

Government of Kerala

Tenth Five Year Plan 2002-07

Report of the Working Group on

'Water Resources & Environment -

Approach, Policies and Reforms'

**State Planning Board
Thiruvananthapuram
May 2003**

Preface

The State Planning Board has constituted 8 Plan Committees for the formulation of Tenth Five Year Plan 2002-07. The Plan Committee on 'Water Resources & Environment' with Shri. V. Ramachandran, Vice-Chairman, State Planning Board as its Chairperson was constituted as per Proceedings No. 6149/2001/Ag/SPB dt. 20.10.01. The first meeting of the Plan Committee held on 24.10.01 has decided to constitute 4 working groups namely,

- (i) Working Group on Water Resources & Environment – Approach, Policies & Reforms
- (ii) Working Group on Drinking Water
- (iii) Working Group on Environment
- (iv) Working Group on Local Level Water Resources Development

The Working Group on 'Water Resources and Environment – Approach, Policies & Reforms' was constituted with Shri. K. Jayakumar, Secretary to Government (Irrigation & Water Supply) as Chairman as per Proceedings No.6149/2001/Ag (W1)/SPB dt. 31.10.2001 (Annexure – 1)

The Working Group had three sittings and held detailed deliberations on the various issues pertaining to the terms of reference. This report is prepared based on the deliberations of the working group. The group is grateful to one and all who contributed to bring out this report.

The report is presented to the State Planning Board for consideration of the Plan committee on 'Water Resources and Environment'.

Chairman

Introduction

Water is one of the primary natural resources on which the sustenance and eco-development of the State are largely dependent. Kerala State is endowed with rich water resources. The water bodies of the State includes 44 rivers, tanks and wells, backwaters, innumerable rivulets and streams. In the All India perspective the rivers of Kerala are not so significant that even the largest of them cannot find a place among the major Indian rivers. Major rivers with a length of over 15 Km. alone are 44 in numbers, 41 flowing westwards to the Arabian Sea and 3 flowing eastwards and joining the Cauveri river. Most of the rivers are perennial although the water flows shrink considerably after the monsoon months. The western ghats from where the river basins originate is devoid of snow and therefore the river systems do not have the benefit of water supplied during the summer seasons as in the North Indian rivers. However the bimodal pattern of rainfall compensate to a large extent and help spreading the period of water flows. Being located in the high rainfall tropical region the State falls in one of the regions in the world having the highest potential for biomass production. The State receives year round solar radiation, warm temperature and high rainfall with an average annual precipitation of 300 cm. In view of its strategic location the State is endowed with both the monsoons. The average rainfall combined with a very luxurious vegetative cover over a vast area of the land surface provides ample opportunities for the recycling of the available water resources. The normal annual rainfall in Kerala is 3000 mm against the national average of 1190 mm. Though the rainfall in the State is higher than the national average, the undulating topography, extreme unevenness of the rainfall in time and space, very short river lengths, unique physiography, geology, soil, vegetation and very high population density have resulted in low capability for utilisation. Optimal utilization of the available water resources through appropriate conservation and management measures therefore assumes critical importance in sustaining the life support systems.

The demand for water in Kerala is mainly for drinking, agriculture as well as for prevention of salt water intrusion, and generation of electricity. The annual yield of water in Kerala in a normal year is around 7030 crore cubic metres. The ground water resource available in Kerala is estimated at 7048 MCM. As per the rough estimate of the projected demand of water, Kerala would require around 3000 crore cubic meters of water for agriculture, 750 crore cubic metres for domestic use and 1220 crore cubic metres for prevention of salt water intrusion. The total requirement works out to 4970 crore cubic meters. The utilizable water resources as per the earlier assessment is around 4200 crore cubic meters. Nearly 40 percent of the available resources are lost as run off causing heavy floods. The pattern of demand for water is also undergoing gradual but continuous changes towards increasing pressure for drinking and other domiciliary needs and decreasing demand for irrigation. The demand for irrigation support is changing because the state has almost reached a saturation point in respect of land use for agriculture and the emerging trend is towards less water demanding perennial crops in lieu of seasonal crops. Planning for irrigation development in the context of Kerala should therefore be part of the total plan for development of water resources and its rational utilization. It should necessarily encompass surface and ground water development and it should take into account the opportunities for their development through public and private investment. The first and foremost step to be initiated in this regard is updating assessment of the demand pattern. The latest assessment was in 1974. Water resources development planning should therefore have in its agenda the objective of reducing the degree of loss on this account through appropriate conservation measures and recharge mechanisms. Conjunctive use of ground water and surface water resources needs to be planned with irrigation projects from the beginning. There is a need to take effective steps for improving water use efficiency through renovation and modernisation of existing systems. The available supplies could be effectively utilized to benefit more number of people through better management. The local level planning already launched by the state has set the ground for prioritising the various needs for water at the grass root level and planning for their development in a systematic manner.

I. Development of Irrigation over the Plan periods

Irrigation plays an important role in the growth of agricultural income of the State. The planned development of irrigation was initiated during the fifties right from the beginning of the first Five Year Plan and continued thereafter through the successive plans. The investment so far made in the Five Year Plans for the sector is given in Table – 1. From the table it seems that the flow of plan finance has increased considerably from the second plan onwards. The percentage share of plan investment to the sector to the total state plan investment during the first plan was 19.73%. Eventhough the plan investment to the sector has shown an increasing trend in absolute terms, the percentage share to the State total investment had shown a varying trend. The investment, which was 19.73% in first plan, has decreased to 12.47% in 8th plan and 6.38% in the 9th Plan.

Irrigation development in Kerala was mainly centered on the development of surface water resources. Keeping in line with the national perspective, Kerala also relied mostly on the development of major and medium projects. In each Plan, priority in allocation was given for the development of major and medium projects. About 60% to 70% of the investment in each plan was made for this purpose. Minor irrigation schemes, though they are more appropriate for Kerala conditions received less attention during the earlier Plan periods. About 14 to 17 percent of the investment under Irrigation in each Plan only was utilised for the development of minor irrigation. Ground water development took momentum only from VI Plan onwards. The amount so far (3/2002) invested for the development of Ground Water schemes amounts to Rs. 103.65 crores which accounts for 3.28% of the total investment under irrigation.

Anti-sea erosion is an item supported under plan from the second plan onwards. About Rs. 201.29 crores (about 6.37%) were invested for anti-sea erosion works upto 3/2002 from the state funds. This activity was supported by the Central government also. Government of India invested an amount of Rs. 71.79 crores for this purpose.

Flood Control activities were continued under Plan from Third Plan onwards. A cumulative sum of Rs. 119.84 crores (3.8%) was invested upto 3/2002 for protecting an area of 54485 Hectares of land.

Table - I
PLAN-WISE EXPENDITURE

(Rs. Lakhs)

Sl. No	Plan	Major & Medium	Minor SWD	Minor GWD	Flood Control	Anti Sea Erosion	CADA	Total
1	2	3	4	5	6	7	8	9
1	I Plan (1951-56)	511.00	-	-	-	-	-	511.00
2.	II Plan (1956-61)	892.43	226.20	-	-	189.35	-	1307.98
3.	III Plan (1961-66)	1031	564.69	-	63.00	457.00	-	2115.69
4.	Annual Plan (1966-69)	1015	653.02	-	109.76	123.68	-	1901.6
5.	IV Plan (1969-74)	2892	1122.00	10.83	158.00	540.09	-	4722.92
6.	V Plan (1974-78)	7513	1266.67	73.41	228.25	454.10	-	9535.71
7.	Annual Plan (1978-80)	7235	1055.33	52.47	313.01	369.07	-	9024.88
8.	VI Plan (1980-85)	26207	3408.96	584.44	530.84	1260.27	83.64	32075.15
9.	VII Plan (1985-90)	30190	3572.24	890.78	813.24	982.34	1475.79	37924.39
10.	Annual Plan (1990-92)	13459	2839.68	661.50	612.87	953.05	1510.46	20036.56
11	VIII Plan (1992-97)	58693	12864.85	3139.87	4060.14	7259.36	4778.04	90795.26
12.	IX Plan (Exp:upto3/2002) (Provisional)	68879	14782.00	4952.00	5095.00	7541.00	4939.00	106188.00
Total		218520.43	42355.64	10365.3	11984.11	20129.31	12786.93	316148.00

Command area development activities were started in Kerala from 1980 onwards. Upto 3/2002, an amount of Rs. 127.84 crores has been expended under State plan for implementing the CAD activities. Central assistance to the tune of Rs. 112.75 crores was also invested for CAD activities in Kerala

Past Performance

Irrigation plays an important role in the growth of agricultural income of the State. The development of irrigation in Kerala lags behind many other states in

the country. The planned development of irrigation was initiated during the fifties right from the beginning of the first Five Year Plan and continued thereafter through the successive plans. With the advent of five year plans a number of new projects were taken up. Till the end of 3rd Plan 19 projects were taken up and all of them continued as spill over projects in the Fourth Plan. One of the achievements during the fourth plan as that out of the 19 spill over projects 10 could be completed. New projects were taken up during the successive five year Plans.

The strategy adopted for the development of water resources and its management during the Ninth plan aimed at conservation of natural resources including rainwater through appropriate intervention and ensuring its optimal utilisation. It also contemplated optimum utilisation of the potential already created by introducing appropriate system of participatory management suitable to the systems and social groups. Consequent to the introduction of the decentralised planning. Demarcation of the responsibility has been brought about in the area of irrigation management at the state level and the local bodies.

At the beginning of the Ninth Plan there were 14 completed projects and 15 ongoing projects which were in different stages of implementation. The strategy adopted for the major and medium projects during the plan period was (i) time bound completion of projects which are in an advanced stage of completion. (ii) revamping and consolidation of old generation projects through modernisation programmes, (iii) reinvestigation of projects which are in the initial stages of investigation (iv) optimum utilisation of the potential already created through proper maintenance and (v) introduction of multi purpose and self supporting medium projects under autonomous authorities. Under time bound completion eight projects namely Kallada, Muvattupuzha, Karappuzha, Idamalayar, Kanhirapuzha, Pazhassi, Kanakkankadavu and Chimmoni-Mupli. Out of this, 4 projects namely Pazhassi, Kanhirapuzha, Chimmoni-Mupli and Kanakkankadavu could be completed. Even though the schedule of completion for the plan could not be strictly adhered to, there was considerable progress in the execution of the projects for which priority was given. Accordingly Kallada project could almost be completed except for some minor works, Muvattupuzha and Karapuzha are

projects nearing completion and execution of Idamalayar is progressing. The status of the major and medium projects are given in Table 2.

