauge stations and based on their inspection report, proper actions were taken for obtaining correct data.

List of rainfall, climatic and river gauging stations are detailed in appendix 1.

Locations of Gauging stations in Kerala River Basins are shown in Map 1

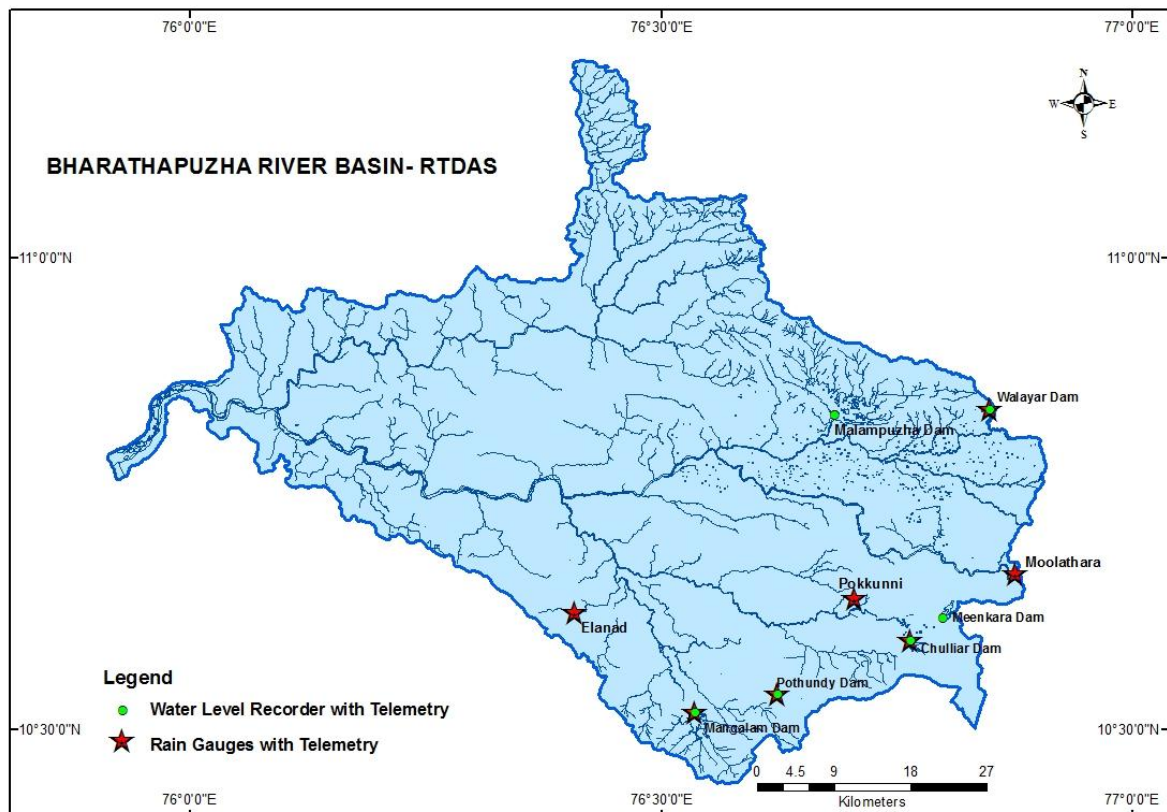


Map 1

A.2 Real Time HIS Upgradation

The Existing Rain Gauge Stations at Elanadu, Thrithala, Mangalam Dam, Chulliar, Pokkunni, Walayar and Moolathara in Bharathapuzha River Basin has been upgraded to Real Data Acquisition Systems and installed Tipping Bucket Type Rain Gauges with Telemetry Systems. In addition to this Reservoir locations in Walayar, Meenkara, Mangalam, Pothundy, Chulliar and Malampuzha upgraded with telemetric Systems.

Locations of Real Time Data Acquisition Systems in Bharathapuzha River Basin are shown in Map 2.



