GOVERNMENT OF KERALA
KERALA STATE PLANNING BOARD

FOURTEENTH FIVE-YEAR PLAN
(2022-2027)

WORKING GROUP ON RIVER BASIN PLANNING: ROADMAP FOR GOVERNANCE AND ADMINISTRATION

REPORT

AGRICULTURE DIVISION
MARCH 2022

FOREWORD

Kerala is the only State in India to formulate and implement Five-Year Plans. The Government of Kerala believes that the planning process is important for promoting economic growth and ensuring social justice in the State. A significant feature of the process of formulation of Plans in the State is its participatory and inclusive nature.

In September 2021, the State Planning Board initiated a programme of consultation and discussion for the formulation of the 14th Five-Year Plan. The State Planning Board constituted 44 Working Groups, with more than 1200 members in order to gain expert opinion on a range of socio-economic issues pertinent to this Plan. The members of the Working Groups represented a wide spectrum of society and include scholars, administrators, social and political activists and other experts. Members of the Working Groups contributed their specialised knowledge in different sectors, best practices in the field, issues of concern, and future strategies required in these sectors. The Report of each Working Group reflects the collective views of the members of the Group and the content of each Report will contribute to the formulation of the 14th Five-Year Plan. The Report has been finalised after several rounds of discussions and consultations held between September to December 2021.

This document is the Report of the Working Group on "River basin planning: Roadmap for governance and administration." The Co-Chairpersons of Working Group were Dr E. J. James and Sri. T .K. Jose IAS. Dr. R. Ramakumar, Member of the State Planning Board co-ordinated the activities of the Working Group. Sri. S. S.Nagesh, Chief, Agriculture Division was the Convenor of the Working Group and Dr. C. Anilkumar, Assistant Director, Agriculture Division was Co-Convenor. The terms of reference of the Working Group and its members are in Appendix 1 of the Report

Member Secretary

PREFACE

As part of formulation of the 14th Five Year Plan, the Kerala State Planning Board had constituted working groups of experts in all the major sectors. In Agriculture and Allied Sectors, 6 working groups were constituted viz. Agriculture and Cooperation, Animal Husbandry and Dairy, Inland and Marine Fisheries, Forest and Environment, Water Resources and Regional Packages. To discuss and frame policies in each of these sectors, the working groups were further divided into 28 Expert Sub-Groups (ESG) with specific mandates.

Each Expert Subgroup held at least three meetings beside one focused group meeting before finalising the report. We, the Co-Chairs, place our deep appreciation and gratitude to all the esteemed members of the ESG for their valuable contributions in preparing the report. We are extremely grateful to Dr. V. K. Ramachandran, the Honourable Vice-Chairperson, Kerala State Planning Board, Dr. R. Ramakumar, Member, Kerala State Planning Board and Sri. S. S. Nagesh, Chief, Agriculture Division for their consistent guidance and suggestions in preparing the report. The drafting team put in commendable work in bringing together all the views and opinions of the members. We sincerely hope the recommendations in the report can lead to important changes in the public policy for water resource development in the State

Dr E. J. James
Expert co-chairperson

Sri. T .K. Jose IAS
Official co-chairperson

CONTENTS

HIGHLIGHTS

- As a river basin is a logical unit for the integrated development of natural resources from the points of view of water, soil, and bio-resources management, it is necessary to adopt integrated river basin management to achieve sustainability.
- The strategic priorities of the Kerala River Commission are listed in this document, along with specific steps for the way forward.
- A sample logical framework analysis, as well as preferred performance parameters are listed in the appendix.

RIVER BASIN PLANNING: ROADMAP FOR GOVERNANCE AND ADMINISTRATION

EXECUTIVE SUMMARY

INTRODUCTION: The need to reconcile the demands of conservation and development is a challenge for present-day decision makers. Integrated River Basin Management (IRBM) is an approach focusing on the development and management of land, water, and bio-resources in a coordinated manner with the primary aim to ensure society development, which is well balanced from the environmental, economic, and social points of view. Recognizing the fact that river basin is a logical unit for integrated development of natural resources from the points of view of water, soil and bio-resources management, it is necessary to adopt principles of integrated river basin management to achieve sustainability.

RIVER BASIN ORGANIZATION IN KERALA: Kerala River Commission is an organization to promote and coordinate sustainable development and management of water and related resources for the benefit of the State and the well-being of people. The strategic priorities of the organization on different fronts are as follows:

- Environment: Maintaining the ecological function of the river basins
- Social: Enabling inclusive access and utilisation of the basin's water and related resources
- Economic: Enhancing optimal and sustainable development of water and related sectors
- Climate change: Strengthening resilience against climate risks, extreme floods and droughts
- Cooperation: Strengthening cooperation among all basin stakeholders including the government departments and agencies.

RIVER BASIN MANAGEMENT IN KERALA: THE WAY FORWARD: The first activity is essentially the setting up of an institutional mechanism. This can be as follows.

- Establish Kerala River Commission (KRC) through an Enactment after obtaining clearance from the Law Department
- Constitute Six River Authorities for major rivers, river systems or cluster of rivers
- Each Authority may have a three-tier system: Gram Panchayat Level Committees representing small watersheds, District Level Committees representing larger sub-basins and Basin/Cluster Level Committees

The Authority is meant as a facilitating institution with a lean organizational structure and the Committees are intended to give feedback to the Authority to function in an efficient and transparent manner. The details of the structure and functions of the organization are provided. The specific outcomes from the functioning of such State level and basin level organizations are:

- Basin plans prepared for all river systems/clusters in relation to the small watersheds contained in them with emphasis on sustainable development with due consideration for social, economic, environmental and institutional factors
- Projects formulated for optimal utilization of water resources considering all require-

ments, especially water for drinking, food, energy and ecosystems
- Rivers and other water bodies monitored and water quality standards adhered to
- All plans and designs formulated considering climate change and other projected changes in future
- Targets of capacity building and awareness creation fulfilled and participatory water resources management ensured
- Sustainable development of water resources achieved through IWRM by considering equity and social justice.

Constant dialogue with the Ministry of Jal Shakti, MoEF&CC, MES, MoP and MRD are important in the context of national policies, financial and technical support and environmental clearance of projects. Dialogue with Development Partners like World Bank, ADB, JICA, UNDP, EU, UNEP are desirable for financial support for upgrading existing systems, initiating new projects, improving the physical systems, etc., are also important.

The logical framework analysis, as well as performance parameters are listed in the appendix. Steps for the implementation of these plans are also listed.

1. THE CONTEXT
GLOBAL PERSPECTIVE

The past few decades have witnessed the recognition that the Earth's resources are finite and call for implementation strategies which ensure the maintenance of these resources for the benefit of future generations. The world also faced several natural disasters, some of which were related to hydrologic extremes and global warming attributed mainly to anthropogenic activities. At the same time, development is undoubtedly a desirable economic and social objective which seems to achieve or maximize several attributes, such as, increased income, improvements in health and nutrition status, educational achievements, access to resources and a 'fairer' distribution of income (Pearce et al. 1990).

The World Conservation Strategy (WCS), brought out by the UNEP, WWF and IUCN, acknowledged that 'development and conservation are equally necessary for our survival' (IUCN et al. 1980). The strategies outlined by WCS include: (i) the maintenance of essential ecological processes within 'life support ecosystems' such as agricultural land and soil, forests, and coastal and freshwater wetlands; (ii) the preservation of genetic diversity; and (iii) the promotion of sustainable utilization of species and ecosystems. The concept of 'eco-development' advanced by the WCS was brought into the realm of political development by the establishment of the World Commission on Environment and Development in 1983. The Commission's report *Our Common Future* renewed the debate over sustainable development, defining it as "development that meets the needs of present generation without compromising the ability of future generations to meet their own needs" (Brundtland 1987).

Several new paradigms are being propounded to achieve the goal of sustainable development of natural resources, one such significant concept being 'ecosystem' approach. The concept of a 'holistic approach' is relatively easy to preach but difficult to practise, mainly because it encompasses not only the domains of physical and natural sciences but also that of social sciences. To achieve success in natural resources management for sustainability, it is necessary to carefully plan for bringing together the two important components, namely (i) the complex web of interactions in nature, and (ii) still more complex web of interrelationships among human needs, expectations and value systems. In such an approach, sustainability calls for due consideration of economic, social, environmental, and institutional aspects (Figure 1).