Table 2

Status of Major irrigation Projects as on 3/2001

Completed Projects		Ongoing Projects		Projects under Investigation	
Sl. No.	Name of Project	Sl. No.	Name of Project	Sl. No.	Name of Project
1	Malampuzha	1	Kallada	1	Vamanapuram
2	Mangalam	2	Muvattupuzha	2	Chaliyar
3	Peechi	3	Idamalayar	3	Meenachil
4	Vazhani	4	Karapuzha	4	Aralam
5	Pothundi	5	Kuriyarkutty Karappara	5	Palakappandi
6	Gayathri	6	Chamravattom B/R	6	Payaswini
7	Cheerakuzhy	7	Thrithala B/R	7	Munnamkadavu
8	Walayar	8	Attappady	8	Projects in Kabini Basin
9	Chalakydy	9	Banasurasagar		
10	Neyyar				
11	Pamba				
12	Periyarvalley				
13	Chitturpuzha				
14	Kuttiyady				
15	Chimmoni				
16	Kanakkankadavu B/R				
17	Pazhassi				
18	Kanjirapuzha				

Revamping and consolidation of old generation projects was one of the strategies adopted for augmenting the water distribution efficiency of the old generation projects which had deteriorated over the years and occurred radical changes in the water distribution system. Detailed baseline studies have been conducted for identifying the most critical intervention necessary for renovation of the system, categorising them into head works, main canal, branches and distributaries. This would also involve restructuring delivery system to suit the shift in cropping pattern occurred in the ayacuts over the years. The nature of works supported include repairs in head works and regulators, providing measuring devices, lining works in canal systems, repair/renovation of control structure; improvement in CD works, protection works in conveyance systems etc, which would help in preventing leakage/seepage and other losses. The implementation has been scheduled in a phased manner sequencing the intervention from head works, main canal, branches and distributaries. Nine projects out of the 10 old

generation projects were taken up initially and the implementation of the scheme is progressing.

In the case of projects where the construction part has not been taken up yet preliminary investigations were done in late seventies and early eighties. It is desirable that a fresh study of the feasibility of these projects is made before proceeding further. The crop situation in the prospective commands of all these projects has undergone drastic changes as part of the large scale shift in cropping pattern taken place all over Kerala from food crops to commercial crops. In most of the commands the wetland ecosystems might have already given way to garden land agriculture and as such the original project assumptions are no more relevant. Not that the projects themselves have become redundant under the new situation and cropping system, but the nature of irrigation system and the frequency of irrigation required for the new cropping pattern will be different from what was originally envisaged while designing these projects. The new cropping pattern, with less water demanding crops such as coconut, rubber etc. replacing the high water demanding crops such as rice would enable the existing irrigation network to support more areas with the same quantity of water. The design of the dam, the lay out of the distribution system and the management of water would definitely require a new orientation and a fresh appraisal. The projects, Meenachil, Vamanapuram, Attappady, Banasurasagar, Chamravattam B/R, Thrithala B/R were included for reinvestigation. The investigation works in respect of Banasurasagar, Chamravattam B/R and Thrithalla B/R were completed and works were started.

Physical Performance

On the physical side, the irrigation potential of Kerala is estimated at 15 lakh ha (net) and 25 lakh ha (gross). The cumulative coverage under irrigation till the end of **3/2002** as assessed by the Directorate of Economics and Statistics was 3.77 lakh ha (net) and 4.32 lakh ha (gross). The irrigation support did not appear to have helped either in bringing new areas under cultivation or increasing the cropping intensity. In all these areas, the overall performance in Kerala presents more or less a static picture. As already mentioned, rice is the major crop benefited through irrigation infrastructure. Even in the case of this crop, the incremental yield, which the irrigation support could bring, is insignificant. With the fast

changes taking place in the farm front of Kerala with considerable reduction in the area under rice cultivation, even the systems already developed for gravity irrigation to service rice cultivation require realignment in the distribution systems.

1.1 Performance during the Ninth Plan

Financial Analysis

The Ninth Plan outlay for the Irrigation sector was Rs. 1028 crores which include Rs. 650 crores for major and medium irrigation, Rs. 250 crores for minor irrigation, Rs. 40 crores for CADA and Rs. 88.00 crores for Flood Management and Coastal zone Management. The outlay budgeted during the period aggregates to Rs. 1154.65 crores, i.e. nearly 12% more than the Plan outlay for the sector. The anticipated cumulative expenditure for the Ninth Plan period was Rs. 1061.88 crores which works out to 103% of the Plan outlay and 92% of the budgeted outlay.

Physical Performance

Ninth Plan contemplated realisation of additional irrigation potential of 2.44 lakh hectares through completion of the ongoing major projects (1.50 lakh hectares) and extension of minor irrigation facilities (0.94 lakh hectares). The cumulative targets projected for the first 4 years of the plan are 1.56 lakh hectares, which includes 0.80 lakh hectares under major and medium and 0.76 lakh ha. under minor irrigation. Against this, the achievement during the first 4 years aggregates to 0.65 lakh ha.(0.30 lakh ha. under major and medium and 0.35 lakh ha. under minor irrigation) i.e., nearly 27% of the target could be achieved during the Ninth Plan period. The shortfall is mainly in the major irrigation sector. Though the physical coverage under minor irrigation is relatively better, it is not commensurate with the enhanced scale of investment through the State Plan as well as from the local plans. The physical performance in respect of completion of projects as well as additional coverage under irrigation is not encouraging.

A major transformation, which the state could bring in during the Ninth Five Year Plan, is the devolution of funds and authority for planning and execution of minor irrigation projects to the local bodies.

1.2 The major strategies adopted for the development of the Major & Medium projects under the Ninth Five Year Plan and its achievements.

A five-pronged strategy has been adopted for the implementation of the major irrigation schemes during the Ninth Plan period which includes (i) time bound completion of projects that are nearing completion. (ii) revamping and consolidation of major irrigation projects through a modernisation programme, (iii) reinvestigation for reassessment of the costs and benefits of the projects which are under consideration. (iv) optimum utilisation of the potential already created through proper maintenance of the completed systems with participatory management and (v) introduction of the concept of multipurpose and self-supporting medium projects under autonomous authorities.

Achievements

(i) Time bound completion of projects

Projects targeted for completion – 8

Projects completed – 3

Chimmoni

Pazhassi

Kanakkankadavu

Projects nearing completion – 2

1. Kanjirapuzha

2. Kallada

Projects behind the schedule – 3

Karapuzha

Muvattupuzha

Idamalayar

(ii) Optimal utilisation of the potential created through proper maintenance and under participatory management.

Introducing appropriate systems of participatory management suitable to the systems and social groups by involving the local bodies was envisaged. No concrete steps have so far been taken to operationalise this strategy.

(iii) Revamping & Consolidation of old irrigation projects.

Under the new programme introduced for revamping and consolidation of old generation projects, 9 out of 10 projects coming under the category of those completed before 1970 could be taken up. Rehabilitation packages have been drawn up based on detailed study of the current status of each project, its resource base, current level of utilisation, changes that have taken place over time and the modifications necessary to make it more effective and beneficial. The duration of the project was three years. Although the planning phase has been done in an organised manner, the implementation part has not been satisfactory. The progress of implementation of the scheme was very slow leading to considerable time over run resulting in cost escalation. The project cost which was Rs. 58.50 crores in 1997-98 has been revised to Rs. 90 crores in the 99 schedule of rates. The implementation of this time bound programme was not in the right direction. The programme has been spilled over to the X plan.

(iv) Re assessment of the cost benefits of the projects which are pending execution for long time since their formulation

Four projects namely Vamanapuram, Meenachil, Attappady, and Banasurasagar come under this category. However re assessment of the cost benefit as envisaged in the plan has been initiated only in the case of Banasurasagar and Vamanapuram. The construction work has just started in Banasurasagar

project. DPR in respect of Vamanapuram integrating irrigation, water supply and power generation is yet to be finalised.

(v) Concept of self supporting, multi purpose medium projects under autonomous authorities

The new concept has been approved in principle for operationalisation in connection with the implementation of Kuriyarkutty – Karappara, Chamravattom, Thrithala and Attappady projects. However much head way could not be made in conceptualisation of the projects on these lines. Implementation of the Kuriyarkutty – Karappara project has been in a stand still stage for want of clearance for construction of the head works. Thrithala and Attappady projects have been started as multipurpose projects though they are not conceived as self supporting under autonomous authorities. Chamravattom project has been taken as a pilot project in this direction.

Review of Ongoing Major Irrigation Projects

1. Kallada.

Kallada Irrigation and Tree Crop development Project is the second largest project in Kerala started in 1961 with an original cost of Rs.13.28 crores. The final estimate of the project was Rs.725 crores in the 1999 schedule of rates. The cost escalation reported is 5356%. The ayacut targeted was 61630 ha.(net) and 92800 ha. (gross). Though the project was targeted for completion and priority in allocation was given during Ninth Plan it could not be completed and commissioned fully. The implementation of the project was not in a systematic way. The organisation of the work programme was so sporadic and piece meal without any perspective for completing the project in meaningful sequence commencing from the main canal followed by branches and distributaries. This has been the major reason for prolonging the work and as a result the ayacuts in the completed portions of the main and branch canals could not get the benefit of irrigation through partial commissioning. The delay in the execution of the project led to cost escalation substantially and it became difficult to complete the project with the normal plan funding. Eventhough an amount of Rs.630 crores has been

expended as on 6/2001, the project could not be completed due to the following reasons.

(i) Huge establishment cost

A huge establishment was provided for the construction by the Irrigation department, for land acquisition by the Revenue Department and for agriculture by the Agricultural Department in the project. Hence the establishment cost has exceeded more than that expected in the project.

- (ii) litigation of the contractors
- (iii) non-settlement of arbitration cases
- (iv) non-allocation of funds in time.

This project was posed for assistance from the AIBP of Government of India for quick completion. An assistance to the tune of Rs. 28.85 crores was availed under AIBP for the project. Even then it could not be completed. A project-wise comparison reveals that the project consumed nearly 1/4 of the total investment under major irrigation projects in Kerala. Though full commissioning of the project could not be done during the Ninth Plan period, almost all the works in head structure, main canal and branches could be completed. Only minor works remain to be completed. Hence it is decided at the Department level to complete the project by 3/2002 in all respects by completing the essential works, which will optimise the benefit of the infrastructure already created.

2. Muvattupuzha.

Muvattupuzha Valley Irrigation Project is a major multipurpose project started in 1974 with an estimate cost of Rs.20.86 crores. The estimated cost of the project at present is Rs.515.00 crores in the 1999 schedule of rates. The works connected with the project started in 1974. The project envisages provision of irrigation facilities in 17737 ha. of land utilising the tailrace water from Idukki Hydro-Electric Project and run off from the catchment stream of Thodupuzha river by constructing a dam at Malankara – 8 km. upstream of Thodupuzha town.

The original estimate was revised thrice due to major deviations from the original design and cost escalation. The design of head works to the mini-hydro-

electric project of 10 MW has been changed. The project is scheduled for completion by 2004. Besides irrigation, the project aims at:

Generation of 4.77 MW of power, Release of 700 cusecs of water for effluence treatment in Newsprint factory down steam of Velloor; and
Release of 65 cusecs of water for industrial and domestic water supply.