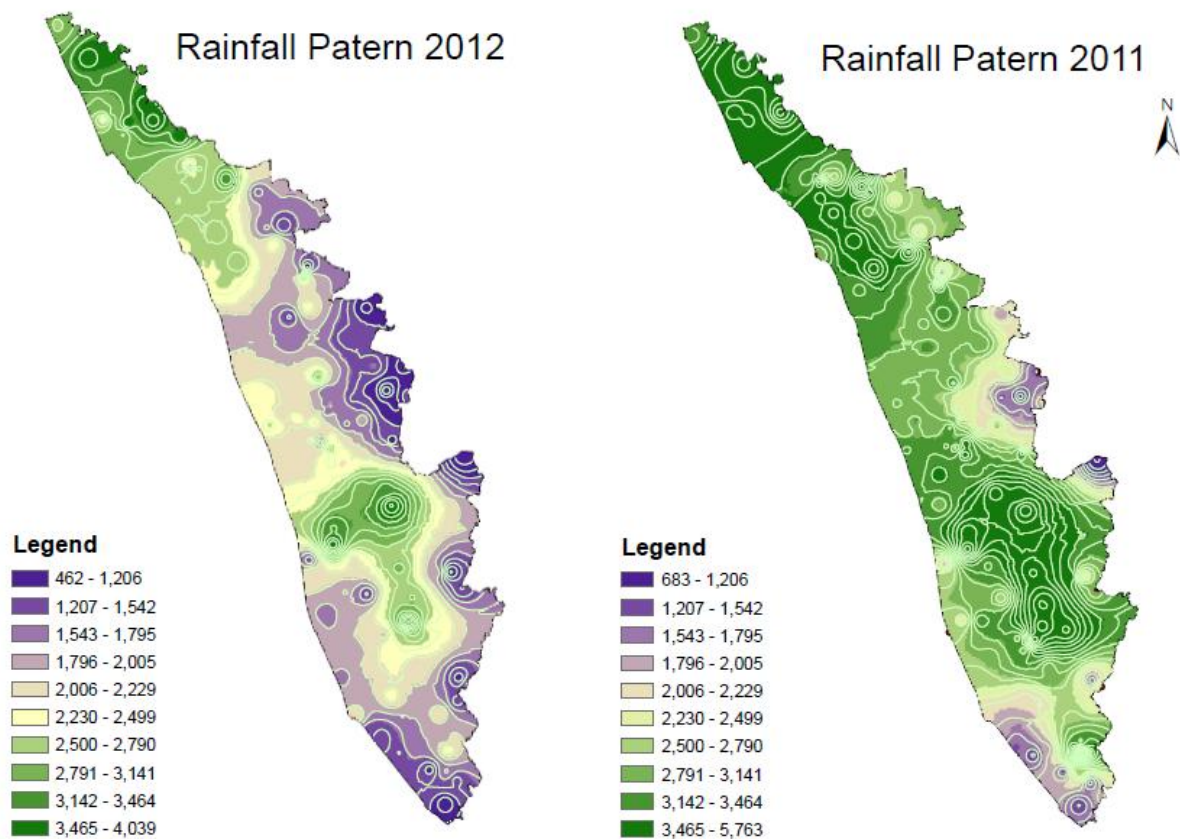
Map 2

A GSM telemetric System also installed at State Data Processing Centre, Thrissur. Gauge readers send daily rain fall data by SMS from all SRG locations, spread in Kerala River Basins and these data utilized by District Authorities for Monitoring rainfall pattern in various seasons.

