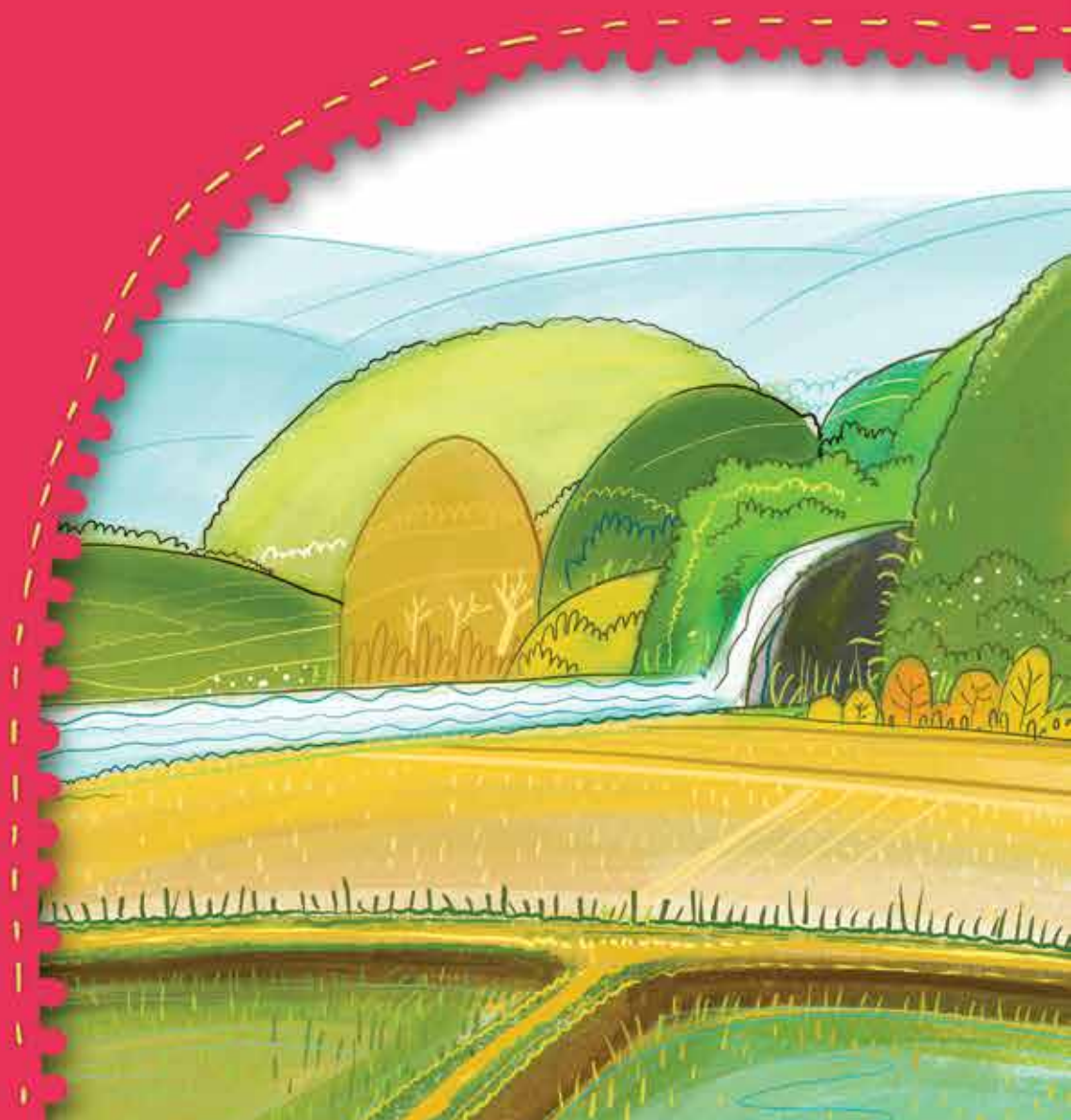
Govt. of Kerala

Guidelines for Water Budgeting



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KSCSTE - CWRDM

Govt. of Kerala

നവകേരളം കർമപദ്ധതി

Guidelines for Water Budgeting

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KSCSTE - CWRDM

SEPTEMBER 2023

Guidelines for
Water Budgeting

Prepared by
Haritha Keralam Mission & CWRDM

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Roshy Augustine
Minister for Water Resources
Government of Kerala