The left bank canal has a length of 37.10 km. It is designed to irrigate an area of 12713 ha. The right bank canal is 28.34 km. long to irrigate 5024 ha. The command area of the project comprises of both wet and dry lands and 64.6% of irrigation is meant for paddy and 35.4% for tree/garden crops. The ayacut of the project stretches out in the district. of Ernakulam, Kottayam and Idukki benefiting the taluks of Muvattupuzha, Thodupuzha, Kothamangalam, Kottayam, Vaikom and Meenachil.

The work relating to the dam and major portion of the main canals were completed. The branches and distributaries remain to be completed. Out of a total length of 58.5 km. of branches only 21.05 km. have been completed and 34.33 Kms of distributaries out of a total of 184 Km. has been completed. The expenditure incurred as on 3/02 is Rs. 375.15 crores. The progress of execution is very slow and the ayacut achieved is only 2750 ha. While analysing the project the major reasons that attributed to the delay in implementation are:

- (i) Pending settlement of 56 vigilance cases.
- (ii) Non-availability of adequate funds in time.
- (iii) Delay in land acquisition process.
- (iv) Lack of supply of construction materials.

For the speedy implementation of the project, MVIP has been posed for assistance under AIBP and an amount of Rs. 12.00 crores has been released for the project. The project is spilled over to Tenth Plan.

3. Karapuzha

Karapuzha is the first irrigation project taken up in the Kabini basin in Wayanad district in 1975 with an estimated cost of Rs. 7.60 crores. The projected ayacut is 9300 ha. (Gross) and 5221 ha. (Net). The latest revised estimate as per 1999 schedule of rates is Rs.253 crores. Changes were affected in the design of head works, main canal, branch canals and distributories. Additional constructions like masonry dam, bridge over spill way, crown point of spill way, works of radial shutters and service gates etc. were included in the project. This is one of the projects scheduled for completion during Ninth Plan. In spite of large investment, the Project is neither completed nor any benefit materialized. The dam and the 80% of the main canal works were completed. The distributaries are only in the investigation stage. The project was supported under the RIDF of NABARD from 1995-96 to 1999-2000. The assistance expected from NABARD has been availed in full. Even then the project could not be completed.

As per evaluation by NABARD on the performance of implementation of the project, the sunk cost on the project is too large and it is not economical to pump in more money in this project as the ayacut area has been shrunk due to change in cropping pattern and other reasons. Hence it is prudent to stop the project as and where it stands by completing the essential items of works that will be helpful in achieving the ayacut. An assessment of the present ayacut is necessary before further investment. The expenditure incurred upto 3/2002 under the project is Rs. 180.37 crores. The per ha. investment works out to Rs.1.94 lakhs. The project is spilled over to Xth Plan.

4. Idamalayar

The Project envisages the utilisation of the tailrace water from the Idamalayar Hydro electric Project. The tailrace water which is impounded under Periyar Valley Irrigation Scheme is drawn through a canal system. The main feature of the scheme is the construction of the main canal from Periyar Barrage towards right. This bifurcates into two, one is low level canal and the other is link canal. The low level canal is to irrigate the low lying areas. The link canal is connected with the Chalakudy left bank main canal at Poothekutty. The project is

proposed to irrigate 14060 ha. net. The work on the project was commenced in 1981 with an estimated cost of Rs. 17.85 lcrores. The latest estimate of the project as per 1999 schedule of rates is Rs. 412 crore. This is a project scheduled for completion during the IX Plan. The progress of work in this project is also not satisfactory. There is no head works for this project under Irrigation. Out of 32.28 Kms. of main canal, only 8.192 Kms. were completed and in the branches only 3.523 Kms. were completed. The work in the distributaries is yet to be started. The expenditure incurred upto 3/2002 for this project is Rs. 119.12 crores. The project is not likely to be completed as scheduled and a rescheduling is therefore necessary. It was reported that the implementation of the project was delayed due to the non-availability of forestland. The project is to be carried to X Plan.

4. Kuriyarkutty - Karappara

This is a medium project intended to provide irrigation to the drought prone Kozhinjampara area in Palakkad District. Under the Irrigation department only canal construction is envisaged. The original estimate of the project is Rs.10.36 crores and the revised estimate is Rs.158.30 crores. The expenditure incurred up to 3/2002 is Rs.12.37 crores. On a review of the progress of execution of the project it was revealed that the Irrigation Department has gone ahead with the execution of the delivery systems while the head structure, which is conceived as a power project is pending clearance of Government of India. State Government therefore constituted a committee with representatives of Power, Irrigation and Planning, as members. The Committee realising that the clearance of the power project was not imminent, recommended the Irrigation Department not to proceed further till clearance for the head structure is obtained. Only the establishment cost is provided during 2001-02.

5. Thrithala Bridge – cum – Regulator

The project envisages the construction of a Regulator cum Bridge across Bharathapuzha at Thrithala (Velliyamkallu) in Ottapalam Taluk in Palakkad District. The main objectives of the project are (i) To provide Irrigation facilities to 1303 ha (net) and/3997 ha (Gross) in Ottapalam Taluk. (ii) To provide drinking water to Kunnamkulam, Chavakkad, Guruvayoor Municipalities and 18

Panchayats in the project area. (iii) The Distance of the Kozhikode – Guruvayoor (Via. Valancherry) road is reduced by 11 Km. The investigation work of the project was started in 1983 and the latest revised estimated cost is Rs.26.60 crores as per 1999 schedule of rates.

The project has been posed for assistance under the RIDF of NABARD. As insisted by NABARD a quick study was conducted to find out the environmental aspects of the project. The environmental impact assessment conducted by CESS pointed out that while impounding water for 13.33 Mm³ as originally envisaged, there will be water logging and drainage problems for the land. Hence a reduction of the storage capacity to 6 Mm³ (half of the envisaged capacity) was suggested. The reduction in the storage capacity to 6 Mm³ will not help the project to fulfill the objective. The project is only in the initial stage of execution.

6. Attappady Valley Irrigation Project

The project envisages the construction of a masonry dam at Chittoor across Siruvani river, a tributary of Bhavani, in Cauvery basin to irrigate an area of 4347 ha (net) and 8387 ha (gross) in Palakkad District. This is the first irrigation project in the Bhavani basin in the State. The investigation of the project was started in 1970. The work of the project was stopped due to the interstate water dispute. Now according to the decision of the Hon'ble High Court of Kerala, the execution of the project has been resumed limiting the operation within the boundary of Kerala. The latest estimated cost of the project is Rs.161 crores as per 1999 schedule of rates. Even though the project is pending execution for want of environmental clearance the present stage of the project is as follows:

Completed preliminary works such as survey and investigation, Geological surveys, model studies and design of Dam and its various components and canal systems, rehabilitation of 51 tribal families from dam site, completion of Infrastructural facilities such as 13 kms. black topped road to the dam site, utility bridges across Siruvani River in the downstream side of the dam site, construction of Permanent Division Office and Sub Division Office at Agali, a project house, two site offices, work shop, store building, 3 residential colonies for Engineer's

and subordinate supporting staff with internal roads, water supply facilities and electrification works, and completed one permanent hostel block at Chittur near dam site, partial leveling of the site at D/S side of dam for terracing, partial completion of blasting of rock and earth work excavation for dam foundation river diversion works in the construction area, and completion of works for combined main canal from 0 to 6.20 kms. Now the project is in a stand still stage. the progress of execution has to be decided.

7. Banasurasagar Project

The project consists of a dam across Karamanathodu a tributary of Panamaram river which is being constructed by K.S.E.B. and a Canal system to be constructed by the irrigation department for irrigating 2800 ha (net) and 4740 ha (Gross) area in Wayanad District by using water released from a sluice in the dam constructed by KSEB. The dam is in an advanced stage of execution. The work of this project was started in 1979 with an estimated cost of Rs.8.00 crore. The latest cost is Rs.50 crores. (1999 Schedule of rates). The investigation and land acquisition of the main canals are completed and the land acquisition for the branches and distributories are progressing. The project will spill over to X Plan.

8. Bridge-cum-Regulator at Chamravattom

The scheme envisages the construction of a Bridge-Cum-Regulator at Chamravattom across Bharathapuzha. The work for the above scheme was started in 1999. It is intended to irrigate 3106 ha (net) and 9659 ha (Gross) area in Malappuram District and to provide drinking water for the Municipalities of Ponnani and Tirur and nearby 14 Panchayats. Latest estimated cost of the Project is Rs.70.00 crores. The work of the Project is at standstill even after the formation of the Chamaravattom Regulator Authority. The project is to be taken up on BOT basis, with only a plan provision for start-up expenses.

Other Schemes

(1) Efficient management of Irrigation systems

Realising the inadequacy of non Plan funds for maintenance of irrigation projects as a supplement a new scheme was introduced in Ninth Plan. The budgetary support provided during the first 2 years of the Ninth Plan was utilised in a sporadic manner. Even projects which received considerable support under revamping programme were supported under this scheme. From third year onwards it was therefore decided to utilise the provision exclusively for the maintenance of the 4 projects Pamba, Periyar valley Kuttiyady and Chitturpuzha, which are the second generation projects not supported under revamping. This scheme will continue during the X Plan also.

2. Investigation of Major Irrigation Projects

There are projects pending execution for want of clearance/preparation of detailed project reports/revision of the project reports as multi purpose ones for establishing viability etc. They include Chaliyar, Vamanapuram, Meenachil, Munnamkadavu, Payaswini, Palakkappandi, Aralam, five projects in Kabini basin and projects in Pambar basin. State Government have also decided to complete the investigation of all the projects in the pipeline in the Kerala portion of the inter state river systems on a priority basis. All these projects are under investigation.

(3) R&D support

The need for realistic estimates and cost effective designs cannot be overlooked, especially after the experiences of time and cost escalation of several projects. The Kerala Engineering Research Institute (KERI) is the only institute under Water resources department for research works on the head works of the major irrigation systems. Restructuring the KERI into a full fledged institution

with mandate for research and design of major irrigation systems was envisaged in the IX Plan. The scheme has not been implemented. This has to be implemented during X Plan. Centre for Water Resources Development and Management (CWRDMN) is the only institute imparting training under water resources. All the training programmes under irrigation management are carried out by this institute. The irrigation management training programmes will be continued during X Plan.

Minor Irrigation

Kerala has a wide network of rivers and rivulets and springs spread over the State. Minor Irrigation deserves top most priority in the perspective for irrigation development of Kerala due to its relative advantages. The undulating terrain combined with concentration of rain in 4 to 5 months leads to high velocity of the rainwater resulting in severe soil erosion during the rainy season and acute moisture stress during the summer. Soil and water conservation and minor irrigation are therefore the two important areas that require priority attention in Kerala for developing agriculture. Minor Irrigation schemes are intended for irrigating large areas by way of diversion of water from rivers and channels and also by effecting proper drainage by constructing side walls, sluices, cross bars etc. Minor irrigation can serve a large number of cultivators at a much lower cost within a short period and provide large quantum of employment for semiskilled and unskilled labour classes. Minor irrigation can extend water even to isolated pockets of arable land. Thus it is the most appropriate system suitable for Kerala.