The need for integrated approaches to water resources management and the linking of water management to land use has been stressed in several national and international forums in recent years. Ensuring availability of freshwater and other environmental components to the ever-increasing population is one of the greatest challenges of the present and future generations. One of the most important conferences preceding and feeding into the Rio Conference was the International Conference on Water and Environment held in Dublin in January 1992. Principle 1 of the Dublin Statement reads: "Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic

development with protection of natural ecosystems" (ICWE 1992). These recommendations were subsequently incorporated into Chapter 18 of the Agenda 21 of the United Nations Conference on Environment and Development (UNCED), the Earth Summit, held in Rio de Janeiro, Brazil in June 1992 (UN 1992). Agenda 21, Chapter 18 stresses the need for the Protection of Quality and Supply of Freshwater Resources, which calls for integrated water resources management, including the integration of land and water-related aspects to be carried out at the level of the catchment, basin, or sub-basin (UNCED 1992).

It is worthwhile to note that the UN General Assembly held in June 1997, while examining the progress on sustainable development, made a call for the formulation and implementation of policies and programmes for integrated watershed management. In such an approach, it is essential to ensure the involvement of all stakeholders, encourage public participation, raise public awareness, build capacity, and develop appropriate institutional structures. All these will help in building a consensus and resolving conflicts of interests; such exercises are essential for effective natural resources management (Anonymous 1997). Integrated Water Resources Management (IWRM) concept sprung up as an offspring of the Dublin Conference and several attempts were made in different parts of the globe to achieve sustainable development. There has been a general recognition that the success of Millennium Development Goals (MDG) and the subsequently introduced Sustainable Development Goals (SDG) may depend on the implementation of IWRM.

Several countries drew up river basin management plans and initiated their implementation. This called for establishing institutional mechanisms to coordinate different activities at various levels by different agencies and to ensure capacity building, generate awareness and ensure data collection, dissemination, analysis and modeling. The importance of such institutions became paramount in the context of population growth in the developing countries, over-exploitation of natural resources, pollution and degradation of ecosystems, and the threats posed by climate change. The greatest challenge faced by these organizations in the context of river basin management has been in ensuring stakeholder participation. Though several attempts were made in the past to manage river basins in an integrated manner, most of which did not succeed in the absence of proper conceptualization of the idea, lack of scientific and technological support, failure to achieve stakeholder participation, and above all the absence of a proper institutional mechanism.

The Mekong River Council, Angat Project Authority – Philippines, International Commission for the Protection of Danube River, Mississippi Valley Conservation Authority, erstwhile National Rivers Authority of England represented presently by Environment Agency are examples of institutional mechanisms functioning in different river basins of the world.

NATIONAL INITIATIVES

Even before the Independence, experts like Dr. A.N. Khosla were proponents of comprehensive management of river basins. After the formation of Damodar Valley Corporation (DVC), the Government of India enacted the River Boards Act 1956 followed by Interstate Water Dispute Act -1956. These Acts are based on the assumption that a river is a state

property and that is a commodity for use of mankind alone. The Constitution of India made the entry of 'water' in the State list, recognizing the difficulty in monitoring and regulating this resource by the Central Government.

The DVC, first among the river basin organizations in the country, was originally modelled in the pattern of Tennessee Valley Authority (TVA). The DVC focused only on macro-level interventions and not on micro-level management with the participation of people. Catchment treatment measures and direct and indirect environmental consequences were not given priority in the management plans. Several River Basin Boards established by the Government of India were either project-specific or subject-specific. These River Basin Boards established after the Independence were primarily meant to take up projects and subsequently promote river basin development. The Damodar Valley Corporation, Bhakra Beas Management Board, Tungabhadra Board, Narmada Control Authority, Betwa River Board and Bansagar Control Board were all originally intended to construct and operationalize specific engineering projects. Though these Boards had an engineering perspective, all of them lacked a community outlook. So far, no single River Basin Board has been empowered to take up integrated development of water. Moreover, these Boards were mainly helping the people in the rich plains at the expense of socially and economically backward communities uphill. Dams constructed to address flooding contributed themselves to accelerate peak-flows downstream, examples being Bhakra, Damodar Valley, Hirakud, and Ukai. Some of them also caused water-logging and health hazards in the flood plains and most importantly, they failed to address the questions on economic and social inequality. Often, the concept of river basin planning and management concentrated on a comprehensive assessment and prioritization of the chain of contemporary management interventions, which the river basin organizations are to carry out in a phased manner.

As part of the focus on the Ganga, the Central Government established the National Council for River Ganga (NCRG) in 2016 under the Ministry of Jal Shakti in place of the erstwhile National Ganga River Basin Authority (NGRBA) under the Ministry of Environment, Forest, and Climate Change; this change came in to effect based on the 'River Ganga (Rejuvenation, Protection and Management) Authorities' Order of 2016, assigning the overall responsibility for superintendence of pollution prevention and rejuvenation of the Ganga basin to the NCRG. The performance of the Council based on the outcome has yet to be studied in detail. The National Water Policy 1987 had expressed the need for the States to plan and manage the river basins through their respective boards.

The greatest limitation of river basin organizations in the country is their inability to anticipate, assess and address the negative impacts of large dams and evolve a management practice considering the changing environment. Another limitation is the absence of a mechanism to address the social and economic inequalities. In spite of the decentralization trends through the empowerment of local self-governments, the actual power to plan, take decisions and mobilize resources for natural resources management are still centralized. What is practiced now is a post-facto-after-thought kind of band aid solution to overcome the criticisms. There has been reluctance on the part of the government to devolve powers to the people and local institutions, mainly because of the resistance from the complex

political, bureaucratic and departmental systems. The potentials and weaknesses of the present management actors were not understood in the proper perspective and the advantages of river basin organizations not properly recognized.

The major drawbacks of river basin organizations in India are lack of autonomy, failure in involving the communities, and limitations of institutional mechanisms, and dearth of data and absence of modern technologies for analysis and modelling. Of late, several participatory concepts are imposed by funding agencies in this area, some of the important examples being the specialist Water Resources Organization under the Water Resources Council and Revenue Board (WRCRB) of Tamil Nadu, State Water Resources Board of Odisha, Water Resources Authority of Maharashtra, and Water Resources Council of the Punjab. They have neither made use of the past experience nor made a honest attempt towards participation of people, accountability, and transparency, which are important in the context of water resources development and management. Based on an analysis of Water Resources Consolidation Project of Odisha, several of these shortcomings were illustrated. It is time that we have moved away from the 'stability equilibrium' of river system to 'metastability equilibrium', where river managers appreciate the dynamic nature of the river systems, and evolve flexible institutional and technical options for management. This 'threshold approach' involves 'process-oriented' investigation of river management problems and efforts to plan and manage them by understanding site-specific approach. This is all the more important in the context of global environment change and uncertain behaviour strategies of the river systems.

It is suggested that uncertainties can be brought down by blending modern scientific tools for prediction with the knowledge spectrum of local community. The river basin organizations have to play a major role in facilitating the objectivity through consensus and cross-fertilization of technological options with social actors for better results in river basin management. This calls for difference in orientation, regulation, type of communication, economic restoration and redistribution of political power through 'institutional pluralism' to manage the complex uncertainty. In recent years, there have been significant attempts to evolve river basin institutions through NGO and LSG-driven watershed or sub-basin development programmes. Attempts made by Tarun Bharat Sangh of Rajasthan, DHAN Foundation in Tamil Nadu, N.M Sadguru Water Development Foundation of Gujrat are some examples. 'Co-management' of natural resources by the Government and people is the right approach.

KERALA CONTEXT

To address the water management issues of a thickly populated and fragile State like Kerala, the need for adopting Integrated Water Resources Management (IWRM) has been recognized. The steep, short and monsoon-fed rivers of Kerala present several problems related to hydrology and river mechanics. The spatial and temporal distribution of rainfall, now affected by climate variation, pose several problems. Kerala has high rainfall areas in the Western Ghats like certain pockets in Idukki District with more than 5000 mm average annual rainfall and Walakkad in Silent Valley in the Palakkad District with 10000 mm of average annual rainfall. The average annual rainfall in certain pockets of Attapady, just

adjacent to Silent Valley is only 400 mm and in Vattavada in Idukki District, it is less than 400 mm. Almost 70 percent of the average annual rainfall in the State is received during the south-west monsoon season, 20 percent during the north-east monsoon season and the rest 10 percent during the six summer months. In a State already facing the problems associated with hydrologic extremes is sure to face more challenges of frequent floods and dry periods posed by climate change. The biodiversity of the State depends much on its water management. The State heavily depends on its hydropower, and irrigation is a must for its rice cultivation and certain plantation and spice crops. Most of the people in Kerala traditionally depended on open-well based drinking water system, which is gradually transforming into piped water supply. Different departments and agencies are involved in managing the water resources of the State, and efficient coordination of their activities are called for. Several drinking water sources are in the coastal belt and some of them are bound to be affected by the sea level rise and consequent salinity intrusion. The tourism of Kerala is highly dependent on its wetlands, which are facing several water quality problems, degradation and loss of ecosystem services.