Thiruvananthapuram
16.02.2023

Message

Kerala is a land of water resources that include rivers, lakes, ponds, and springs. Rainfall that we receive annually is sufficient for making these sources live. However, it remains a fact that several locations in our State could not cater to the water demands of the residents throughout the year. We also face issues related to quality of water. This situation is not warranted in a State with copious rainfall and numerous water sources. Water budgeting is one scientific step towards finding a solution to our water management issues. This set of guidelines, being published by Haritha Keralam Mission as part of the exercise, with the technical support of CWRDM and Water Resources Department is expected to benefit the users. Hope that this would expedite the activity while retaining its scientific content.

Roshy Augustine

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M.B. Rajesh
Minister for Local Self
Governments and Excise
Government of Kerala

Thiruvananthapuram
20.02.2023

Message

Our Local Self Governments have gone a long way in terms of their capability to face disasters and crisis situations from the early days of decentralised planning. They have successfully implemented several new initiatives. The Government have decided to prepare water budgets for the Local Self-Governments considering their capability to take up such an exercise.

Water budgets are similar to financial budgets in the sense that water scarcity and water surplus can be determined. Local Self-Governments can decide on their strategies for water conservation and planning based on the water budgets. This is a continuation of the activities already underway as part of the Harithakeralam Mission programme under Navakeralam Karma Padhathi. Several water conservation activities have been successfully implemented under the Mission. Water budgeting is another step towards the building of a modern Kerala. This activity is technically supported by the Centre for Water Resources Development and Management (CWRDM). Guidelines being published as part of this exercise will help in its speedy implementation while maintaining the quality of the work.

M.B. Rajesh
Minister for Local Self Governments

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Dr. Manoj P. Samuel

Introduction

Water sector in Kerala is passing through a crisis period. Although there is no considerable difference in the total annual water availability, several locations in the State face acute water scarcity. Severe rainfall being received in the State as a result of climate change quickly finds its way to the sea. Many of the water sources are getting abandoned as they are polluted beyond usable limits. We can pinpoint changes in land use pattern and such other reasons for water scarcity. Scientific water management is the only way to tide over the situation. Water budget is one important step towards scientific water management. Balancing the water demand and availability through scientific interventions is the methodology being followed here.

Centre for Water Resources Development and Management (CWRDM) is providing technical support and training for preparing water budgets as a programme under Harithakeralam Mission. Local Self Government institutions are equipped to carry out this scientific exercise and they are expected to follow it up with planning of water management activities suitable for their locality. This would create another Kerala model in water resources management.

These interventions would go a long way in resolving the present management issues in the water sector. The guidelines prepared for water budgeting would, no doubt, benefit the officers and elected representatives at the local body level as well. This guideline can be used to prepare water budgets considering the local peculiarities. Water Balancing should naturally lead to planning for future interventions more precisely.

Dr. Manoj P. Samuel
Executive Director
Centre for Water Resources Development and Management

Dr. T.N. Seema

Preface

Stories, poems and myths on water abundance of Kerala have always made us proud of our serene natural resource heritage. A State with 44 rivers, numerous streams and copious rainfall, thanks to the Western Ghats, should not have any issues with water availability. However, the reality is that many locations in the State face acute water shortage. Unequal distribution of rainfall, impacts of climate change in the rainfall pattern, changes in land use have all contributed to the present situation.

There is a marked increase in the water demand from sectors like agriculture, commercial and industrial usages which includes tourism and other activities that support the economy. Lack of focused interventions in water conservation and increasing pollution levels in water bodies are matters of concern. Harithakeralam Mission, which is one of the four Development Missions under Navakeralam Karma Padhathi has made concerted efforts in the last seven years to address the issues at micro level.