The ongoing minor irrigation works in Kerala under surface water are mainly classified into Class I, Class II & Lift irrigation. Class I minor irrigation works are those works having an ayacut in the range 50-2000 ha. (Main activities are for strengthening the outer bunds of padasekharams, providing sluices for dewatering and prevention of salt water intrusion.). Class II minor irrigation works are diversion weirs/cross bars, constructed in running streams to head up the water level of the flowing water which is to be directed to crops by gravity flow. The area targeted under this category is up to 50 hectares. Lift irrigation schemes are those involving drawal of water by mechanical means from rivers, tanks etc.

Even though minor irrigation schemes are best suited for irrigation under Kerala conditions adequate priority could not be given in the allocation of resources to minor irrigation sector till Sixth Plan. Much headway could be done only from the Seventh Plan onwards. With the introduction of decentralised planning in the IX Plan, implementation of MI schemes were vested with the local self governments.

From 1995-96 onwards NABARD has been providing assistance under the RIDF for the speedy completion of the minor irrigation schemes. Assistance has been provided to take up 614 schemes under the different phases of RIDF. Implementation of minor irrigation schemes with people's participation was also given due importance from VIII Plan onwards. The externally assisted Kerala Minor Irrigation Project and Kerala Community Irrigation Project were implemented with people's participation.

The physical achievement under MI (surface water) is given in table -3.

Table 3

Physical Achievement under Minor Irrigation Schemes

Area in hectares

Sl.No.	Name of Schemes	Physical Achievement (net area)				
		1997-98	1998-99	99-2000	2000-01	2001-02
1	2	3	4	5	6	7
1	Minor Irrigation - class -I	3213	2184	2766	924	714
2	Minor Irrigation - class -II	1514	1716	2458	821	587
3	Lift Irrigation	1161	378	943	512	160
4	Jaladhara Padhathy	562	735	--	-	-
5	EEC assisted M.I Programme	1282	1544	932	881	-

On the physical side, the irrigation potential of Kerala is estimated at 1.5 million hectares out of which 0.90 million hectares is projected from minor irrigation sources. Till the end of 3/02 the state could bring only 2.32 lakh hectares

(net) under irrigation through implementing ground water schemes as well as minor irrigation schemes.

Ground Water Development

In Kerala, groundwater occurs under phreatic, semi-confined and confined conditions. The groundwater resources are largely concentrated in the sedimentary aquifers of the coastal regions. The groundwater resources are tapped mainly for drinking and irrigation purposes. The state has a replenishable groundwater resource of 7048 million cubic meters. The net groundwater availability is 6430 million cubic meters. The gross groundwater draft is 2697 million cubic metres and the net groundwater available for future use is 3126 million cubic meters. The potential so far utilised is only one fourth of the total. The ground water resources are largely concentrated in the sedimentary aquifers of the coastal region. The foothill regions of the Western Ghats and selected pockets in the midland region are also endowed with ground water resources, though an accurate assessment is yet to be made.

Monitoring and conservation of groundwater is an important aspect which requires serious attention. The factors like over exploitation of groundwater, the deep infiltration of surface water from irrigated fields using chemical fertilisers and pesticides, infiltration of saline soils, effluents from industries affect the quality of ground water.

As per the latest groundwater estimation carried out by the Central Groundwater Board, Government of India and Groundwater Department, Government of Kerala based on Groundwater Estimation Committee norms (1997), 15 blocks of the State fall under overexploited, critical and semi critical categories and 33 blocks show more than 70% development. Blocks were categorised based on the stage of development and long term trend of groundwater levels during pre and post Monsoon seasons. The details of the groundwater resources of the State and list of blocks in overexploited, critical and semi critical categories are given in Tables 4 & 5 respectively.

Table - 4
Ground water resources of Kerala

Total replishable Ground water resource	7048.66MCM
Net ground water potential	6430.06 MCM
Gross ground water draft	2696.94 MCM
Net ground water availability for future irrigation	3126.13 MCM
Overall stage of development - State	44%

Table - 5

Details of over-exploited, critical and semi-critical blocks in Kerala

Sl. No.	Category	Block	District
1	I. Over exploited	Chirayinkil	Thiruvananthapuram
2		Kasaragod	Kasaragod
3		Kodungallur	Thrissur
4	II. Critical	Tellichery	Kannur
5		Parassala	Thiruvananthapuram
6		Adiyannur	Thiruvananthapuram
7		Mukhathala	Kollam
8		Anchalamoodu	Kollam
9		Balusseri	Calicut
10	III. Semi Critical	Pampaguda	Ernakulam
11		Paravur	Ernakulam
12		Mulenthuruthi	Ernakulam
13		Mala	Thrissur
14		Calicut	Calicut
15		Nemom	Thiruvananthapuram

Traditionally irrigation management has been considered as a departmental exercise without any provision for participatory approach either in the selection of works or in their execution and management. There is no effective mechanism for assessing the resource availability, its conservation and efficient utilisation during each season with a view to optimising the returns. There is need to encourage involvement of masses through community participation in the regulation of groundwater usage and its augmentation through artificial recharge. In order to regulate the over exploitation of groundwater resources a law has to be brought in for enactment . The enactment of such a law is on the anvil.

Groundwater management needs and options vary between areas and change over time. Artificial recharge of acquifer system is gaining importance. Rainwater harvesting and similar recharging techniques requires to be popularised and implemented with participation of water user associations and voluntary agencies. The activities under ground water development include ground water exploration, identification of potential zones, assessment of recharge and use of ground water, hydrological and geological studies to identify suitable sites for wells, preparing the community for ground water conservation and management. The physical achievements of the activities of the department are given in table 5.

Table 6**Physical Achievement under Ground Water Development Schemes**

Sl. No	Items	Unit	1997-98	1998-99	1999-00	2000-01	2001-02
1	2	3	5	6	7	8	9
1	Detailed hydrological survey	Km ²	162	617	-	-
2	Siting and providing technical assistance for open wells	No.	227	317	511	245	142
3	Siting and construction of different types of drilled wells	No.	473	623	473	554	460
4	Creation of additional irrigation facilities	ha.	1036	1246	1036	1214	1010
5	Failed well compensation	(persons)	15	12	5	5	-

Flood Management

Flood Management and coastal zone management are the areas coming under the functional responsibility of the State Irrigation Department. The strategy contemplated under the Ninth Plan envisages their implementation through local bodies on the basis of location specific modules.

The high intensity of rains over a short spell of time combined with undulating terrain make the State highly prone to floods. The surface run off which originates during heavy rains in the highland regions traverse through the midland and flush the narrow low lying lands adjacent to the coastal regions causing heavy floods. The low lands which are narrow compared to the mid and high lands cannot contain the flash floods and as a result heavy damages to crop and properties occur. The flood control measures operated by the State are more of a relief work for the affected areas. It was in this background that the State's Ninth Plan suggested a new approach for flood proofing after identifying prone areas through basin wise studies. However, progress in this direction is limited. Flood control works continue to be on conventional lines like strengthening the river banks, construction of retaining walls, embankments, lay out of field channels etc. The physical coverage upto 3/2002 is 57629 ha.

Coastal zone Management

Kerala has a long coastal stretch of 590 kms and more than half of it is subjected to sea erosion. Unlike other parts in the country, Kerala sea coast is thickly populated and as a result the loss due to sea erosion is relatively very high. Instead of the traditional approach of construction of sea walls for protection, the Ninth Five Year Plan suggested a multipronged approach integrating engineering, eco preservation, regulatory and management measures. The type of management, including the type of measures for protection, has to be opted on the basis of a detailed study of the vulnerability of the region and the nature of erosion. However, for want of operationalisation of the new strategy, construction of sea walls continues to be the sole intervention for coastal zone protection. In the area of sea wall construction and protection, modern technologies like geo textiles, polyethylene fabrics/sheets, nourishment of foreshore with bio-materials, etc. may be explored.

Command Area Development

Command Area Development Authority as conceived by Government of India under the National Programme are meant for optimal utilisation of the irrigation potential created by organising the beneficiary farmers and motivating them for scientific management of irrigation water through promotion of appropriate onfarm development works, layout of field delivery systems making the water accessible to all the areas within the command and improving the efficiency of water use through proper selection of crops, systems and practices.

In Kerala, the Command Area Development Authority was constituted in March 1978, but the activities took momentum only after 1986, when the Kerala Command Area Development Act came into existence. Initially ten irrigation projects in the State namely Malampuzha, Walayar, Mangalam, Gayathri, Peechi, Pothundy, Vazhani, Cheerakuzhy, Chalakudy and Neyyar were brought under this programme. Six more projects namely Kuttaiyadi, Chitturpuzha, Periyar valley, Pamba, Pazhassi and Kanhirapuzha were also brought under CADA. Kerala has

opted for a statewide authority with field support in the commands of the projects coming under its purview.

CADA stands for bridging the gap between the irrigation potential created and potential utilised. To achieve this, engineering activities undertaken by CADA are construction of field channels and farm channels, introduction of Warabandhi system, construction of drainage channels, construction of farm roads, improvements to existing tanks in the ayacut of the project etc. The Agriculture Wing is doing extension activities like conducting seminars, training camps and agricultural demonstration programme in order to enlighten the farmers for the effective management of water and utilisation of agricultural inputs. Studies are conducted to ascertain the soil fertility and texture by Soil Conservation Wing. Beneficiary farmers' associations are organised and registered with a view to encouraging farmers, participation in CAD activities. This is being done by Co-operative Wing. Evaluation studies are also conducted to assess the achievement of CAD activities. The expenditure for all these works are shared by State and Central Governments on a matching basis of 50:50

CADA is also undertaking works like improvements to tanks in the ayacut for re-use of water, construction of vented cross bars etc. The CAD activities started momentum in Kerala from 1985-86 onwards. Physical and financial achievements under CADA are given in Table - 7

Table - 7
Financial Achievement under CADA

(Rs. Lakhs)

Sl. No.	Name of Scheme	1980-85	1985-90	1990-92	1992-97	1997-2002
	State Share	83.64	1475.79	1510.46	4778.04	4939.00
	Central Share	154.06	1475.82	1479.96	4220.07	4293.4
	Total	237.70	2951.61	2990.42	8998.11	9232.40

Physical Achievement Under Command Area Development Programme

No.	Item	Unit	Till 95-96	1997-98	1998-99	1999-00	2000-01	2001-02
1	2	3		6	7	8	9	10
1	Construction of field channels	Ha.	121769	7897	14482	2593	2858	926
2	Construction of field drain	Ha.	1994	16374	11305	21228	18456	8207
3	Warabandhi works	Ha.	113556	9113	759	5743	995	-
4	Training programme For farmers	No.	2684	390	204	305	400	129
5	Adaptive trails	Ha.	19226	405	139	392	102	-
6	Large scale demonstration	Ha.	39449	16393	9390	12082	10896	5201
7	Subsidy to small & marginal farmers	No.	313	361	-	-
8	Beneficiary farmers associations organised and registered	No.	3577	87	99	41	26	2
9	Detailed soil survey conducted	ha.	23312	3035	1750	-
10	Land levelling & shapping	ha.	22683	230	321	82	111	32
11	Bench mark and evaluation survey conducted	ha.	22682	2199	1761	3084	309	1263

However it has to be recognised CADA has not been able to fully identify with the needs of the farmers. Its style of implementation has to be revitalised with less rigidities and better rapport with the farmer. Participatory Irrigation Management (PIM) methods will have to be introduced. Besides CADA has to move on to new projects rather than stagnating in existing areas.