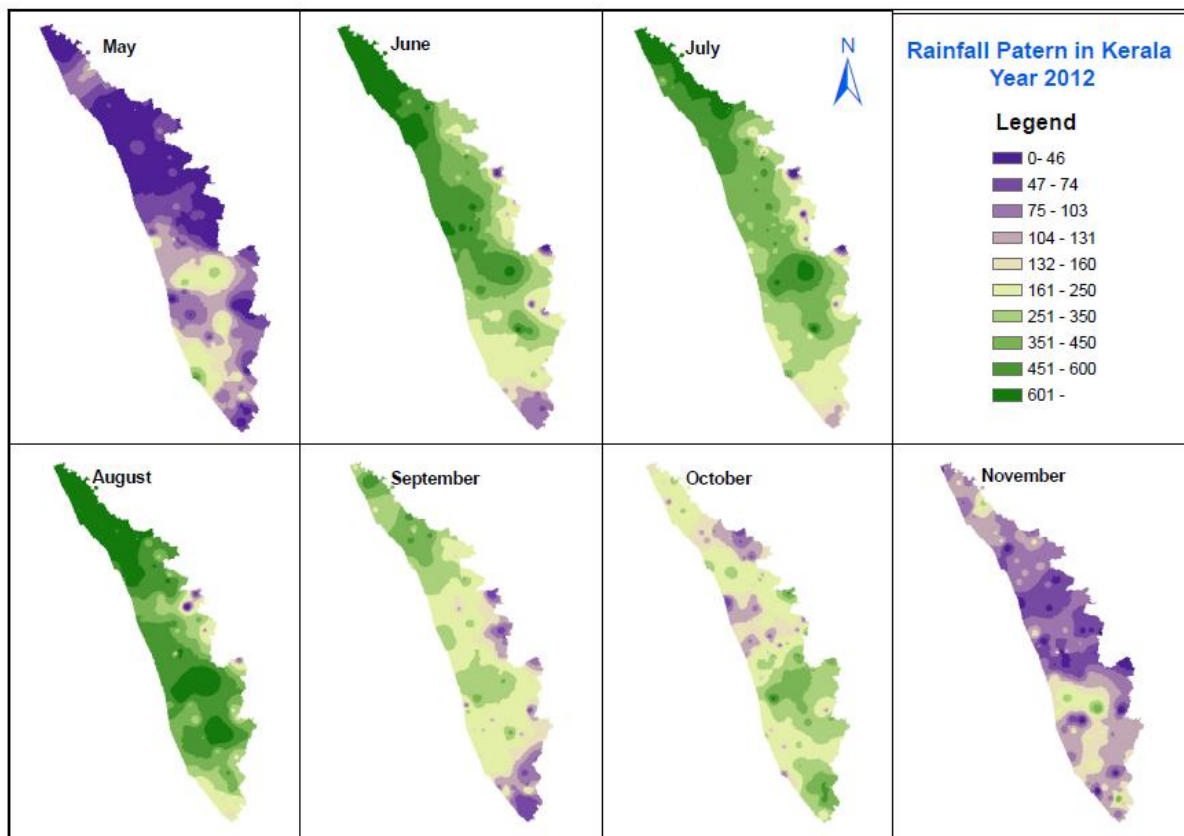
A.3 Data Processing and Analysis

Comprehensive data validation, processing, analysis of Hydrological and Meteorological data in consultations with the staff from two division offices is being carried out at State Data Processing Centre, Thrissur.

Rainfall pattern of Kerala during the year 2011 and 2012 are illustrated in Map 3 & 4.



Map 3



Map 4

A.4 Data Storage and Dissemination

All historical and current data stored in databases in Data Storage Centre, Thiruvananthapuram.

A large group of organizations like Government agencies, Educational Institutions, NGO's and other Research organizations inside and outside the state were utilizing the available data free of cost until March 2009. As per GO (MS) NO.12/2009/WRD dated 23.03.2009, Government of Kerala has fixed the pricing of data to various data users and as per this, validated Data is being issued to the users as per requirement.

In addition to this the validated data is being utilized by our own department for planning and design purposes. This includes DSS (P) of all river basins, Yield Calculation of rivers, preparation of Water Atlas of Kerala, River Management of

Pamba basin, Dam Rehabilitation and Improvement Programmes, Design of Check Dams, Vented Cross Bars and various regulators, Kole Land Development project in Thrissur District, Kuttanad Development package, NABARB Schemes.