Mission, in the initial phase had attempted to create awareness through participatory approach in conservation of water bodies, prevention of pollution and rejuvenation of water bodies. This approach had remarkable results and the Local Self Government Institutions have included water conservation among their priority activities. Now, Mission is focusing on more scientific approach towards water conservation by equipping the local bodies in planning and implementing appropriate interventions. Preparation of water budgets for all the local bodies of the State is an attempt towards this end.

Water budgeting is a scientific attempt to calculate the water availability and demand of a locality. This exercise is required to identify water scarce localities in the State. This is a laborious and scientific process attempted with the technical support of Centre for Water Resources Development and Management (CWRDM). Officers from the State Irrigation Department, Soil Conservation and Soil Survey Department, Ground Water Department and Local Self Governments have joined hands with MGNREGS and Harithakeralam Mission in preparing water budgets for the local bodies.This participatory approach can be seen as a model for convergence in implementing development activities.

Preparation of water budget is seen by Harithakeralam Mission not as the end goal but as the initial scientific step towards water security. Local bodies and other Government Departments in the water sector shall use the water budgets for planning projects in the water sector. This should also imbibe a new water use culture.

Integration of water budgets now prepared at Panchayath level to Blocks, Districts and to State level would also help in getting a State level water budget. This can be used to plan future projects in various sectors based on water availability. This would, no doubt create a model like many such models created by the State.

Several projets are being implemented in the State promoting a modern Kerala for the future generations. It is the Government's endeavor to plan projects in the water sector based on watershed level planning and integration. Possibilities of the latest technology can be made available at the local self-government level through convergence of technical agencies. This guideline should open the doors towards participatory water budgeting.

Dr. T. N. Seema
Coordinator
Navakeralam karma padhathi

Executive Summary

The development model of Kerala is well accepted across the globe. However, there is a section of its population who is missed out warranting a revisit of the development models. The service sector needs modernization to ensure quality service to the public. The State has planned mission mode interventions under 'Navakeralam Karma Padhathi' in prioritized sectors to achieve this goal.

Harithakeralam Mission is one of the four development missions under Navakeralam Karma Padhathi. Harithakeralam Mission has three complementary sub-missions in Water Resources, Waste Management and Agriculture. Local Self Government Institutions (LSGIs) are the focal points in implementing mission mode programs. Mission works with the concerned Government Departments, agencies, Non-Governmental Organizations, and experts to ensure their convergence at the LSGI level. Ensuring water security is one of the declared programmes of the State Government.

Rain is the only source of water for the State. Annual rainfall in Kerala is sufficient to meet its annual water demand. However, spatial and temporal variations of rainfall and insufficient storage facilities make several parts of the State water scarce. The topography of the State is another important factor influencing water availability. Geographic peculiarities and being a highly populous State make it difficult to construct large reservoirs.The current scenario can at best be described as laissez faire where water consuming (demand) sectors are not concerned about water availability nor is there any state level single agency which oversees and coordinates to hold any sector or entity accountable for over exploitation and excessive use (demand). It is this management gap that is majorly responsible for over exploitation and contamination of water.

Therefore, it is required to estimate the water availability and demand for each locality in different periods of time and plan interventions appropriate for the locality accordingly. Micro watersheds are the basic units for preparing water budget. However, considering the practical easiness in planning future interventions, water budgets are now prepared for LSGIs. This can be later integrated to sub basins and river basins. As rain is the main source of water, water availability in sources like rivers, ponds, lakes and ground water sources like wells all depend on the rainfall that is received in the locality. Runoff will be calculated based on geographical area. However suitable coefficients will be applied for areas under forest, commercial usage and agriculture land. Water may be supplied to another geographic area for drinking water and irrigation purposes. Similarly, certain LSGIs receive water from others through different schemes. This must be accounted for, in preparing water budgets. Only 50% of the water availability thus calculated would be considered, leaving provision for environmental usage.

Water demand will be for domestic purposes, irrigation, animal husbandry, commercial and industrial usages including tourism. Population of the local body, its area, area under cultivation, categories of commercial and industrial institutions by water usage will be enumerated for preparing water budgets.