Performance of Externally Aided Projects

The externally aided projects under implementation during the Ninth Plan period include (i) World Bank assisted National Hydrology Project (NHP), (ii) EEC assisted Kerala Minor Irrigation Project (KMIP) and (iii) Dutch assisted Kerala Community Irrigation Project (KCIP).

National Hydrology Project is a World Bank aided project implemented by the Water Resources Department (both Surface and Ground water components) with an original estimated cost of Rs. 35.97 crores. The project was started in 1995-96 and the duration of the project was 6 years from '95-96 onwards. The original scheduled period of completion was March 2002. During the Mid term review by the external agency, the financial target has been reduced to Rs. 32.78 crores and extended the term of completion to one more year and scheduled for completion by March 2003. After reviewing the performance by the Joint Supervision Mission in April 2002, the financial target has again been reduced to Rs. 28.81 crores (Ground Water – Rs. 12.66 crores and Surface Water Rs. 16.15 crores) from Rs. 32.28 crores and physical target has also revised.

The objective of the National Hydrology project is to develop a sustainable hydrological information system covering all aspects of surface and ground water hydrology which generates data for the present and future use. Improvement of organisational arrangements, technical capabilities, physical facilities available for measurement, validation, transfer and dissemination of data which are more reliable are envisaged under the project.

More stress has been given for data collection, data management, collation, supervision and monitoring of data. The project implementation in Kerala has achieved sufficient progress towards project objectives in terms of improving the organisational arrangements, institutional and technical capabilities and physical facilities for measurement, validation, collation, analysis, transfer and dissemination of hydrological, hydro-meteorological and water quality data and for basic water resources development. Under civil works, the construction of the State Data Center is nearing completion. Though sufficient progress has been achieved, much headway could not be done in the dissemination and use of hydrological data by the Surface Water Component.

Kerala Community Irrigation Project was implemented in Kerala jointly by the Government of Kerala and Government of Netherlands from 1994 to June 2000. The Project was started in Thrissur District in 1994 and implemented through an agency called Kerala Samuhya Jalasechena Samithy. The original cost of the project was Rs. 21.7 crores with the pattern of funding of Rs. 18.2 crores. from Government of Netherlands, Rs. 3.14 crores from Government of Kerala and Rs. 0.36 crores from the beneficiaries. The objective of the project was to develop an integrated approach to improve the living standards of small and marginal farmers especially women farmers through the harnessing and efficient use of the ground water resources for sustainable community irrigation schemes. The implementation of the project was by drilling bore wells and bringing water to each farmer through an effective conveyance system. After commissioning of the schemes the wells were handed over to the respective Water Users Associations. The cost of the maintenance of the system will be met fully by the beneficiaries by collecting monthly contribution and water cess based on the land holding or hours of water use. In KCIP, the farmer participation was developed in managing the small scale irrigation systems Beneficiaries were involved in the planning, execution and management of the programmes. The original target was to drill 210 borewells.

Later after a midterm appraisal, the target was reduced to 131 borewells. The original period of completion of the project was December 1998, which was extended to June 2000. During the project period 131 borewells were drilled; out of them 96 bore wells were commissioned. All the commissioned schemes were implemented by the farmers with the technical support of KSJS and with the financial support of RNE & GOK. An amount of Rs. 13.18 crores have been allotted to KSJs during 1994-2000 and the total release was Rs. 9.98 crores. The expenses incurred was Rs. 6.88 crores. The claim preferred for reimbursement from Government of India upto 30.9.2000 was Rs. 4.33 crores and the amount released by Government of India as on 30.9.2000 was Rs. 4.02 crores and the project was completed by 30.6.2000.

The EEC - assisted Kerala Minor Irrigation Project aimed at creation of or rejuvenating surface water irrigation structures such as vented cross bars, tanks, weirs and sub-surface dykes in potential areas. The project was started in 1994-95 with a total cost of Rs. 52.04 crore. As per the original work plan, the area targeted for irrigation was 17,500 ha. of paddy through implementation of 575 schemes. considering the tardy performance, the target for coverage has since been reduced to 7,300 ha. and number of schemes to 251. The expenditure upto 3/2000 was Rs. 18.90 crore and created an irrigation potential of 6766 ha. The project has been completed.

II. PROBLEMS AND ISSUES

The problems and issues identified in the sector are given below :

- ❖ Non-availability of reliable and comprehensive hydrological data.
- ❖ Unscientific way of project preparation.
- ❖ Inadequate provision and delay in getting the funds.
- ❖ Delay in completion of projects resulting in time and cost overrun.
- ❖ Lack of proper maintenance of the existing major and minor irrigation systems leading to reduction in carrying capacity.
- ❖ Poor collection of cess.
- ❖ Lack of participatory irrigation management affects the optimum utilization of the potential created.
- ❖ Inadequate institutional arrangement for PIM.
- ❖ Poor linkage with CADA, Lack of coordination among the related departments
- ❖ Reclamation of wetlands
- ❖ Poor R&D facilities.
- ❖ Indiscriminate construction of river protection barriers.
- ❖ Blockage of drainage through construction of roads.
- ❖ Deforestation of catchment areas.
- ❖ Non-availability of modern geophysical and latest Landsat Imageries in relation to ground water.
- ❖ Lack of base maps in detail for planning and management of groundwater extraction structures, recharging structures and implementation of rainwater harvesting techniques.
- ❖ Delay in implementation of Groundwater Bill for Control and Regulation of groundwater in notified areas/critical/ over exploited areas as per GEC norms.
- ❖ Intervention of unscientific private drilling which leads to groundwater depletion and interference of wells.
- ❖ Unscientific approach to groundwater management.

- ❖ Delay in availability and consent from the public for various recharge structures.
- ❖ Lack of a model for future planning in relation to the actual field situation.
- ❖ Non-availability of dismantling type of rigs with high-pressure compressors for competing with the private agencies and speedy implementation of the works at the department level.
- ❖ Lack of research oriented works for finding out solutions in the problematic areas.

III. APPROACH AND STRATEGY

As already mentioned the pattern of demand for water in Kerala and its relative importance for the various needs are quite different from the rest of the regions in the country. But unfortunately there is no system for continuous and regular monitoring, recording, processing, analysis and evaluation of hydro meteorological data like rainfall, discharge, ground water table fluctuation, temperature, humidity, evaporation, salinity intrusion etc. so that the utilisation of the available resources could be optimally planned and systematically extracted for the best advantage of the State. The integrated development of land and water resources of any region is possible only if it is planned and organised on a watershed basis which would ultimately lead to development of a perspective plan for the development of the river basin. The first and foremost step in the development of water resources in Kerala would be the development of a master plan for water resources development which would encompass establishing a regular system for resources assessment and monitoring, integrated river basin development plans, conservation and regulatory mechanism with necessary legal support that ensure proper upkeep and maintenance of the water sources and systems that ensure distribution of the available resources in accordance with the relative importance of the demand for water from the various segments of economic activity. A river basin approach has to be followed in assessing the availability of resources and their optimal utilization integrating it with the various needs in the command area. River has to be taken as a unit and it has to be harnessed with holistic vision. River Basin Organisation may be created in the five major rivers viz., Chaliyar, Bharathapuzha, Periyar Valley, Pamba and Muvattupuzha during the X Plan. The various purposes for which river water is utilised has to be evaluated by these organisations. The RBOs should also take care of the pollution, erosion and such other threats to the river and initiate creative and preventive action by the integrated intervention of various agencies. Care has to be taken to see that RBOs do not become yet another agencies.

As far as ongoing major projects are concerned the strategy should be one of completing all the major and medium projects, which are in advanced stages of execution in a time bound manner. New projects need be taken only if they are need based and demand oriented. The revamping programme introduced for optimizing the efficiency of the first generation projects will be continued and extended to the second generation projects.

The projects that have been conceived long back and which are yet to be taken up need redesigning both in respect to their head works and delivery systems to make them in tune with the changes in cropping pattern that has happened over the years and to implement them as multipurpose projects.

Emphasis should also be shifted from major irrigation to minor irrigation. A new approach for participatory planning, execution and management of the minor irrigation structures has to be brought in.

Irrigation infrastructure already created has to be properly maintained and put to optimal utilization by constituting Water Users Associations under the decentralized system and evolving mechanisms for generating funds for their regular upkeep and maintenance.

As far as ground water development is concerned priority should be for developing sources for drinking water purposes. The upper midland regions lying in the foot hill regions of the high ranges deserve special attention.

Second priority should be for the coastal belt extending from Quilon to Ponnani as well as the lower reaches of the midland regions where coconut is the major crop and where multi tier systems of agriculture are possible.

Areas prone to recurring floods will be identified based on the data generated through the basin wise study proposed. Depending upon the nature of floods, its intensity and spread, management measures will be drawn up to reduce its gravity and to minimise the damages. Protective structures will be restricted only to those areas which are vulnerable to heavy floods inspite of such management measures.

Coastal zone management will also be given a new orientation. Instead of restricting the intervention to construction of sea walls an integrated approach supported by a combination of regularly, preventive and protective measures will be adopted on an area based manner with peoples' participation.

The strategy for water resources development and utilization for irrigation purpose is set up with a new perspective recognizing water as a scarce/economic resource and ensuring its utilization and management with utmost care and prudence. The major components of this strategy are:

- ❖ Water Resource Management on river basin basis.
- ❖ Time bound completion of all ongoing projects that are in the advanced stages of execution.
- ❖ The revamping of the first generation irrigation Projects will be completed and the programme will be extended to second-generation projects also.
- ❖ Shift of thrust to minor irrigation projects
- ❖ Introducing participatory irrigation management (PIM) with full involvement of Water user Community.
- ❖ Revival of traditional systems of water management like pond irrigation and promotion of alternate irrigation system such as the harvesting of run off rain water.
- ❖ Zonation for ground water exploitation
- ❖ Recognising drainage as an integrate component of irrigation projects for prevention of water logging.
- ❖ Thrust on integrated catchment treatment including vegetative measures on Watershed basis to prevent siltation.