Other than above there are a good number of requests for data from different agencies and academic organizations in every year. Main utilization areas are – Central Ground Water Board, CWRDM Kerala, Jananidhi Project, Water shed development projects under Local Self Government, Japan aided Kerala Water Supply Project, various projects under Kerala Ground Water Department, Hydro Electric Projects under KSEB, Kerala Industrial Technical Consultancy Organization for industrial studies, Indian railways, Kerala Road transport corporation and students from Engineering colleges, Geology students and officers of forest department etc. for academic purpose. Data also issued to individuals as per RTI Act.

A.5 Training Programmes

Training programmes were implemented to handle the latest, sophisticated technologies, software and protocols in HIS. The subjects and activities include

- In house training programmes to gauge readers.
- In house training programmes in SWDES, GIS, Water Quality sampling and analysis etc.
- National level training programmes in Hydrology, climatic change, real time data acquisition systems, GIS and applications on Water Resources Sectors, Hydrological Design Aids, River Basin and Rain fall- run off modelling related to DSS(P), TOT in Water Quality, online training programmes in basic hydrological science etc.
- International training programmes.
- Awareness Raising Programmes to data users.

Details of various training programmes conducted by Kerala Surface Water Component and attended are attached in Appendix 2.

A.6 Water Quality Monitoring

Water Quality Laboratories are established in Hydrology Project with an objective to analyse Physical, Chemical and Microbiological parameters of water samples and to create a comprehensive Water Quality database of the river basins of the state of Kerala, which did not have such a water quality monitoring programme before the inception of Hydrology Project.

As envisaged in the Hydrology Project, all the River Gauge stations established under HP are also monitored for Water Quality. Analyses of samples from various river gauge stations are being carried out on bi monthly basis. Samples received from Gauging locations after the analysis of Level I/Basic parameters, are analysed for Level II parameters at Level II Lab.

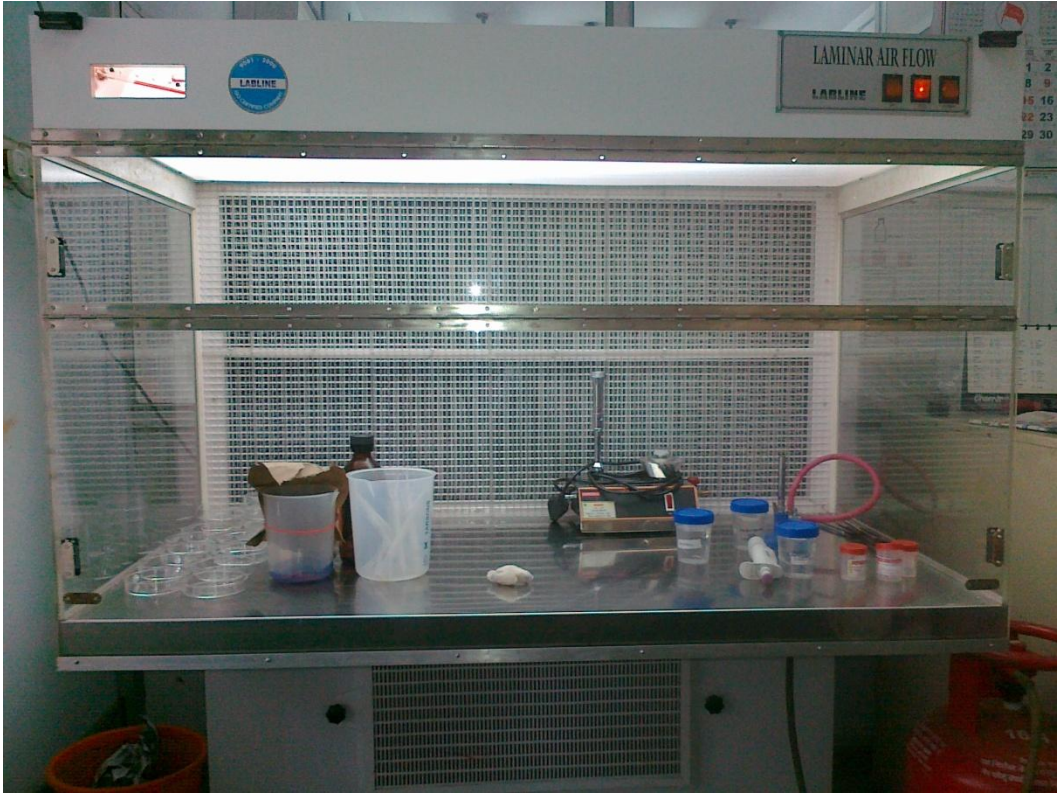
In addition to this during Hydrology Project-II Implementation period, the infrastructure facilities in Level II lab was strengthened and upgraded by procuring equipments for microbiological analysis and instruments like UV Spectro Photometer for Chemical analysis.