As annual water budgeting will not be realistic for a State like Kerala, a water year starting from June till May next year is divided into 10 day units and water availability and demand for these units are calculated.

Collection of data and preparation of water budgets will be participatory, through the local bodies with the assistance of all technical departments and agencies. Technical committees for Harithakeralam Mission will be the nodal agencies for ensuring data integrity. Centre for Water Resources Development and management (CWRDM) is the Water and land Management Institute for Kerala. CWRDM has designed the process in such a way that the entire exercise is simple and easy to use without compromising on scientific perfection.

Details of the programme will be explained to the elected representatives of the local bodies. A special convention or Grama Sabhas for explaining the process will be the next step. Technical committees under Harithakeralam Mission for the LSGIs will be given training for ensuring data integrity and preparing the water budgets. The Technical committees ensure convening of meetings and shall lead the process.

Excel sheets prepared for data entry have been designed to simplify the water budget calculations. Coefficients and formulae for different calculations are incorporated into the data sheets and cannot be altered. Availability of data from different sources will

be decided at the technical committee meetings. Data received will be scrutinised by the technical committees before entering them on the excel sheets.

Data related to the land use, soil classification, soil series, watershed details, peculiarities of the landscape, details of fallow land, existing irrigation structures and such other details are also collected as part of the water budgeting exercise. This will be used to plan future interventions ideal for the locality with the support of experts. As LSGIs are leading this exercise, they can include some of the interventions in their future budgets and annual plans. Possibilities under MGNREGS can be tapped scientifically for implementing water conservation activities. Other technical departments like Water Resources, Soil Conservation and Ground Water can also plan future interventions appropriate to the locality. It is expected that convergence of different agencies would eventually lead to a sustainable water security plan.

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1. Foreword

Water budgeting is seen as an exercise to assess water availability and sustainability in its distribution. Variation in the quantity of water stored in an area is balanced by the rate at which water flows in and out of the area. Water budgets are influenced by the underlying hydrologic processes specific to the area. Plans for conservation of water resources would sustain if they are based on scientific understanding of these processes.

Improving water use efficiency and ensuring equitable and appropriate usage of water resources is possible through water budgeting. Data on water availability in a geographic area, water requirements of the locality, agricultural practices, irrigation facilities being used and usage of ground water are required for the preparation of water budgets.

Surface water and ground water is available in the State through rainfall, and we have reasonably accurate estimates on annual availability of surface and ground water. Water demand includes environmental requirements and therefore, while calculating available water, provision is made to consider environmental requirements as well.

Kerala being a State with copious rainfall, annual water budgeting will not be realistic. Water requirements vary from place to place. Prominent tourist destinations in the State have more'floating population' than permanent residents. Agricultural practices

being followed in many regions of the State are distinct. Therefore, after considering the peculiarities of a locality, water budget reveals whether the area is water scarce for a particular period in a water year and if so the actual quantity of shortage.

Methodology adopted for collecting data is participatory and involves the local community. This would create awareness on the factors influencing water budgeting. Community involvement should eventually lead to appropriate interventions in conserving the water sources.

2. Need For Water Budgeting

Peculiarities of Kerala landscape warrants caution against climate change impacts. The State is a narrow strip of land sandwiched between Arabian sea and Western ghats. The landscape slopes steeply towards west enabling rainwater to traverse the average width of less than 90 Km from Western Ghats to Arabian sea in a few hours. The coastline of the State stretches more than 590 km and is vulnerable to severe wave attack. Water sources, soil, ecosystem, agriculture, human settlements, and wild and aquatic life are also prone to climate change. Kerala receives an annual average rainfall of 3000 mm, which is more than 2.7 times annual average for India.The State has 44 rivers, 13 lakes, more than 40000 ponds, 236 springs and several wetlands that form its water source network. However, several parts of the State face severe water crisis during the lean season primarly due to the spatial and temporal variation in the rainfall. Changes in land use pattern, increase in population and large-scale constructions along with climate change have put stress on the water resources of the State.