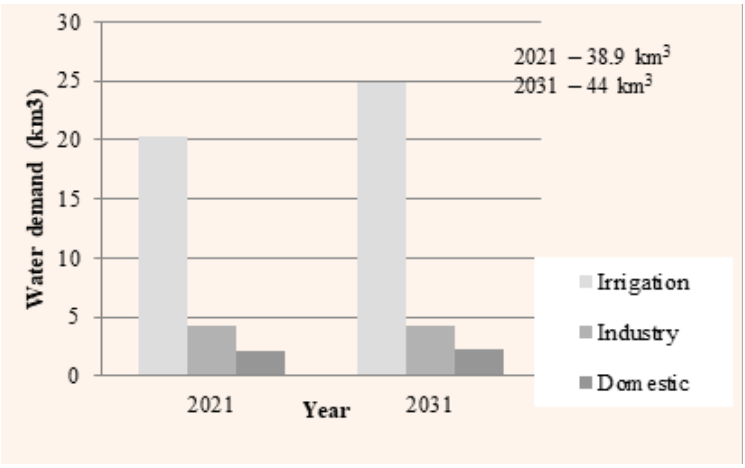
To illustrate the need for integrated river basin management in Kerala, the present status of the Periyar river basin may be considered as an example. A century and quarter ago, water of Mullaperiyar was transferred to the east coast to irrigate the drought-prone areas there. Around five decades ago, water from Periyar was transferred to Muvattupuzha river to generate power at Moolamattom using the water from Idukki reservoir. Apart from several comparatively small hydroelectric projects, the Idamalayar hydroelectric project and the Periyar Valley irrigation project changed the temporal and spatial availability of water in the river basin. Some water from this river was also transferred to cater to the requirements of Parambikulam-Aliyar project. All these attempts to tap the waters from the upstream reaches of the Periyar basin brought down the availability of freshwater in the downstream reaches, so much so that the salinity intrusion to the Periyar from the Cochin mouth increased. This caused salinity intrusion into the intake points of the water supply scheme to Greater Cochin. The extraction of water for industries in the downstream reaches augmented the problem considerably. Moreover, the discharge of untreated effluents and sewage to the river caused further deterioration of the river. Uncontrolled sand mining lead to salinity intrusion into the nearby wells and also degradation of the riverine ecosystem. All these were responsible for the deterioration of water quality and degradation of the Periyar ecosystem and consequent impact on the flora, fauna and health of the people. Even the regulators constructed recently could not address the problems completely. The floods in 2018 created another set of problems in the downstream reaches. The water that is diverted to Muvattupuzha initially lead to bank erosion in the Nachar and Thodupuzhayar. It is reported that the increase in fresh water availability at the mouth of Muvattupuzha in Vembanad wetlands adversely affected the natural growth cycle of fish in the wetland. The impact of frequent floods and dry periods as also sea level rise due to climate change are yet to be understood. Moreover, reliable data for flood routing studies are not available for this river basin. It is in this context that the need for a river basin organization to plan, monitor and manage the river basin recognized. The necessity for data collection, analysis and modelling

has also been realized to manage the river basin to optimally meet the several water uses and also to develop strategies to face the challenges of climate change. Coordination of different departments and agencies, LSGs, NGOs are found to be necessary. The past experience shows that only through a fully participatory approach, the objectives of the river basin organization can be realized. Institutional autonomy, accountability and transparency are essential components to be fulfilled for the success of river basin organizations.

Another example to highlight the importance of establishing river basin organizations is that of the river systems draining into the Vembanad wetland, the rivers being Achencoil, Pamba, Manimala, Meenachil and Muvattupuzha. All the five rivers draining in to the Vembanad wetland decide its wise use from the point of view of its ecosystem services. Two of the rivers draining to the wetland, namely Achencoil and Meenachil, are close to water scarcity condition, ie, 1000 m^3 / capita as per the World Bank norms. Another two, namely, Manimala and Muvattupuzha are close to water stress condition. Only flows to the wetland are from Pamba to arrest the salinity intrusion upstream. The operation of Thottapilly spillway and Thanneermukkam regulator to a large extent depends on the flows from the five rivers upstream. The operation of the reservoirs upstream in these river basins can play a major role in maintaining the wetland ecosystem and also the cultivation and biodiversity status of the wetland. The operation of the regulator is important from the point of view of the drinking water schemes in the downstream reaches of these rivers, especially at Perur for Kottayam water supply in Meenachil. The recent floods have opened the eyes of the water managers to plan for flood mitigation works, which call for scientific management of water within the river basins and the wetland as such. The rise in sea level as a consequence of climate change is sure to pose a great threat to the existence of Vembanad wetlands. Proper management of river basins and the wetland is called for in this context, based on reliable data and scientific analysis of data and modelling. With regard to these river basins, control of pollutants and sediment transport are important as also optimal utilization of water for drinking, irrigation, power generation and ecosystem conservation. Being a Ramsar site, integrated management of rivers draining into the Vembanad for enabling wise use of the wetland is the need of the hour. The water utilization and treatment measures have to be scientifically streamlined to avoid further deterioration of the wetland (James, et al. 1997).

The water demand for domestic, irrigation and industrial purposes, as projected by the GoK for 2021 and 2031, as part of Mission 2030, is given in Figure 1. Though this may be taken as an indicator of future trends in water demand, several other factors related to anthropogenic interventions and climate change have to be considered in future projections.

Figure 1 Water demand projections – Kerala



Source: GOK, 2013 - Mission 2030 document

The Chaliyar river has not been properly utilized to meet the requirements of the State, though Tamil Nadu has already diverted the waters from the upstream of this river for power generation and also irrigation. There is a need to come out with a basin plan for this comparatively large river system, not much exploited by the State, to meet the requirements of the people of Malappuram and Kozhikode Districts, some pockets of which are already facing water problems.

As part of the award of Cauvery Water Disputes Tribunal and the subsequent verdict of the Supreme Court, Kerala was allocated 30 TMC of water in the three sub-basins of Cauvery in Kerala, namely Kabini, Kerala Bhavani and Pambar; large quantum of this allocated water is not yet utilized by Kerala State. All the three sub-basins located in Wayanad, Attappadi and rain-shadow area of Idukki District need scientific water resources development to tide over the requirements during the summer months. The proposed river basin organization is expected to provide an opportunity to fine-tune the projects sanctioned by the Tribunal, which may form part of the basin plan, and optimally utilize the water resources for meeting the livelihood issues of the people in these areas.

There has been several requests from the Bharathapuzha basin for constituting a river basin authority for optimally utilizing the resources of the basin. A part of the water from the basin is diverted to the PAP project and in turn certain quantity of water is to be supplied from the project at Moolathara weir. However, there are complaints from the farmers in the area that the quantum of water due is not often received on time. The basin has several irrigation projects depending on dams and weirs, apart from a number of drinking water schemes. During the summer months, the crops suffer considerably due to non-availability of water in this rice-bowl of Kerala. There is an immediate need to form a river authority for this river basin, on which large number of farmers depend, to optimally utilize the waters based on a systems study. Conjunctive use of surface and groundwater resources are

recommended in the basin.The operation policies and rotational system of water allocation have to be streamlined and operated in line with the principles of participatory irrigation management.

Some of these cases were presented to highlight the importance of river basin organizations for optimal utilization of the water resources of these basins of Kerala for different uses of stakeholders for drinking, irrigation, ecosystem services, etc. There has been a general feeling among all concerned that the present institutional mechanisms may not be able to address the challenges in the area of water management, especially in the context of climate change, frequent occurrence of hydrologic extremes, pollution and ecosystem degradation threats, lack of coordination among the water related departments and agencies, and also in the absence of active participation of all stakeholders. The Water Policy of Kerala – 2008 also has emphasised the need for integrated water resources management.

RELEVANCE

Integrated River Basin Management (IRBM) is an approach focusing on the development and management of land, water and bio-resources in a coordinated manner with the primary aim to ensure society development, which is well balanced from the environmental, economic, and social points of view (Figure 2).