- ❖ Zonation of the flood plains for various rainfall events.
- ❖ Evolving legal measures for land use management including removal of drainage blocks.
- ❖ Preparation of location specific action plans for flood proofing.
- ❖ Insistence of EIA as a pre-requisite for the Project clearance.
- ❖ Ensuring close liaison between irrigation and agriculture departments and institutions dealing with water management activities so as to develop a multi disciplinary and integrated system of irrigation management.
- ❖ Dissemination of the hydrological data to the public.
- ❖ To introduce rational pricing of irrigation water based initially on O & M costs and then to encourage higher level of water use efficiency.
- ❖ To promote PIM
- ❖ R&D support to State Water Resource Sector.

IV. Reforms/Recommendations

- ❖ Updating of data base in the irrigation sector.
- ❖ Formation of River Basin Organisations with a multidisciplinary approach.
- ❖ Implementation of State Water Policy and enactment of Irrigation Bill
- ❖ Formation of the Department of Water Resources bringing the water related disciplines under one fold.
- ❖ Pricing of water to cover operation and maintenance of the infrastructure created under irrigation.
- ❖ The supply oriented distribution may be converted to demand oriented one.

- ❖ Awareness programme for PIM.
- ❖ Promotion of indigeneous and traditional water technology and water management practices such as pond/, tank, streams, irrigation which were neglected due to introduction of modern technology.
- ❖ Thrust on recharging, and conservation of ground water.
- ❖ Need for a regulatory act to control the unbridled exploitation of ground water.
- ❖ Formation of an autonomous, self supporting highly competent investigation organisation responsible for investigation project preparation and providing consultancy services to the Panchayat Raj Institutions (PRIs)
- ❖ Formation of high level committee for monitoring and concurrent evaluation of the progress of implementation of the project for time bound completion.
- ❖ Strengthening the monitoring and evaluation system.
- ❖ Strengthening the R&D support.
- ❖ Modernisation of the designing activities and project management by appropriate use of technology and human resource development.
- ❖ Introduction of responsible methods of project management and inbuilt mechanisms for timely completion of projects
- ❖ Demystification of project conception and implementation

List of Schemes Recommended by the Working Group for implementation during the X Plan

I. Major & Medium Irrigation

I.1. Time Bound completion of projects which are in the advanced stages of execution.

(a) Muvattupuzha

The construction of the dam is over, 75% of works in the Main canals and 25% of the works in the branches are over. The remaining works are mainly in branches and distributories. The project is expected to be completed by 2003 December. An outlay of Rs. 180 crores is proposed for the project. AIBP assistance will be expected for the project for speedy completion.

(b) Karapuzha

Karapuzha was one of the projects given priority for completion during IX Plan. The project was supported under the RIDF of NABARD and scheduled for completion during 98-99. Even though the full amount targeted for completion has been availed, the project could not be completed. While analysing the project, it was observed that Pumping more money into the project is not economical as the ayacut area of the project has been shrunk due to change in cropping pattern and other reasons. Hence the working Group recommends to complete the project as and where it stands by completing the essential items of works which will optimise the benefit of the infrastructure already created within a period of 3 years in a phased manner as follows.

- | | | |
|-------|---|-------------------------|
| (i) | Completing the remaining works in the head works & main central | - 1 st year. |
| (ii) | Completing the remaining works in the branches | - 2 nd year |
| (iii) | All finishing works for commissioning | - 3 rd year. |

An amount of Rs. 50 crores is proposed for completion within a period of 3 years. Clear and actual estimate of the remaining works which are going to be taken up with the actual ayacut benefited may be got approved before taking up the work. No annual outlay will be provided after the first 3 years of the plan period. The acquired land available with the project has to be recommended.

(c) Idamalayar Project

The project was started in 1985 with an estimated cost of Rs. 17.85 crores. The revised estimate (99 Schedule) is Rs. 412 crores. The progress of implementation of the project is very slow and going by this trend the possibility of completing the project in the near future is limited. Hence the Working Group recommends to place 3 options for the consideration of the Plan committee for finalising the future course of action of the project.

- i) According to the revised estimate, the anticipated requirement for the entire plan period (X Plan) for 5 years is Rs. 300 crores. In realistic terms, this will escalate upto Rs. 500 crores at the time of completion of the project. The Plan commitment may be around Rs. 500 crores. Then the per ha investment will work out to Rs. 2.00 lakh which may not be economical.
- ii) To make a possible provision of Rs. 150 crores during X Plan and allowing to spill it over to XI Plan. The consequences of the 2nd option is further escalation in cost.
- iii) To revise the project and scale down the project cost judiciously in keeping with the ayacut area benefited and try to complete the project immediately within the X Plan. This will help to optimise the cost and benefit of the project.

The Plan committee may take a decision on these 3 options and decide the future course action of this project.

(d) Kuriyarkutty – Karappara

The head structure of the project is under Power Sector and only canal construction is envisaged under irrigation. The clearance for the construction of head structure under Power Sector is not imminent, the canal construction has to be stopped at a convenient stage. An outlay of Rs. 1.00 crore is proposed for the completion of the executed works. As the project is intended to irrigate the drought prone Kozhinjampara area of Palakkad district, considering the arid nature of the area the possibility of redesigning the project has to be considered. Hence the project is placed for reinvestigation. The reinvestigation may be completed within the first year of the X Plan.

(e) Thrithala Bridge-cum-regulator

This is a multipurpose project in Ottappalam Taluk in Palakkad district. The objective of the project are (i) to provide drinking water facilities to 18 Panchayats in the project area and Kunnamkulam, Chavakkad and Guruvayoor Municipalities. (ii) reducing the distance of Kozhikode-Guruvayoor road by 11 KM. The total cost of the project is Rs. 26 crores. This project has been posed for assistance under the RID Fund of NABARD. As insisted by NABARD, CESS has conducted a quick EIA study of the project. As per the study report if the project is implemented with the envisaged storage capacity of 13.33 Mm³, the ayacut area will become waterlogged. Hence they had recommended to reduce the storage capacity to 6 Mm³ which is half the original. If the capacity is reduced the purpose of the project for providing drinking water to 18 Panchayats cannot be served. In this circumstance if NABARD agrees to provide assistance under RIDF, the project can be taken up and the whole amount will be provided during X Plan itself.

(f) Attappady Valley Irrigation Project

This project is the first project in the Bhavani Basin in the state. The execution of the project was held up due to interstate water dispute. According to

the decision of the Hon'ble Court of Kerala, the execution of the project has been resumed limiting the operation within the boundary of Kerala. On reviewing the progress of implementation it is felt that as the irrigable area in the ayacut is less and gravitational flow is very expensive in this region, the scope of the project should be scaled down to a net work of series of Check dams to utilise the water eligible for our State. Reinvestigation for the purpose is necessary. First year of X Plan can be for investigation. Any irrigation work in the Attappady area may be dovetailed with the activities of 'AHADS' which is meant for the development of the Attappady area.

(g) Banasurasagar Project

The project is in Wayanad district. The execution of the project will be completed within the first two years of the X Plan period.

(h) Bridge-cum-regulator at Chamravattom

The implementation of the Project is through an Authority (Chamravattom Regulator Authority) constituted for the purpose. It is proposed to take up the work on BOT basis. Only a token provision for starting expenses need be provided.

ii. Revamping and Consolidation of Major irrigation projects.

This is a spill over scheme and under this scheme, the revamping and consolidation of the nine old projects viz., Malampuzha, Mangalam, Peechi, Walayar, Gayathri, Vazhani, Cheerakuzhy, Pothundy & Neyyar were taken up. The duration of the project was 3 years during the IX Plan. But delay in sanctioning the 3rd year action plan, the project has been spilled over to X Plan. The spill over works will be completed during the first year of the X Plan. The programme will be extended to the second generation projects also. An outlay of Rs. 50.00 crores (Rs. 25.00 crores for spill over projects & Rs. 25 crores for new projects) is proposed.

iii. Efficient Management of Major Irrigation Systems.

Realising the inadequacy of non-plan funds for maintenance of projects as a supplement a new scheme was introduced during IX Plan. Projects which were not supported under revamping and consolidation programme need be assisted under this scheme.

(iii) Investigation of Major & Medium Projects

The projects under investigation include Meenachil, Chaliyar, Vamanapuram, schemes in Kabani basin schemes in Pambar basin, Aralam, Palakappandy, Payaswini, Moonnamkadavu etc. Besides these, according to the new strategy of river basin approach to be adopted for X Plan, new minor schemes may be investigated in Pamba-Achancoil river basins on a priority basis. An outlay of Rs. 75.00 crores is proposed for investigation.

(v) National Hydrology Project

This is a World Bank aided project operated jointly by the Irrigation and Ground Water Departments for building up a data base covering all aspects of the surface and ground water hydrology. The project was started in 1995-96 and duration of the project was 6 years. Later, the term has been extended to one more year ie, 2003. The project will be completed in 2003.

(vi) Restructuring the R&D Institute.

KERI into a full fledged organisation with mandate for research and design of major irrigation systems.

II. Minor Irrigation

(a) Ground Water Development

1. Investigation and development of Ground Water Resources (Ongoing)

The scheme is for identification and realistic evaluation of ground water potential, preparation of detailed hydrological map and compilation of district ground water reports, technical support for development of ground water sources and their utilisation through local schemes of panchayats and helping farmers for acquiring sources of irrigation on individual as well as self help basis, guiding farmers in the adoption of appropriate lifting devices, ground water management etc. Design and construction of effective structure like sub surface dykes for inducing recharge will also be included under the scheme. Apart from this the Department would concentrate on resource conservation, recharging etc.

2. Enactment of Ground Water Legislation (Ongoing)

The scheme is for the enactment of enforcement of legislation already came into force to avoid over exploitation of ground water and equitable distribution of the resources to all sections of the society. The outlay is to meet the expenses in connection with the enforcement of the legislation.

3. Training of Technical and Scientific Personnel. (Ongoing)

The scheme is to provide training for the technical and scientific personnel of the department in the relevant fields of scientific source finding technology of well construction, ground water conservation, modern techniques of rain water harvesting etc.

(b) Surface water

1. Rehabilitation of the Lift Irrigation Schemes

All L.I. schemes now in operation are under dilapidated conditions and need revamping in order to increase the efficiency of the system. A rehabilitation programme may be drawn up in a need based manner to rehabilitate the system. The system after rehabilitation may be handed over to PRIs or Water Users Associations (WUAs) for proper maintenance and upkeep. The present stage of all the L.I. structures have to be assessed and the system which may become worth after renovation need be taken. A provision may be included under Plan for this purpose.

2. MI Class - I

During the X Plan, the strategy is to transfer all MI schemes to PRIs. The ongoing Class I schemes and the schemes with RIDF assistance need be taken under the State sector.

IV. Flood Management

The present efforts of 'flood controlling' is to be replaced by 'flood prevention. For this the following activities are envisaged for the 10th Plan.

1. Basin wise study to evolve flood proofing strategies.
2. Preparation of the master plan for the management of flood.

V. Anti Sea Erosion

The present programme for construction of sea wall to control sea erosion will be continued. The XI Finance Commission assistance of Rs. 50 crores for the management of coastal area will also be utilised for the programme during the tenth plan.