2.1 Landscape

Topography of the State has a direct influence on the water availability and environmental peculiarities. Physiographically, the state is divided into three zones. Coastal area having an elevation up to 7.6 m is classified as Lowland. Midland has an elevation between 7.6 and 76 m above MSL. The Highlands cover the Eastern part of the State with an elevation more than 76 m above MSL. Kerala, having a geographical area of 3886 Sq. km has a forest cover of 27.83% of its area.

2.2 Climate

Kerala has a humid tropical climate. Annual average temperature of the State is 27.5°C. Lowlands experience a temperature of 25.5°C to 27.5°C, midlands 17.5°C to 29.5°C and the Highlands 17.5°C to 21.5°C. Maximum temperature of 33°C is reached during April. However Palakkad District experiences a temperature up to 40°C during April. Humidity would be in the range of 70 to 95%.

Kerala has two monsoon seasons. Southwest Monsoon between June and September is the rainy season for Kerala accounting for 70% of the total rainfall. Northeast Monsoon is between October and December. Summer and winter showers account for 15 % of the rainfall. Spatial variation of the rainfall is evident during Southwest monsoon, when the Northern Districts get more rainfall. Rainfall also shows temporal variation resulting in water scarcity. Temporal variation of rainfall benefits Southern Districts. (Figure 1)

Water budgets are being discussed in India for quite some time. Efforts have been made to prepare water budgets for areas under coverage of some irrigation schemes or tube well networks. However, comprehensive and practical water budgeting for a local body area has not been attempted to so far. Participation of local bodies, stakeholders and non-government organizations are essential to prepare a scientific water budget for Grama Panchayat or Block Panchayat area.

Ideally, water budgets should be prepared for sub basins or river basins. However, considering the scope for future interventions, more focused data collection and involvement of stakeholders, Harithakeralam Mission has opted for preparing water budgets for Grama Panchayats and Block Panchayats. Harmonization of hydrologic and political units can be addressed by making water budgets first at local body level and then integrating to Sub basin or river basins of the State. A water budget simply states that the rate of change in water stored in an area, such as a watershed, is balanced by the rate at which water flows into and out of the area. An understanding of water budgets and underlying hydrologic processes provides a foundation for effective water-resource and environmental planning and management. Water Budgeting (WB) is geared towards ensuring optimum, equitable and most efficient use of water. This involves gaining an understanding of water availability, a community's existing needs and requirements of water, crop planning based on water availability, optimizing irrigation, equitable sharing of water, and considered decisions on ground water withdrawals.

Centre for Water Resources Development and Management (CWRDM) is the Water and Land Management Institute for Kerala. CWRDM has lot of experience in water management related activities, having done extensive research and field work in Kerala and outside the State. Mission meeting of Harithakeralam Mission chaired by the