Instruments Procured under Hydrology Project II

1. UV-VIS Spectrophotometer
2. Laminar Airflow – Horizontal Type
3. Autoclave – Vertical Type
4. Bacteriological Incubator
5. Auto Loop Sterilizer.



UV-VIS Spectrophotometer



Laminar Airflow – Horizontal Type



Bacteriological Incubator



Autoclave – Vertical Type

A.7 Other Physical Achievements

i. Construction of training center at Thrissur

The training programmes under Hydrology Project were started since the inception of Phase I of the project and in house training needs were then met from rented buildings. Frequent training needs of various functionaries led to the proposal of Training Centre at Thrissur, near existing Hydrology Complex Building. Construction of Training Centre Building Completed.

The two storied building includes a training hall to accommodate 100 people, a library, dining room and office rooms. The training hall is provided with an acoustically sound environment. Sufficient air conditioners are provided for training

hall and library. Necessary furniture were procured for the training Centre. Total Cost of Construction is Rs.76.40 lakhs.



- ii. Procured Arc GIS Software with 3D Analyst and Spatial Analyst extensions for Data Processing and Analysis, Purpose Driven Studies and for the development DSS (P) Softwares.
- iii. Upgrading IT hardware, software and network capacities: Procured Computer Systems, Printers and other accessories.
- iv. Procured Hydrological and Meteorological Equipments for replacing damaged ones.
- v. Renovation works of 21 Gauging Stations completed.
- vi. Procured furniture and other office Equipments for the smooth functioning of offices.
- vii. Procured training Equipments like interactive white Board, Sound Reinforcement System, Projector etc.
- viii. Procured reference books for library and NPTEL Course Materials.
- ix. Procured vehicles for monitoring of observation networks and data collection activities.
- x. DSS Data base Server having internet connection with static IP installed at State Centre Thrissur and Three Work Stations installed at Satellite stations viz. Thiruvananthapuram, Chengannur and Thrissur. Final model of Bharathapuzha River basin was registered in the DSS (P) software installed in the Data base Server. Remote access of database of the server is established and is functional.
- xi. Maintenance of Gauging stations, Computer Systems, laboratory Equipments, Office Equipments etc.
- xi. **Construction of Regional Centre for Ground Water Building and Lab Level II at Ernakulam.**

This work is being done for Kerala State Ground Water Department, one of the implementing agencies of Hydrology Project in Kerala, as per their request and concurrence of World Bank. Technical personnel are available in Kerala Surface Water Component for Construction job. The Structural design for this building was done by the design wing of Kerala State Irrigation Department.

This is a framed structure having four stories- Basement floor, Ground floor, First floor and Second floor - to accommodate Water Quality Lab, Data processing centre, Data storage centre and other facilities.

The work was awarded to M/s. Fins Engineers and contractors pvt ltd, Trissur at a bid price of Rs. 449,95,019.05/-. The work is nearing completion and spill over work will be done under State Fund.