VI. Command Area Development Programme

At present the command area development programmes are implemented in 16 completed projects. Of this, the 'onfarm development works' of 5 projects viz., Malampuzha, Mangalam, Walayar, Pothundi and Gayatri are completed. The programme will be continued in the remaining projects. During the Xth Plan two more projects viz., Chimmoni and Kallada will be brought under CADA.

The CAD programme has to be reoriented and revitalised for realising optimal utilisation of the available water for irrigation. During Xth Plan Participatory Irrigation Management (PIM) will be given thrust. The existing Beneficiary Farmers' Associations (BFAs) and Project Advisory Committees (PACs) are to be revitalised or strengthened. Local bodies also have to be actively involved in PIM.

Financial Projections for the X Plan

1. Major & Medium Irrigation

(Rs. Crores)

Sl. No.	Name of Scheme	Outlay proposed
Major & Medium Irrigation		
1.	Muvattupuzha	180.00
2.	Karappuzha	50.00
3.	Idamalayar	300.00
4.	Kuriyarkutty	1.00
5.	Thrithala	26.00
6.	Banasurasagar	50.00
7.	Chamravattom	1.00
8.	Dam Safety Fund	10.00
9.	Revamping and Consolidation of major projects	50.00
10.	Investigation of Major & Medium Projects	50.00
11.	Efficient Management of Irrigation Systems (Maintenance)	50.00
12.	National Hydrology Project (NHP)	8.00
13.	Assistance to CWRDM	3.00
14.	Investigation & Design organisation and restructuring of KERI, Peechi	10.00
	Total : Major & Medium Irrigation	789.00
II.	Minor Irrigation	
	(a) Surface Water	
1.	Rehabilitation Programme of the existing L.I. Schemes	5.00
2.	M.I. Class I (Committed schemes + RIDF assisted schemes)	50.00
	Total Surface Water	55.00
	(b) Ground Water	
1.	Investigation and Development of Ground Water Resources	45.00
2.	Scheme for Ground Water Conservation and recharge	2.00
3.	Training of Technical and Scientific personnel	0.10
4.	Scheme for control and regulation of Ground Water	.25
5.	National Hydrology Project	7.00
	Total : Ground Water	54.35
	Total: Minor Irrigation	109.35
III.	Command Area Development	
	Command Area Development Programme	170.00

IV.	Drainage & Flood Management	
1.	Basin wise study to evolve flood proofing strategies	5.00
2.	Preparation and implementation of a Master Plan for prevention & Management of flood	5.00
	Total: Drainage & Flood Management	10.00
V.	Coastal Zone Management	
	Coastal Zone Management	40.00
	GRAND TOTAL	1118.35

Annexures

Annexure - I

STATE PLANNING BOARD PROCEEDINGS

Sub: Formulation of 10th Five Year Plan – Constitution of Working Groups –

Ref: Order No.6149/2001/Ag/SPB dated 20-10-2001.

Order No.6149/2001/Ag(W1)/SPB dated 31/10/2001

As per the reference cited, State Planning Board has constituted Plan Committee on 'Water Resources & Environment' to suggest reform measures and to formulate draft proposals integrating the sectors of Irrigation, Water Supply and Environment for the Tenth Five Year Plan. The first meeting of the Committee held on 24-10-01 has decided to constitute 4 Working Groups namely,

- (i) Working Group on Water Resources & Environment – Approach, Policies and Reforms
- (ii) Working Group on Drinking Water
- (iii) Working Group on Environment
- (iv) Working Group on Local Level Water Resources Development.

The Working Group on '**Water Resources & Environment – Approach, Policies and Reforms**' is hereby constituted with the following members:

1. Shri. K. Jayakumar, Chairman
Secretary to Government,
Irrigation and Water Supply,
Secretariat, Thiruvananthapuram
2. Dr. K.N. Shyamasundaran Nair, Member
(Former Member (Agriculture), SPB)
RASS,
Pattom, Thiruvananthapuram
3. Dr. R. Gopalakrishnan, ”
(Former Director of Research, KAU),
Plot No. 28, Estate No. 4
Hill Gardens, Kuttanaloorthousing
Colony,
Thrissur – 680 014.

4. Shri. N. Lekshminarayanan Nair,
(Former Chief , Agriculture),
State Planning Board),
Narayana Vilasom,
Palliyadi, K.K. District,
Tamil Nadu. ”
5. Dr. Satishchandran Nair,
Director,
INTACH (Southern Regional Office),
Kuravankonam – 3
Thiruvananthapuram. ”
- 6 Shri Renjith. C.S.,
Advisor,
Sector Reforms Project (RWSS),
3rd Floor, PTC Towers,
S.S. Koil Road,
Thampanoor, Thiruvananthapuram. ”
7. Shri. Sreekumaran Nair
(Chief Engineer (Rtd.), Irrigation) ”
Sarada Vilas
TC 3/2331
Pattom
Thiruvananthapuram 4
8. Dr. E. J. James,
Head, Surface Water Division, CWRDM ”
9. Shri. V.K. Gangadharan,
Director -in-Charge,
Meteorological Station,
Thiruvananthapuram. ”
10. Shri. G. Balagangadharan Nair,
Director,
Ground Water Department,
Thiruvananthapuram. ”
11. Shri. John Kurien,
General Manager,
NABARD,
Corporation Building,
Thiruvananthapuram ”

12. Shri. V. Viswanatha Prabhu
Member (Generation)
K.S.E.B. Vidyuthi Bhavan, Pattom,
Thiruvananthapuram. ”
13. Shri. T.K. Sasi,
Chief Engineer
(Irrigation and Administration),
Public Office Buildings,
Thiruvananthapuram ”
14. Shri. Ramanujan,
Managing Director,
Kerala Water Authority,
Thiruvananthapuram ”
15. Smt. A. Komalavally Amma,
Chief Engineer (Investigation)
Vikas Bhavan,
Thiruvananthapuram ”
16. Shri. N. Balakrishnan Nambeesan,
Chief Engineer, CADA,
Chempukavu, Thrissur ”
17. Shri. C. Muraleedharan,
Chief Engineer, Projects – I,
Kozhikode ”
18. Shri. S. Thomas, Chief Engineer,
Projects – II, Public Office Buildings,
Thiruvananthapuram ”
19. Shri. N. Sasi,
Chief Engineer(in charge),
Projects – III, Kottarakara ”
20. Shri. Jacob Daniel,
Deputy Chief Engineer,
Public Office Buildings,
Thiruvananthapuram ”
21. Dr. S. Radha,
Joint Director,
Office of the Chief Engineer
(Investigation & Planning),
5th Floor,
Vikas Bhavan
Thiruvananthapuram. ”

22. Dr. P. Sukumari, Agronomist, State Planning Board, Thiruvananthapuram ”
23. Smt. P. Saraswathy Amma, Deputy Director, State Planning Board, Thiruvananthapuram Convenor

The Working Group will meet as and when required and submit the Report to the Plan Committee on 'Water Resources and Environment' on or before 30-11-2001.

The expenditure towards T.A. and D.A. of all members will be met from the head of account 3451-101-99-SPB-Plan. All non-official members will be treated as Class-I officers.

S.M.V IJAYANAND
MEMBER-SECRETARY

Forwarded/By Order

Dr. P. Sukumari,
Agronomist,
State Planning Board.

Copy to:-

The Accountant General, Kerala (A&E) with C/L
The Sub Treasury Officer, Vellayambalam.
All Divisions, State Planning Board.
P.S. to V.C
P.A. to M.S.
C.A. to A.O.
P. P. O.

Terms of Reference of the Plan Committee on Water Resources and Environment

The Committee shall

1. Assess water resources (surface and underground), their current level of utilisation (for various purposes such as irrigation, drinking water, drainage etc.) and productivity.
2. Assess the performance of irrigation (major, medium and minor), ground water and water supply schemes in relation to their duration for implementation, cost structure, effectiveness (benefits) and efficiency.
3. Suggest strategy for cost-effective and productive utilisation of States water resources in an integrated manner for irrigation, drinking water, drainage and other purposes.
4. Review the time schedule for implementation of the existing irrigation and Water supply projects/schemes and the cost over runs and suggest a strategy and a time bound schedule for the speedy completion or termination at appropriate stages.
5. Examine the relevance of major/medium irrigation projects which have already been included in the plan, but are still in the preliminary stages of investigation especially in the context of the changed cropping pattern and cost escalation.
6. Evaluate the Command Area Development Programme and make suggestions for improvement of their performance including (i) the integration of irrigation, drainage and drinking water supply (if possible), (2) watershed management of soil and water conservation, (3) the efficient use and management consistent with the existing as well as emerging cropping systems and other forms of water use such as aquaculture and (4) the participation of users in management, utilisation and cost sharing.
7. Review the existing policies and framework under which minor irrigation schemes are identified and implemented and suggest appropriate modifications in the modalities to enhance participatory management and involvement of Panchayat Raj Institutions.
8. Assess the ground water potential and identify the constraints and design programmes in realising its optimal use and management.
9. Review the flood control and coastal erosion control measures and programmes, assess control effective alternate methods, formulate master plans for flood control and coastal erosion control and determine the priorities for the implementation of programmes included in the master plan, integrate coastal erosion control with coastal area development programme of the Authority.

10. Evaluate the existing mode of operation of water supply schemes and suggest means for improving the efficiency and effectiveness by modifying the nature and management of the schemes.
11. Examine the existing coverage under various water supply schemes, analyse the various aspects of drinking water scarcity experienced in the State, and evaluate the existing schemes and systems.
12. Assess research and development (R&D) support for the development, utilisation and management of water resources, review the performance of R&D institutions in the State and to suggest programmes and priorities for the 10th Plan.
13. Assess the training requirement for the development, efficient use and management of water for different purposes.
14. Assess the institutional and legal support currently available and suggest the initiative required for the sustainable use and management of water resources in the State.
15. Suggest measures to mobilise additional resources for the development of the sectors.
16. Analyse the nature of linkages required between the different departments to optimise the use of water resources of the State and suggest changes in the Administrative set up for Water resources.
17. Review the existing efforts and endeavours for
 - (1) operation of systems.
 - (2) creating environmental awareness among the public
 - (3) environment restoration, protection conservation and improve
 - (4) controlling different kinds of pollution
 - (5) integrating environmental concerns with development imperatives.
18. Review the existing institutional set ups and legislature instruments for the implementation of the environmental policies.
19. Evolve a perspective for environment management and formulate the policies and programmes for operationalising the perspective in a participatory approach.