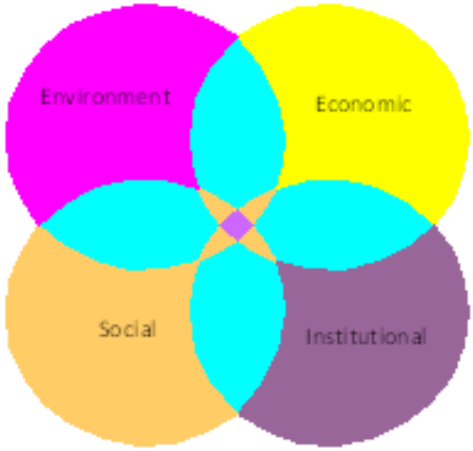


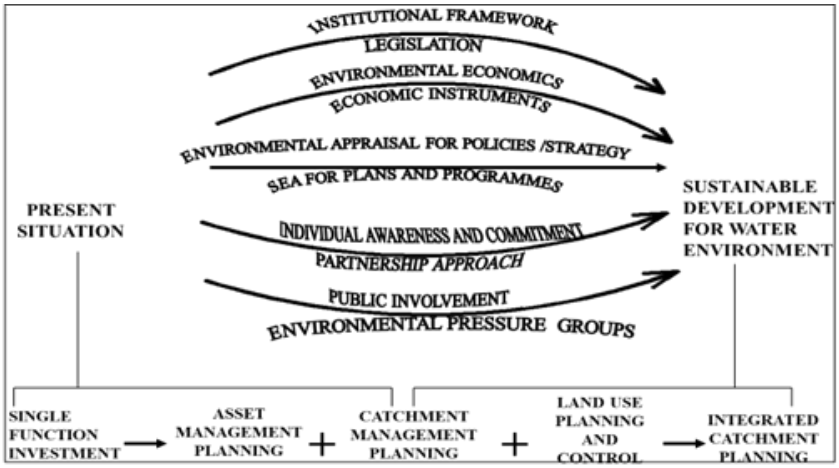
Figure 2 Factors contributing to sustainability: social, economic, environmental and institutional considerations

According to Young et al. (1994), the fact that water interacts with and, to a large extent, controls other natural components within a basin such as soils, vegetation and wildlife suggests that human activities, which are so strongly influenced by water availability and quality, might best be coordinated within an administrative structure which reflect river basins.

The river basin, watershed or catchment is a natural integrator of all the hydrologic phenomena pertaining to its boundaries, and as such, it is a logical unit for planning optimal development of soil, water and bio-resources. The strategies and pathways leading to integrated management of water resources leading to sustainability of river basins are given in

Figure 3.

Figure 3. River basin management: Strategies and pathways for sustainable development



The major challenges to be faced by river basin organizations are:

- Activities to encompass all aspects of water resource management–water/aquatic ecosystem protection, disaster management, and water use
- A wide range of disciplines to be covered - hydrology, ecology, environmental management, and economics
- Cross-cutting issues to be addressed - climate change, data sharing, and involvement of stakeholders
- Approaches to include: river basin management plan preparation, water-food-energy-ecosystem nexus assessment, science-policy integration, and trans-boundary cooperation.

The water balance in a river basin has to be viewed from the following perspectives:

- Blue – green water
- Upstream – downstream requirements
- Human – ecosystem needs
- Irrigation – other needs
- Quantity – quality conflicts

The largest consumer of freshwater in Kerala is irrigation, even as the area under rice and other crops, essentially requiring irrigation, are on the decline. The efficiency of irrigation using the harnessed water in the reservoirs is only about 30 percent. Most of the reservoirs are not following scientific operation policies, schedules for water releases, rotational water supply and a roster system as recommended by CWC. Much more is expected of the physical systems; operation and maintenance have to be improved to efficiently supply the potential harnessed at great cost. On-farm management has to be efficient and precision irrigation has to be adopted to save water and increase the yield of crops. Kerala depends

considerably on its hydroelectric projects for meeting the energy requirements in the State. Most of the hydro projects are not having scientific operation policies with due consideration to the downstream reaches and requirements. The upstream utilization in the river basins often do not consider the downstream water quality problems, and requirements for drinking water in the thickly populated coastal belt as well as the needs for ecosystem services, fisheries and aqua-tourism. Some of the requirements of water are complimentary while certain others are conflicting. It is necessary to address these problems scientifically with the support of reliable data to achieve sustainable management of water resources.

Recognizing the fact that river basin is a logical unit for integrated development of natural resources from the points of view of water, soil and bio-resources management, it is necessary to adopt principles of integrated river basin management to achieve sustainability. It is also realized that sustainable development depends on social, economic, environmental, and institutional factors. The strategies of Integrated Water Resources Management (IWRM) has been recommended for sustainable development in the background of Dublin Conference. Such an approach is appropriate to face the changes in climate and environment. However, the institutional mechanisms now in vogue in the country and in Kerala State are not congenial for sustainable development of natural resources. All the more, proper coordination among the stakeholder departments are not effective as also participation of people. To face the newly found changes, it is necessary to address the problems with the support of modern tools of science and technology belonging to Industry 4.0 ecosystem. All these call for an effective and efficient river basin management organization equipped with experienced water technologists and natural resources managers and state-of-the-art scientific and technological infrastructure to address the challenges in the field.

2. RIVER BASIN ORGANIZATION IN KERALA

River basin vision : Economically sound, socially just, environmentally safe, and scientifically governed River Basins of humid tropical Kerala for sustainable development

Kerala River Commission Vision : A well governed, financially secure, River Basin Organisation serving the rivers of Kerala to achieve the Basin Vision

Mission of Kerala River Commission: To promote and coordinate sustainable development and management of water and related resources for the benefit of the State and the well-being of people

STRATEGIC PRIORITIES

- Environment: Maintaining the ecological function of the river basins
- Social: Enabling inclusive access and utilisation of the basin's water and related resources
- Economic: Enhancing optimal and sustainable development of water and related sectors
- Climate change: Strengthening resilience against climate risks, extreme floods and droughts
- Cooperation: Strengthening cooperation among all basin stakeholders including the government departments and agencies.

OBJECTIVES OF RIVER BASIN MANAGEMENT

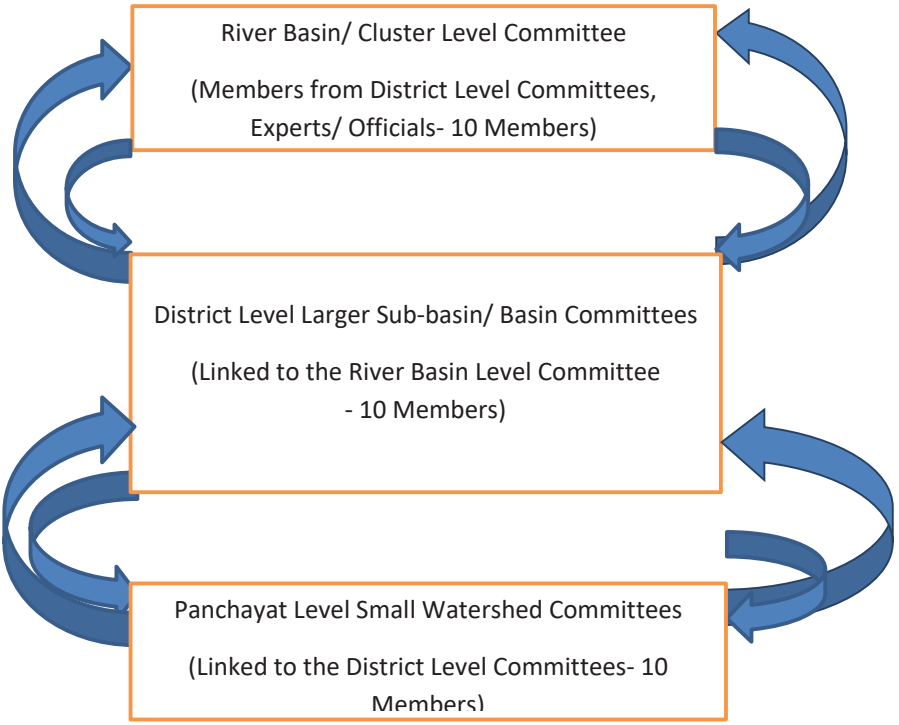
- Conserve water for beneficial use
- Mitigate floods and mudflows
- Address climate change impacts
- Provide needed domestic and industrial water supply
- Optimally utilize the irrigation and hydropower potential
- Stabilize critical runoff and sediment producing areas
- Rebuild eroded and depleted soils
- Protect land against all forms of soil deterioration
- Improve grasslands, wood lands, and wildlife lands
- Coordinate all departments and agencies involved in water management
- Conserve biodiversity including all aquatic flora and fauna
- Facilitate inland navigation, aquatic tourism and recreation
- Integrated management of soil, water and bio-resources
- Carry out data collection, analysis and model studies
- Build capacity and create awareness among all concerned

3. RIVER BASIN MANAGEMENT IN KERALA: THE WAY FORWARD

Institutional Mechanism

- Establish Kerala River Commission (KRC) through an Enactment after obtaining clearance from the Law Department
- Constitute Six River Authorities for major rivers, river systems or cluster of rivers
- Each Authority may have a three tier system: Gram Panchayat Level Committees representing small watersheds, District Level Committees representing larger sub-basins and Basin/Cluster Level Committees (Figure 4).