B. Vertical extension

B.1 Hydrological Design Aids

The proposed HDA modules are not yet delivered in Kerala Surface Water Component.

B. 2 Decision Support System (DSS)

Development of Decision Support System is one of the components of Hydrology Project II, making use of the HIS dataset generated in the Phase I of Hydrology Project.

DSS is a tool that can be used for planning and management of water resources. The systems developed are customized to the unique requirements of the user. The requirement may be surface water planning, integrated operation of reservoir, conjunctive use of groundwater and surface water, Irrigation management etc. on River Basin Scale. Mathematical model coupled with field data is the basis of DSS. Such models convert complex and dynamic system into simple one. Thus DSS produces well structured, user friendly, practical and complete water resources management information system making it easier for planners and decision makers to take appropriate decisions.

The Decision Support System (DSS) has been developed for planning and management of water resources of the states where National Hydrology Project is implemented.

National Institute of Hydrology (NIH), under the Ministry of Water Resources, Government of India (GoI) is the nodal agency for the development and implementation of DSS-P.

B.2.1 Components & Capabilities of DSS

The DSS-P software developed for integrated water resources development and management of water resources system address the following components of water resources planning and management.

- Surface water planning;
- Integrated operation of reservoir;
- Conjunctive surface water and ground water planning;
- Drought monitoring, assessment and management; and
- Management of both surface and ground water quality.

The DSS developed in this project will have a number of functionalities (capabilities), which can be grouped as follows:

- Data Management of spatial and time series data, including facilities for import, presentation and analysis of data;
- Scenario Management to define and execute model simulations and enable further analysis and processing of result;
- Analysis in the form of e.g. benefit-cost analysis or multi-criteria optimization; and
- Reporting of results.

B.2.2 Technical Support

Technical support is given by the Danish Hydrology Institute, Copenhagen who was the Consultants. National Institute of Hydrology, Roorkee, served as the nodal agency for the Project.

B.2.3 Case study Basin – Bharathapuzha

Being one of the participating states in the Hydrology Project II, Kerala has selected Bharathapuzha River Basin with its diverse hydrological and topographical characteristics as the pilot study basin for developing Decision Support System for water resource management.

A Detailed Report on this study is annexured (Appendix 3)

B.3 Purpose Driven Study

Subject: - A Comprehensive Assessment of Water Quality Status of Kerala State

It is a project jointly implemented by Kerala State Irrigation Department, Kerala State Ground Water Department & Hard Rock Regional Centre, National Institute of Hydrology, Belgaum.

B.3.1 Key Objectives

- To ascertain the existing Pollution Level of Rivers, Lakes, Ponds, Streams, Wells, Water Taps and other water bodies in Kerala.
- To evolve Water Quality Index for the surface water bodies and quality modeling for the selected river reaches.
- To develop vulnerability index for ground water Resources.
- To create awareness among the people about the locations causing pollution and thereby to initiate proper pollution control practices.

Total of 485 locations, were identified in different river basins of the state as sample collection points for conducting water quality analysis. Sample collection network was designed systematically, incorporating locations like river gauging stations, reservoirs, ponds, lakes, intake points of Kerala Water Authority, Tap water points of Kerala Water Authority, upstream of major distributory confluences, points likely to be contaminated by pesticides and downstream of discharge points of industries.

B.3.2 Steps involved in the study.

- Sample Network Design
- Collection and Analysis of surface water samples including Physico Chemical parameters, Bacteriological Parameters Trace Metals and Pesticides.
- Onsite analysis of Hourly DO and BOD for selected river Basins
- Discharge measurement at sampling sites
- Data Compilation
- Data exchange to NIH for further processing and reporting
- Awareness dissemination

WQ Data of surface water samples pertaining to various River Basins of the State have been generated for the following seasons.