Annexure -II

RIVERS AND RIVER BASINS OF KERALA

SI.No	Name of River	Length. Km.	Catchment Area. Km2			Total
			Kerala	Karnataka	Tamil Nadu	
1	2	3	4	5	6	7
	1 Manjeswar	16	90	-	-	90
	2 Uppala	50	76	174	-	250
	3 Shiriya	67	290	297	-	587
	4 Morgal	34	132	-	-	132
	5 Chandragiri	105	570	836	-	1406
	6 Chittari	25	145	-	-	145
	7 Neleswar	46	190	-	-	190
	8 Kariangode	64	429	132	-	561
	9 Kawayi	31	143	-	-	143
	10 Peruvamba	51	300	-	-	300
	11 Ramapuram	19	52	-	-	52
	12 Kuppam	82	469	70	-	539
	13 Valapattanam	110	1321	546	-	1867
	14 Anjarakandy	48	412	-	-	412
	15 Tellicherry	28	132	-	-	132
	16 Mahe	54	394	-	-	394
	17 Kuttiyadi	74	583	-	-	583
	18 Korapuzha	40	624	-	-	624
	19 Kallai	22	96	-	-	96
	20 Chaliyar	169	2535	-	388	2923
	21 Kadalundi	130	1122	-	-	1122
	22 Tirur	48	117	-	-	117
	23 Bharathapuzha	209	4400	-	1786	6186
	24 Keecheri	51	401	-	-	401
	25 Puzhakkal	29	234	-	-	234
	26 Karuvannur	48	1054	-	-	1054
	27 Chalakkudy	130	1404	-	300	1704
	28 Periyar	244	5284	-	114	5398
	29 Muvattupuzha	121	1554	-	-	1554
	30 Meenachil	78	1272	-	-	1272
	31 Manimala	90	847	-	-	847
	32 Pamba	176	2235	-	-	2235
	33 Achencoil	128	1484	-	-	1484
	34 Pallickal	42	220	-	-	220
	35 Kallada	121	1699	-	-	1699
	36 Ithikkara	56	642	-	-	642
	37 Ayroor	17	66	-	-	66
	38 Vamanapuram	88	687	-	-	687
	39 Mamom	27	114	-	-	114
	40 Karamana	68	702	-	-	702
	41 Neyyar	56	497	-	-	497
	42 Kabini*		1920			
	43 Bhavani*		562			
	44 Pambar		384			

* Except for these three east-flowing rivers, other 41 are west-flowing ones

Source: Water Resources of Kerala, PWD, Thiruvananthapuram, 1974

Annexure -III

Water Potential in the River Basins of Kerala

<i>Name of basin</i>	<i>Annual yield, Mm3</i>			<i>Annual utilisable yield, Mm3</i>		
	<i>Total</i>	<i>In Kerala</i>	<i>Outside</i>	<i>Total</i>	<i>In Kerala</i>	<i>Outside</i>
	2	3	4	5	6	7
Manjeswar-Uppala	698	309	389	379	106	273
Shiriyā	1337	620	717	973	358	615
Chandragiri-Morgal	3964	1718	2246	3129	1218	1911
Nileswar-Karingode	1710	1356	354	1238	937	301
Kawvauri-Peruvamba	1143	1143	Nil	603	603	Nil
Ramapuram						
Kuppam	1516	1236	280	1024	786	238
Valapattanam	4092	2784	1308	2938	1823	1115
Anjarakandy	986	986	Nil	503	503	Nil
Tellicherry	251	251	Nil	122	122	Nil
Mahe	803	803	Nil	445	445	Nil
Kuttiyadi	1626	1626	Nil	1015	1015	Nil
Chaliyar-Korapuzha	7775	7135	640	3160	2616	544
Kallayi-Kadalundi						
Tirur	165	165	Nil	60	60	Nil
Bharathapuzha	7478	6540	938	4146	3349	797
Keecheri-Puzhakkal	1024	1024	Nil	345	345	Nil
Karuvannur	1887	1887	Nil	963	963	Nil
Chalakkudi	3121	2541	580	2033	1539	494
Periyar	11607	11341	266	8232	8004	228
Muvattupuzha	3814	3814	Nil	1812	1812	Nil
Meenchal	2349	2349	Nil	1110	1110	Nil
Manimala	1829	1829	Nil	1108	1108	Nil
Pamba	4641	4641	Nil	3164	3164	Nil
Achencovil	2383	2383	Nil	1249	1249	Nil
Kallada-Palickal	2270	2270	Nil	1368	1368	Nil
Ithikkara	761	761	Nil	429	429	Nil
Vamanapuram-Ayroor-Mamom	1324	1324	Nil	889	889	Nil
Karamana	836	836	Nil	462	462	Nil
Neyyar	433	433	Nil	229	229	Nil
Kabini*	4333	4333	Nil	4333	4333	Nil
Bhavani*	1019	1019	Nil	1019	1019	Nil
Pambar*	708	708	Nil	708	708	Nil
Total	77883	70165	7718	49188	42672	6516

Source: Water Resources of Kerala, PWD, 1974

*East flowing rivers

Annexure - IV

Fresh Water Discharge Required in the Various Rivers for Arresting Saline Intrusion

Sl.No	Name of River	Discharge of Fresh Water Required, M ³ /sec.	Quantity of Fresh Water Required during the summer period of six months
1	2	3	4
1	Manjeswar	5.60	87
2	Uppala	5.60	87
3	Shiriya	5.60	87
4	Mogral	5.60	87
5	Chandragiri	5.60	87
6	Chittari	5.60	87
7	Nileswar	5.60	87
8	Kariangode	5.60	87
9	Kavayi	5.60	87
10	Peruvamba	5.60	87
11	Ramapuram	5.60	87
12	Kuppam	3.82	58
13	Valapattanam	54.00	840
14	Anjarkandy	22.05	343
15	Tellicherry	5.60	87
16	Mahe	9.50	148
17	Kuttiyadi	29.40	457
18	Korapuzha	5.60	87
19	Kallai	3.06	48
20	Chaliyar	23.60	367
21	Kadalundi	5.60	87
22	Tirur	22.05	343
23	Bharathapuzha	22.05	343
24	Keecheri	5.60	87
25	Puzhakkal	5.60	87
26	Karuvannur	9.50	148
27	Chalakkudy	41.20	642
28	Periyar	26.00	404
29	Muvattupuzha	20.30	316
30	Pallickal	5.60	87
31	Kallada	41.20	642
32	Ithikkara	5.60	87
33	Ayroor	5.60	87
34	Vamanapuram	5.60	87
35	Mamom	5.60	87
36	Karamana	9.50	148
37	Neyyar	8.82	125
	Total		7199

Annexure - V

Reservoirs in Kerala

<i>Sl. No.</i>	<i>Name of Reservoirs</i>	<i>District in which located</i>	<i>Area (Hectares)</i>
1	2	3	4
1	Malampuzha	Palghat	2313
2	Mangalam	Palghat	393
3	Meenkara	Palghat	259
4	Chulliyar	Palghat	159
5	Pothundi	Palghat	363
6	Walayar	Palghat	259
7	Peechi	Trichur	1263
8	Vazhani	Trichur	255
9	Neyyar	Trivandrum	1500
10	Peppara	Trivandrum	582
11	Aruvikkara	Trivandrum	258
12	Parambikulam	Palghat	2092
13	Thunakadavu	Palghat	283
14	Kuttiyadi	Kozhikode	1052
15	Sholayar	Trichur	870
16	Peringalkuthu	Trichur	263
17	Ponmudi	Idukki	260
18	Anayirankal	Idukki	433
19	Mattupatti	Idukki	324
20	Sengulam	Idukki	33
21	Neriyamangalam	Idukki	413
22	Periyar lake	Idukki	2890
23	Bhoothathankettu	Idukki	608
24	Kanjirapuzha	Palghat	1052
25	Pumba	Quilon	570
26	Kakki	Quilon	1800
27	Idukki	Idukki	6160
28	Kallada	Kollam	2590
29	Kundala	Idukki	433
30	Pazhassi	Kannur	648
Total			24137

Annexure - VI

Pattern of Irrigation (Source-wise)

Sl. No	Source	1960-61	1970-71	1980-81	1990-91	1995-96	1999-00	2001-02
1	2	3	4	5	6	7		
1	Government Canals	133049	200553	99400	104265	103136	81231	95270
2	Private Canals	5738	10160	5300	3691	3681	4803	4413
3	Tanks	46952	73113	5050	48952	49213	52932	49945
4	Wells	2032	5460	50920	65678	73137	121605	86297
5	Other sources	130940	141968	77300	110783	113026	119472	110788
6	Total	318711	431254	237970	333369	342193	380043	377162
7	Area irrigated more than once in a year	137545	170131	143030	NA	123311	90655	55055
8	Gross irrigated area	456256	601385	381000	384561	465504	470698	432217
9	Net area irrigated to net area sown(%)	16.57	19.86	10.92	14.83	15.11	16.97	17.20
10	Gross irrigated area to gross cropped are (%)	19.40	20.50	13.21	12.73	15.18	15.68	14.44
11	Irrigated area under paddy to total irrigated area (%)	44.70	55.85	34.53	40.23	49.75	44.21	42.57

Source: Directorate of Economics & Statistics

Annexure - VII

Gross area irrigated (Crop-wise)									
Sl. No	Crops	1960-61	1970-71	1980-81	1990-91	1995-96	<i>(Area in hectares)</i>		20
							1999-00	2001-02	
1	2	3	4	5	6	7	8	9	
1	Paddy	347799	488635	276863	225063	234409	208790	183992	18
2	Sugarcane	3650	4290	854	2180	3844	5780	3267	3
3	Other food crops	65310	55690	25016	37416	44663	50907	55839	5
4	Total food crops	416759	548615	302733	264659	282916			
5	Total non food crops	39497	52770	78193	119902	182588	228592		
6	All crops	456256	601385	380926	384561	465504			

Annexure -VIII

Intensity of Cropping in Kerala

Sl.No	Year	Net Area Sown	Total Cropped Area	(Area in '000 Ha.)
				Intensity of Cropping*
1	2	3	4	5
1	1960-61	1924	2349	122
2	1970-71	2172	2933	135
3	1971-72	2187	2958	135
4	1972-73	2197	2986	136
5	1973-74	2202	2999	136
6	1974-75	2208	3028	137
7	1975-76	2189	2981	136
8	1976-77	2201	2933	133
9	1977-78	2201	2924	133
10	1978-79	2204	2886	131
11	1979-80	2195	2854	130
12	1980-81	2180	2885	132
13	1981-82	2190	2905	133
14	1982-83	2180	2862	131
15	1983-84	2180	2862	131
16	1984-85	2184	2875	132
17	1985-86	2191	2867	131
18	1986-87	2207	2870	130
19	1987-88	2211	2900	131
20	1988-89	2213	2963	134
21	1989-90	2252	3019	134
22	1990-91	2247	3020	134
23	1991-92	2248	3021	134
24	1992-93	2250	3046	135
25	1993-94	2250	3010	134
26	1994-95	2239	3048	136
27	1995-96	2265	3067	135

* Intensity of cropping is the ratio of total cropped area to net area sown, expressed as a percentage

Source: Economic Review and Farm Guide.