Figure 4. Three-tier system linking the LSGs



The details of proposed River Basin Authorities under the KRC, aiming at decentralized and integrated river basin management, are given below:

1. *Valappattanam and Northern River Systems (VNRS)*
   Manjeshwar, Uppala, Shiriya, Mogral, Chandragiri, Chittari, Nileshwar, Karingode, Kavvayi, Peruvamba, Ramapuram, Kuppam, Valappattanam, Anjarkandy , Telicherry and Mahe
2. *Chaliyar and Adjacent River Systems (CARS)*

Kuttiady, Korapuzha, Kallayi, Kadalundi, Kabbini and Chaliyar

3. *Bharathapuzha River Systems*
   Bharathapuzha –Tirur and Bhavani
4. *Kol Wetland River Systems (KWRS)*
   Keecheri, Puzhakkal, Karuvannur, Chalakudy and Periyar, Pambar
5. *Vembanad Wetland River Systems*
   Muvattupuzha, Meenachil, Manimala, Pamba and Achancoil
6. *Kallada, Neyyar and Southern River Systems (KNSRS)*
   Pallickal, Kallada, Ithikara, Ayroor, Vamanapuram, Mamom, Karamana and Neyyar

Committees of ten members at the LSG levels may be constituted with 60% members nominated by the local bodies and another 40% experts/ officials nominated by the State Government and Kerala River Council.

The Authority is meant as a facilitating institution with a lean organizational structure and the Committees are intended to give feedback to the Authority to function in an efficient and transparent manner.

The Secretariat of the Council may be headed by an eminent water technologist, who will coordinate the technical and administrative matters (Figures 5-6). The CEO will be assisted by one expert each with good academic background and sound experience posted on deputation in the areas of water supply, irrigation, hydropower, water quality, ecology/ biodiversity, and land survey from relevant Departments apart from minimum administrative manpower for carrying out the functions. Research/Project Associates may be appointed on temporary basis to support the experts in key areas. The research organizations/ academic bodies of the State shall provide necessary data, and also support the Council in analysis of data and modelling. The Council shall be empowered to assign works and get the support whenever necessary from the Departments/Agencies/ R&D Organizations of the Government dealing with or involved in water management.

Figure 5. KRC structure

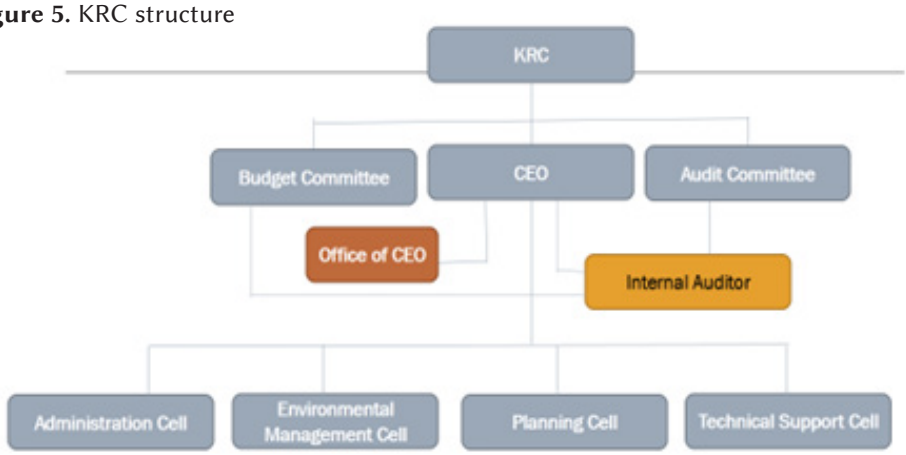


Figure 6. KRC: Programmes

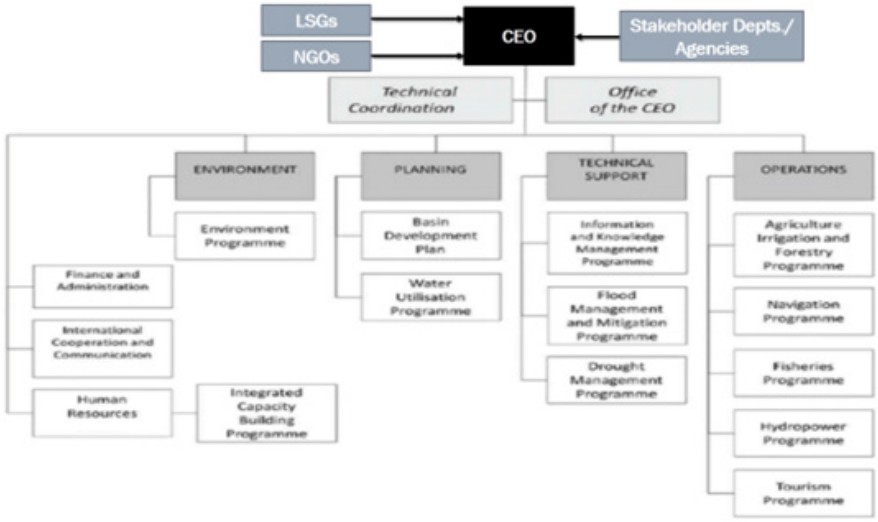


Figure 7. KRC: Functions

Each Authority shall be headed by a senior water technologist on deputation from existing Government Departments. He will be assisted by one expert each with good academic background and sound experience posted on deputation, in the areas of water supply, irrigation, hydropower, water quality, ecology/biodiversity, and land survey from relevant Departments apart from minimum administrative manpower for carrying out its functions. The Authority shall be empowered to assign works and get the support whenever necessary

from the Departments/Agencies/ R&D Organizations of the Government dealing with or involved in water management.

The management plans for watersheds/sub-basins shall be prepared and implemented by the local self-governments and larger projects at the basin level by the departments/agencies dealing with the domain concerned. These plans shall be discussed at the respective committees and submitted to the River Basin Authority to look into the feasibility and viability from the social, economic and environmental angles. The Authority may refer it to the relevant department/agency/ R&D Organization, if required, to get their feedback. However, single window mode shall be adopted as far as possible for scrutinizing/recommending the projects and schemes to avoid delay.

The management of individual watersheds/sub-basins and local water resources shall be the responsibility of the Local Self Government, which can be implemented by them or implemented with the support of Government Departments. These projects shall be discussed in the meetings of respective committees and at the level of the Authority. Monitoring of works of special importance from social, economic or environmental angles shall be assigned to appropriate bodies. Single-window mode shall be followed as far as possible in scrutinizing/recommending projects to avoid delay.

The monitoring and evaluation of projects and schemes shall be done by the Authority with the support of respective committees and other relevant departments/agencies. A monitoring cell will be formed by each Authority to take care of this function.

Other proposed features of the institutional mechanism are:

- Industry 4.0 ecosystem shall be fully made use of in planning, monitoring and implementing the schemes
- The officers of major stakeholder departments shall be represented in the Committees
- Apart from the Central Secretariat of the KRC, there shall be an administrative headquarters for each Authority supported by a group of experts
- Basin level plans shall be prepared and implemented by the department/agency concerned on the recommendations obtained from the three-tier system and also the Authority by consulting stakeholder departments and agencies
- An inter-disciplinary Advisory Committee will guide the Authorities in planning and implementing the schemes and monitoring and evaluating the performance.

Smart Water Management that combines different factors -integrated, secure, stable, sustainable, adaptable and intelligent – shall be promoted through KRC (Figure 8). SWM can be defined as an intelligent water management model that covers from water supply infrastructure to water resource production and distribution, manages digital water data in a scientific way, uses ICT to process information in real time and skillfully uses Big Data devices (Choi et al. 2016).