Pre and Post Monsoon 2008
Pre Monsoon 2009
Pre and Post Monsoon 2010
Post Monsoon 2011
Pre Monsoon 2012

During the season Post Monsoon 2011 and Pre Monsoon 2012 samples were collected from the 15 major River Basins of the state and analysed for physico chemical parameters.

DO-BOD Monitoring of River Basins viz. Pamba, Periyar, Muvattupuzha, Karamana and Chaliyar have been carried out on hourly basis. Same study has been carried out for Vamanapuram, Kallada, Achenkovil, Manimala, Meenachil, Chalakkudy, and Bharathapuzha river basins during 2011 & 2012.

B.3.3 Awareness Programmes and Seminars.

- Mass awareness raising programmes were conducted on all Districts of Kerala during January and February 2012. These programmes were attended by user departments, Local Self Govt. authorities, Non Govt. organizations actively involved in water quality issues and river protection activities.
- Two technical workshops were organized to train the State Government officials involved in Water quality Analysis, Assessment and Management. In both the workshops nominees from Kerala State Irrigation department, Kerala State Ground water Department, Kerala State Pollution Control Board, School/ College teachers, representative from NGO's have actively participated. More than 100 members took part in each training program.
- A regional seminar on Water Quality Assessment and Management was conducted on 05-06, Feb 2013 at PWD Rest House, Thiruvananthapuram jointly by Kerala Ground Water Department, Kerala Irrigation Department and NIH, Belgaum. Following technical papers were presented during the seminar by the officers of Kerala Surface Water Component.
 1. ASSESSMENT OF WATER QUALITY STATUS AND EVALUATION OF WATER QUALITY INDEX FOR THE PURPOSE OF DRINKING AND IRRIGATION OF BHARATHAPUZHA RIVER BASIN, KERALA, INDIA - *Johar T S, V V Cherian and Suseela Mathews, Field Studies Circle, Thrissur.*
 2. WATER QUALITY ANALYSIS OF CHANDRAGIRI BASIN IN KASARAGOD DISTRICT – *M P Jacob and Anilkumar V, Hydrology Sub Division, Thalassery.*
 3. SURFACE WATER QUALITY EVALUATION AND MODELING OF PAMBA RIVER, KERALA –

B K Purandara ,National Institute of Hydrology, Belgaum, Chandramohan T, National Institute of Hydrology, Belgaum, Sajikumar T P ,Hydrology Section, Adoor, and T S Johar Field Studies Circle, Thrissur.

4. A STUDY TO ASSESS SURFACEWATER QUALITY OF ACHENCOIL BASIN – *Haikumar P G and Harikumar K R, Hydrology Sub Division, Chengannur.*
5. WATER QUALITY ASSESSMENT OF KALLADA RIVER – *Sajikumar T.P, Hydrology Section, Adoor and Harikumar K R Hydrology Section, Chengannur*
6. SURFACE WATER QUALITY ANALYSIS IN MANIMALA RIVER BASIN, KERALA - *Harikumar P G ,Hydrology Sub Division, Kottayam and Suseela R, Hydrology Section, Kottayam.*
7. WATER QUALITY ASSESSMENT OF VALAPATTANAM RIVER – *Khalisa Kozhithody and Anilkumar V, Hydrology Sub Division, Thalassery.*

Project Summary and detailed report regarding this study is attached in Appendix 4 & 5.

6. Financial Targets and Achievements

Against the total target of Rs.14.04 Crore, total expenditure upto March 2014 is Rs.10.46 Crore. Committed expenditure by May 31, 2014 is Rs.0.63 Crore. The Component wise expenditure is attached in Appendix 6 and year wise expenditure is listed below. Further all expenditure incurred was entered in web based FMR system and reimbursement claims upto March 2014 was submitted to CAAA, MoWR.

Year wise Expenditure Details

Year	Expenditure in Rs.'000'
2006-07	5545.469
2007-08	5575.551
2008-09	9418.245

2009-10	14615.187
2010-11	13203.514
2011-12	15316.202
2012-13	12039.048
2013-14	28602.872
Total	104316.088