FUNCTIONS OF THE PROPOSED AUTHORITIES

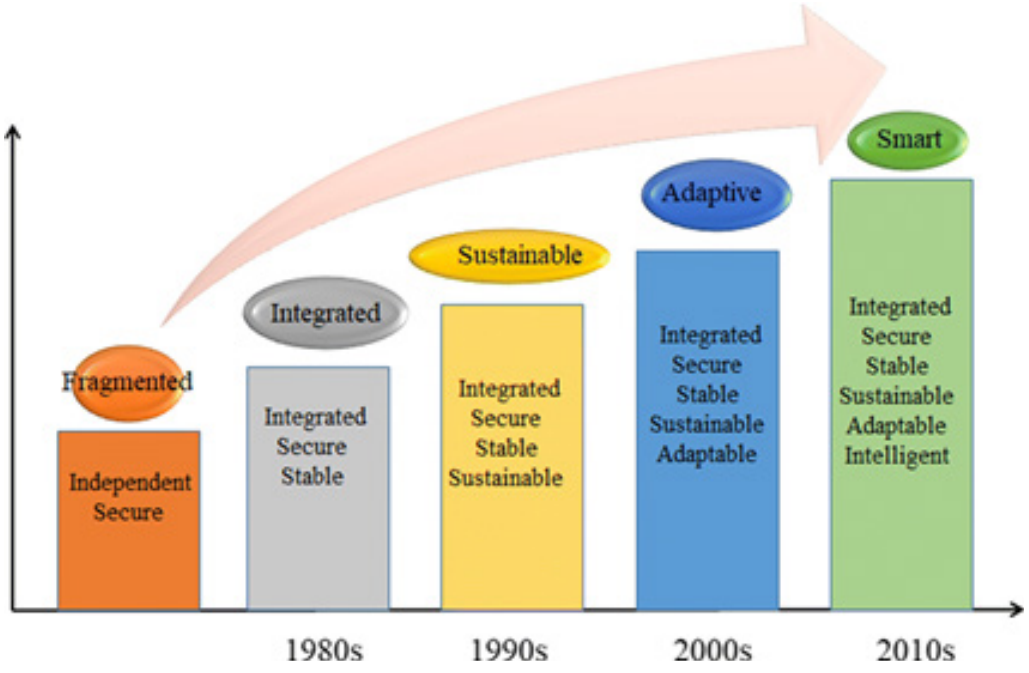
The core functions of KRC and Authorities may be classified under the following heads:

- Data acquisition, exchange, and monitoring

- Analysis, modelling, and assessment
- Support for planning, implementation, monitoring and evaluation at the basin/cluster level and project level
- Forecasting, warning, and emergency response
- Implementing KRC procedures

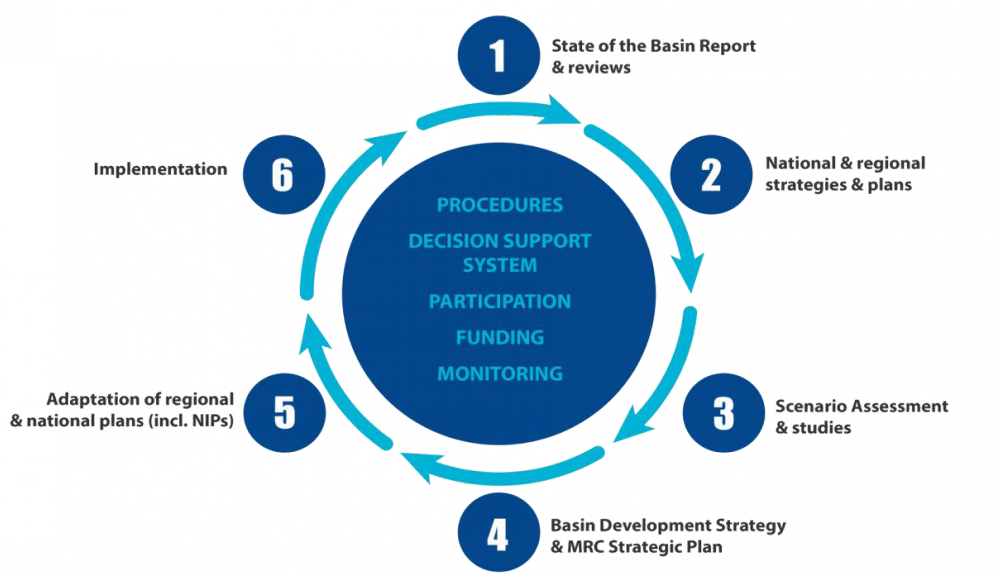
Data and information systems and related services are key to sustainable water resources management; these are gaining more dimensions in the context of Industry 4.0. Basin monitoring by the KRC shall generate reliable data and information about the health and condition of the river systems of Kerala. These data and information are critical for scientific analysis, forecasting, and reporting about status, trends, and potential impacts that are of utmost importance for decision-making at the State, Basin and LSG levels.

Figure 8. Evolution of water management approaches

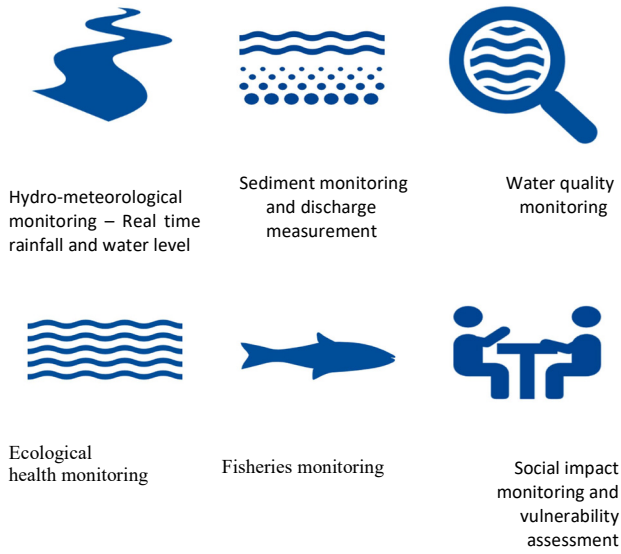


The major domains of activities of KRC/RBA are given in Figure 9 (a) & (b) .

Figure 9. The major functions and areas to be addressed by KRC/RBA
Figure 9 (a) Major functions of KRC/RBA



(b)Major areas of activity of KRC/RBA



Modelling and assessment in water resources are gaining more importance and pose more challenges in the context of human interventions and impact of climate change. Some of the challenges of modelling and assessment are highlighted below:

- Changing global climate, trans-boundary issues and fragility of the short, steep and monsoon-fed rivers add to the complexity, and also equitable sharing of water (models like SWAT and IQQM can be initially attempted)
- Water resources modelling is playing an increasingly important role in the context since it can investigate trends and quantify the risk of over-development to help understand the past, current and future state of water resources and sediment yield in the basins/systems
- The downstream reaches of these river systems in the wet humid tropical zone are hotspots of biodiversity
- Salinity intrusion and water quality problems in the downstream reaches, especially in the context of sea level rise, are to be addressed by resorting to mathematical modelling.

In the context of climate change, the greatest challenge is to forecast hydrologic extremes leading to floods and droughts, and salinity intrusion and inundation due to sea level rise. Some of the areas to be focused include:

- Forecasting and early warning (flood and drought): River Flow Monitoring and Flood Early Warning System - Flash Flood Guidance System
- Near Real-Time Monitoring and Establishing Flood Forecasting and Drought Forecasting and Early Warning Websites
- To improve the data, information, modelling, forecasting and communication systems, the visualization of near-real time hydro-meteorological monitoring and flood and drought forecasts has to be made available using interactive graphs and maps
- This is expected to enhance the quality and effectiveness of reporting, more clearly illustrating the magnitude and extent of flood or drought conditions
- This in turn will lead to more mainstream use of these services by relevant agencies as well as news agencies and social media
- Maintaining IoT enabled accurate flow measurement systems.

The specific functions of each Authority may include:

- Facilitating the preparation of detailed plans and projects from a river basin perspective
- Coordinating scientific studies to understand the problems from a holistic angle
- Providing support for preparing river basin maps, by delineating different zones from the points of view of hydrologic extremes, coastal management, wetland conservation and different development considerations
- Initiating studies on water balance and impact of climate change
- Ensuring water quality monitoring mechanisms and maintenance of water quality status
- Facilitating the planning, design, implementation, monitoring and evaluation of projects in an integrated manner
- Initiating studies on water economics and benefit-cost analysis of projects
- Ensuring environmental impact assessment, wherever necessary
- Facilitating participatory approach in the implementation of projects
- Conducting capacity building programmes and awareness creation

- Ensuring sustainable water resources management by following the principles of Integrated Water Resources Management (IWRM)
- Integrating land use planning with water resources management
- Coordinating with all departments and agencies of the State in all sectors related to water management
- Networking with relevant national and international agencies involved in water and related natural resources management.

The basic approach may encompass, among other factors: Project Implementing Agencies (PIA), Financial Assistance to PIA, Duration of the Programme, Livelihood Orientation, Scientific Planning, Capacity Building, Multi-tier Approach, Common Property Resources Benefit Sharing, Partnership with NGOs, and Convergence with Other Line Departments and Schemes.

OUTCOME

The KRC intends to focus on delivering outcomes in four key result areas as a State river basin organisation. The strategic outcomes and approach to deliver the outcomes in the key result areas are outlined below:

- State level plans, projects and resources – basin-wide perspective
- Policy makers and project planners increase common understanding and application of evidence-based knowledge
- State sector planning agencies optimise environmental management and sustainable water resources development for basin-wide benefits
- State planning and implementing agencies share and apply guidance for the development and management of water and related projects and resources.

The specific outcomes from the functioning of such State level and basin level organizations are:

- Basin plans prepared for all river systems/clusters in relation to the small watersheds contained in them with emphasis on sustainable development with due consideration for social, economic, environmental and institutional factors
- Projects formulated for optimal utilization of water resources considering all requirements, especially water for drinking, food, energy and ecosystems
- Rivers and other water bodies monitored and water quality standards adhered to
- All plans and designs formulated considering climate change and other projected changes in future
- Targets of capacity building and awareness creation fulfilled and participatory water resources management ensured
- Sustainable development of water resources achieved through IWRM by considering equity and social justice.

INITIATING THE ESTABLISHMENT OF KRC AND RBA

For smooth functioning of the KRC/RBA, a few of the documents, procedures and protocols to be finalized *a priori* include:

- Enactments and registration of MoA
- Statutory bodies – constitution and meetings
- Licensing formalities (having an impact on water resources)
- Collection of fee and tax (items/services related to water)
- Policies on relevant matters
- Procedures of governance
- Implementation strategies
- Legal aspects
- Financial proposal

Initial actions to be taken include:

- Constitution of BRC and SIX River Authorities by providing necessary infrastructure after legal clearance and necessary enactments
- Demarcating the river basins/cluster to be included under each Authority
- Mapping of watersheds coming under each river basin/cluster of river basins
- Capacity building and awareness creation
- Identifying the Gram Panchayats and District Panchayats coming in the respective river basin/ cluster along with the included small watersheds
- Constitution of Committees at the Gram Panchayat, District Panchayat and Basin levels to facilitate the planning of watersheds, sub-basins and basins respectively to implement the projects.

PARTNERING WITH LOCAL SELF GOVERNMENTS

The greatest task of the RBA is to integrate all the activities right from planning to implementation of water resources projects with the functioning of LSGs and line departments/ agencies. Another major task is to ensure participatory approach involving all stakeholders. The principles of IWRM and watershed management focus on stakeholder involvement. Some of the strategies to integrate the RBA with LSGs are listed below:

- Member Gram Panchayats/District Panchayats have to be empowered to implement the KRC procedures effectively and coherently with the support of relevant departments/agencies
- Effective dialogue and cooperation have to be a continuous process among the RBA, panchayats, district administration and stakeholder departments/agencies concerned
- Strategic engagement of basin partners and stakeholders on water management calls for appropriate organizational and procedural changes
- Better monitoring and communication of the basin conditions are possible only through proper dialogue, capacity building and awareness creation at all levels
- Strengthening the stakeholder panchayats, departments and agencies in basin-wide monitoring, forecasting, impact assessment and dissemination of results for better decision-making
- The initiatives highlighted above will result in a Leaner River Basin Organisation.

A three-tier system is envisioned to ensure total linking and integration of RBA with the LSGs, as given in Figure 4. The system is expected to help the Gram Panchayats to plan

and implement the projects considering the small watersheds as the logical unit, District Panchayats to plan and implement sub-basin level projects with the support of the line departments and Basin Committees to plan and implement the basin level projects with the support of line departments. Larger projects in the drinking water, irrigation, energy, environment, fisheries and tourism sectors may be planned and implemented by the stakeholder departments/agencies taking into account the views of the LSGs at the three tier committee meetings and the guidelines of RBA/KRC. This mechanism is expected to bring about transparency, efficiency and effectiveness in the planning, implementation and monitoring of water resources projects with the participation of people giving due weightage to social, economic, environmental, institutional and gender factors, pointed out as essential components of IWRM.

PARTNERING WITH RELEVANT DEPARTMENTS AND RESEARCH ORGANIZATIONS

An efficient data management system is essential for planning, designing, implementing, monitoring and evaluating the projects and programmes of water resources development and management in the State. Real-time data are necessary in the context of forecasting hydrologic extremes and to initiate actions well on time to address natural disasters. Analysis of data and modelling form an integral part of efficient water resources management. Considering all these requirements, the activities of the KRC have to be integrated with those of the research and other related organizations within the State and outside like CWRDM, KERI, KFRI, IDRB, SGWD, NCESS, NIH, CWPRS, IMD, IITM, ICAR, CWC, CGWB, CPCB, etc. Their support may be sought to meet most of the data requirements. These organizations also can, to a great extent, support in analysis of data and modelling. The institutions of higher education are also to be engaged. However, a skeletal group of officers/experts in KRC may coordinate these activities.

The planning, design and implementation of works at the small watershed level have to be done by the LSGs. The RBA is expected to ensure that these works fit into the overall basin development plans and are sustainable. The sub-basin, basin and inter-basin level development and management are to be planned, designed and implemented by the respective departments/agencies of the State Government, and RBA ensures that the plans fit into the river basin as a unit and also that the plans are sustainable, mainly from the IWRM point of view. The project implementation and operation and maintenance are systematically monitored and evaluated by the RBA and suggestions and recommendations given to the respective bodies from time to time. Some of the State Government Departments identified for close partnership with KRC are: Irrigation, Agriculture, Revenue, Groundwater, Soil Conservation and Soil Survey, Mining and Geology, Forest, Fisheries, and Industry. The RBA shall also partner with other important bodies of Government like KSEB, KWA, KSBB, KSDMA, KRWSA, KSPCB, CGWB, and MGNARGA. The KRC also shall work in close association with CWC, CGWB and other institutions under Ministry of Jal Shakti, MoEF&CC, MoRD, MoP&NRE, etc.

PARTNERING WITH NON-GOVERNMENT ORGANIZATIONS

Non-government organizations (NGOs) have been playing a major role in the water sector all over the world, and especially in Kerala. They have also helped considerably in some of the World Bank projects like KRWSA in capacity building and awareness creation. NGOs also may be able to play the role of catalysts in implementing the integrated river basin plans. Some of the NGOs in Kerala have experienced personnel in the areas of drinking water and sanitation. Their potential as a catalyst may be fully made use of for implementing the projects in a participatory mode. Civil Societies have a major role to play in implementing the projects on a participatory and transparent mode aiming at the welfare of the people and the conservation of nature. The role of women is highlighted in the principles of IWRM and this has to be given due importance in the activities of KRC. Since drinking water is considered as a social right, participatory approach will considerably help in achieving the goals of SDG and other targets.

DIALOGUE PARTNERS

For the successful functioning of KRC, it is necessary to have constant dialogue with the neighbouring States since some of the inter-State rivers are involved, and in the case of inter-State water transfers, continuous negotiations are called for with regard to the review of certain agreements and operation of some of the projects which have an impact on the water management of Kerala. Constant dialogue with the Ministry of Jal Shakti, MoEF&CC, MES, MoP and MRD are important in the context of national policies, financial and technical support and environmental clearance of projects.

Dialogue with Development Partners like World Bank, ADB, JICA, UNDP, EU, UNEP are desirable for financial support for upgrading existing systems, initiating new projects, improving the physical systems, etc.

Technical collaboration may be established with similar river basin organizations, and policy-oriented research institutions as also the private sector and non-governmental organizations.

A list of CEOs/Heads of Institutions of some of the successfully run river basin organizations in the world along with their academic background, are given below:

- Dr An Pich Hatda, Chief Executive Officer, Secretariat of Mekong River Council (Master of Science in Agricultural Planning and Management from the Asian Institute of Technology and Ph. D from University of Tokyo)
- Donato D. Marcos, Angat Project Authority, Philippines (Degree in Engineering from Mapua Institute of Technology and Masters Degree from Manuel L. Quezon University)
- Momcilo Blagojevic, President, International Commission for the Protection of Danube River (PhD in geological engineering, hydrogeology, transboundary water management)
- Jeffry J Lyash, CEO of Missisipi Valley Conservation Authority, USA (Mechanical Engineer and the Drexel University Distinguished Alumnus and a Graduate of the U.S. Office of Personnel Management and the Duke Fuqua School of Business Advanced Management Program).

LOGICAL FRAMEWORK ANALYSIS

An indicator-based monitoring system like LFA is recommended to understand the performance and outcome of KRC/RBA. A sample framework is given in Appendix.

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APPENDIX

Table A1: Sample LFA for River Basin Management

Step	Task	Tool	Expected Outcome
I Preparation	Vision Building	SWOT PRA	Need Identification: How the needs are identified. How the Segregation and Analysis of needs is done. Vision Building: What is the outcome of SWOT Analysis How Participatory Rural Appraisal is conducted, what are the tools used (eg. Tools like Resource Map, Social Map, Transect Walk, Wealth Ranking, Venn diagram, Seasonal Ranking, Walk through, Focus Group Discussions, etc.) and what information it has generated
II Analysis	Stakeholders Analysis	Identification of Stakeholders Primary Analysis of all stakeholders who have a relation to the area and those who should be involved from outside of watershed area Ranking of problem	Identified Stakeholders in three categories, Primary- Directly affected, Secondary – indirectly affected and tertiary – institutions and their programmes
	Problem Analysis	Problems of Stakeholders Ranking of problem Select priority problems Problem Matrix Scoring Starter Problem Preparation of Problem Tree	Problems of stakeholders and give problem tree
	Objective Analysis	Preparation of Objective Tree Clustering	Clear objectives with objective tree
	Goal Analysis	Writing Goal Statements	Clear and Achievable Goal
III Planning	Project Planning	Net Planning Construction of PPM	Project planning Matrix as per LFA format

	Matrix (PPM) – Logic		
IV Implementation	Institutional Arrangements (PIA)	Action plan preparation	PIA Assets created as activities of action plan

Qualifying Statements in Logical Framework Analysis: Indicative List

- Measures to counter land degradation
- Measures to counter soil erosion
- Measures to counter water scarcity
- Measures to counter fodder scarcity and animal husbandry
- Measures to benefit agriculture
- Measures to improve livelihood
- Measures to improve community mobilization
- Measures to improve community organization
- Measures to improve community functional Skills

Table A2: Indicators in Logical FrameworkAnalysis: Indicative List

Physical works	**Agriculture**	**Training Capacity Building**
• Water sufficiency for various purposes, • Effect on ground water, • Effect on soil, • Effect on Run off, • Effect on bio mass etc	• Crop Production and Productivity • Effect on area under irrigation • pumping hours in kharif and rabi season • cropping intensity • cropping pattern • crop yield • crop water requirement · Farm equipment • Animal husbandry etc.	• Awareness • Skills • Knowledge • Decision Making • Adoption • Change in behaviour
Social and institutional	**Economic**	**Sustainability**
• Pattern of Land Holding and size of Land Holding • Employment	• Annual yield of food grains • Annual Yield of Fish, Milk and poultry, fruits, flowers and medicinal plants	• Availability of alternative livelihood options
Social and institutional	**Economic**	**Sustainability**

• Literacy • Migration • Education • Occupation • Social Status • Market Facilities • Income Levels • Basic Amenities • Infrastructural Development • Communication • Energy Sources • Agro-based industries • Health Care • Community Participation • Capacity Building • Benefit sharing Mechanism • Decision Making • Representation of Marginalized and poor communities • Community Based Organizations (CBOs) – SHGs, UGs and WSCs • Gender issues • Women Participation in CBOs	NTFPs • Recovery of Betterment levy • Water Charges recovery • Benefit Cost Ratio (i) with 10% interest on capital outlay (ii) Cost per ha of Annual Irrigation • Income of Groups involved in Income Generation Activities • Microfinance – loaning and recovery • Savings of groups • Consumption pattern • Employment generation in Man days • Non-farm activities • Transaction in local haats and mandis • Per capita Income	• Convergence • Self-dependency • Sense of ownership for the assets created • Strength to sustain in adverse situation

Table A3: Success Indicators

S.No.	Parameter	Before Treatment w/s area		After Treatment	
		Unit	Quantity	Unit	Quantity
1.	Water Availability				
	(i) Surface Water				
	(ii) Ground Water				
2.	Agriculture				
	(i) Area under Crops				
	(ii) Net area sown in the watershed (ha.)				
	(iii) Different crops being sown in the watershed area	Before Project Production of Yield pre project crop wise		Post Project Production of Yield post project crop wise	
		sown area	per ha yield in Qtls.	sown area	per ha yield in Qtls.
	(v) Application of bio fertilizers	Pre Project		Post project	

	(vi) Fodder production species wise & production wise(Qtls.)	Pre Project		Post project	
3.	Horticultural production (species	Pre project		Post project	
	Parameter	Before Treatment w/s area		After Treatment	
	wise)	Nos.	Production in Qtls.	Nos.	Production in Qtls.
4.	Agro forestry (species wise)	Pre project		Post project	
		Nos.	Production in Qtls.	Nos.	Production in Qtls.
	Arable Land (sp. wise)				
	Pasture Land (sp. wise)				
	Forest Land (sp. wise)				
	Government Land (sp. wise)				
	Total				
5.	Live Stock	Pre Project		Post project	
	(i) Nos. of hybrid animals available (sp. wise)				
	(ii) Av. milk production per animal (sp. wise) (in Kg.)				
	(iii) General diseases found in animals (reduction in Nos.)				
6.	Socio Economic Status	Pre Project		Post project	
	(i) Average income per family				
	(ii) Self Help Group				
	• Total nos. of SHG (activity wise)				
	• Nos. total members				
	• Total savings				
	• Assistance from watershed project (amount)				
	(a) Bank linkage				
	(b) Revolving Fund				
	(c) Loan sanction to the SHG's				

Implementation

- Physical Works
- Agriculture and Livelihood Activities
- Social, Economical, Institutional and Capacity Building Activities
- Social and Community activities
- Institutional Development Activities.
- Training Activities, Withdrawal and Exit Protocol
- Maps and Formats: Various maps are required as immediate reference sheets to the different activities considered relevant in PPM

APPENDIX I

PROCEEDINGS OF THE MEMBER SECRETARY

STATE PLANNING BOARD

(Present: Sri. Teeka Ram Meena IAS)

Sub: - Formulation of Fourteenth Five Year Plan (2022-27) – Constitution of Working Group on Water Resources – reg.

Read: 1. Note No. 297/2021/PCD/SPB dated: 27/08/2021
2. Guidelines on Working Groups
3. This Office order of even number dated 08.09.2021

ORDER No. SPB/342/2021-Agri(5) Dated: 14.09.2021

As part of the formulation of Fourteenth Five Year Plan, it has been decided to constitute various Working Group under the priority sectors. Accordingly, the Working Group on **Water Resources** is here by constituted with the following members. The Working Group shall also take into consideration the guidelines read 2nd above in fulfilling the tasks outlined in the ToR for the Group.

Theme

RIVER BASIN PLANNING: ROADMAP FOR GOVERNANCE AND ADMINISTRATION

Co - Chairperson

- Dr E. J. James, Pro-Vice Chancellor, Karunya institute of Science and Technology, Coimbatore
- Mr T. K. Jose IAS, Additional Chief Secretary, Department of Water Resources

Members

- Dr K. P. Sudheer, Vice-Chairman, Kerala State Council for Science, Technology and Environment
- Dr Manoj P. Samuel, Executive Director, CWRDM
- Dr N. C. Narayanan, Professor, Indian Institute of Technology, Bombay
- Dr C. T. Dhanya, Department of Civil Engineering, Indian Institute of Technology, Delhi
- Dr Seenath Peedikakandi, Assistant Professor, Department of Agricultural Economics, KAU
- Mr K. A. Joshi, Rtd. Chief Engineer, Department of Water Resources
- Mr James Wilson, Assistant Executive Engineer, KSEB
- Adv Thomas Mathew, Chembakathinal house, Arakuzha PO, Muvattupuzha
- Mr Vinod Mohan, Executive Engineer, Department of Water Resources
- Dr.Tapas Singh Modak, Associate Fellow, FAS

Terms of reference

- To scientifically assess the progress towards instituting a River Basin Authority and the preparation of River Basin Plans in Kerala.
- To suggest measures to ensure that the governance and administration of the River Basin Authority are scientifically oriented.

- To suggest a roadmap to prepare River Basin Plans for all the major rivers of Kerala, and ways to integrate them with the question of socioeconomic development.
- To suggest ways in which the activities of line departments and LSGIs in Kerala, and local watershed plans, are integrated with the preparation and implementation of River Basin Plans.
- To suggest how the River Basin Plans can be a part of a larger water management information system, including decision support models and facilities for monitoring.

Convener

Sri. S S Nagesh, Chief, Agriculture Division, State Planning Board

Co- Convener

Dr. C Anilkumar, Assistant Director, Agriculture Division State Planning Board

Terms of Reference (General)

1. The non-official members (and invitees) of the Working Group will be entitled to travelling allowances as per existing government norms. The Class I Officers of GoI will be entitled to travelling allowances as per rules if reimbursement is not allowed from Departments.
2. The expenditure towards TA, DA and Honorarium will be met from the following Head of Account of the State Planning Board "3451-00-101-93"- Preparation of Plans and Conduct of Surveys and Studies.

The order read as reference 3 is modified to this extent.

(Sd/-)
Member Secretary

Forwarded By Order

Chief,
Agriculture Division

To

The Members concerned

Copy to

PS to Vice Chairperson
PA to Member Secretary
CA to Member (Dr.Ramakumar.R)
Economic Advisor to VC
Chief, PCD,SPB
Sr. A.O, SPB
The Accountant General, Kerala
Finance Officer, SPB
Publication Officer, SPB
Sub Treasury, Vellayambalam
Accounts Section
File/Stock File