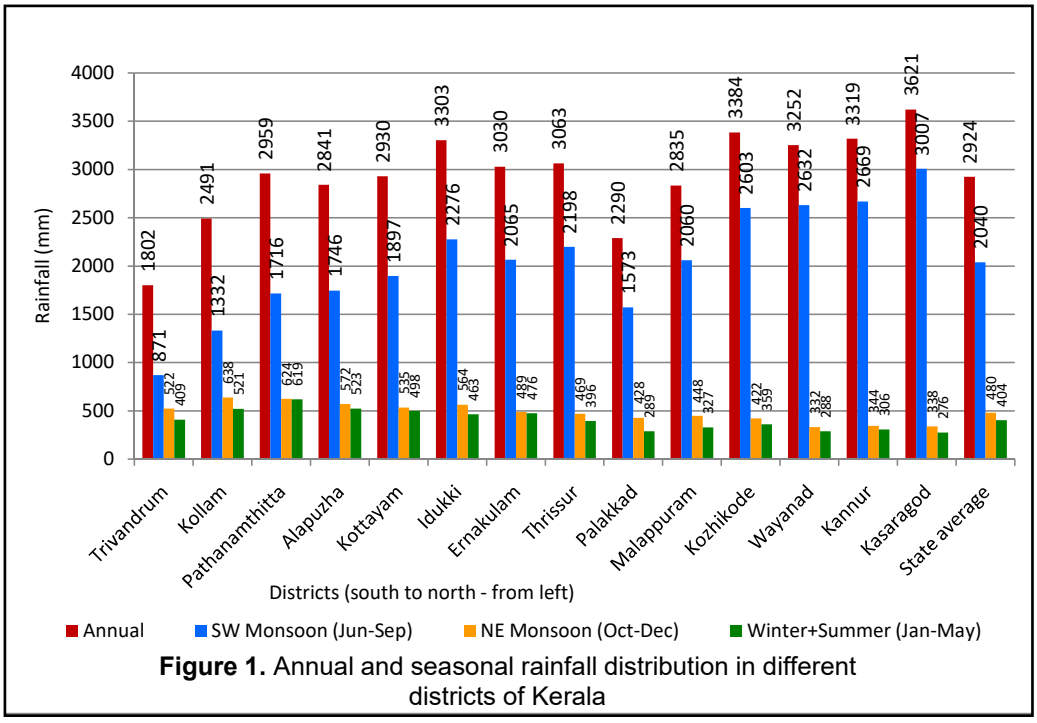

Figure 1. Annual and seasonal rainfall distribution in different districts of Kerala

Hon'ble Chief Minister of Kerala decided to prepare water budgets for local bodies of the State as part of the mission to achieve water security for the local bodies. Water Resources Department, Government of Kerala constituted a technical committee for preparing guidelines for water budgeting. Harithakeralam Mission took the initiative

Inauguration of water budget

in convening the committee, with the technical support of CWRDM and prepared the draft guidelines. Government decided to prepare water budget for Muttil Grama Panchayat in Wayanad District of Kerala on a pilot basis, based on the guidelines. This exercise was completed, and the committee could incorporate several changes to the guidelines, based on the experience.

Incorporating the peculiarities of water sources, topography, rainfall pattern, land uses, sector wise water demands including environmental requirements and other critical data are challenging. It was initially agreed upon by the technical team that there is no point in working out the annual water supply and demand for a State like Kerala. Therefore, it was decided to divide the water year (June to May) into units of 10 days and calculate the demand and supply for that period.

3. Stages In Water Budgeting

- Meeting with Chairpersons of Local Self Governments in the Block Panchayat
- Grama Panchayat level conventions
- Training to Technical Committee members
- Meeting of Technical Committee for preparing timelines
- Data Collection
- Verification of data by technical committee
- Entering data in Excel sheets given
- Draft report
- Presentation of draft report in Grama Panchayats
- Presentation of final report and action plan

4. Methodology

Ensuring water security at local self-government level is the adopted policy of State Government. We need to promote optimum, equitable and most efficient use of water. This would be possible only if we have dependable data on water availability, the communities' existing water demand under different sectors and projected future needs. Agriculture being the largest water user, local cropping pattern, irrigation practices, ground water withdrawal pattern and related data are essential for water budgeting.

Available water resources include surface water, ground water and rainfall. As the source of water is rainfall only, collection of rainfall data from the nearest gauging station is important. Only 50% of the surface run off can be taken as available surface water, as 50% is set apart for environment use. Water demand include the needs of domestic, agriculture, industry, commerce, tourism, and other local demands. By comparing the availability and demand of water in the area, we will get to know whether we have surplus or deficit of water.

In a State like Kerala, where we have two monsoon seasons with spatial and temporal variation in rainfall, annual water budgeting will not be realistic. Therefore, water availability and demand are calculated for each 10 days of a month, dividing the month into three decades. This water balance study is made possible by comparing water availability and demand, calculated from authentic data.

4.1 Rainfall Calculation

Rainfall is a form of Precipitation. The term "rainfall" is used to describe precipitation in the form of water drops of sizes larger than 0.5 mm. Rainfall should be calculated by Arithmetic mean method.

$$A = \frac{1}{n} \times \sum_{i=1}^{n} x_i$$

A = Average rainfall
n = the number of terms (e.g., the number of items or numbers being averaged)
x_i = the value of each individual item in the list of numbers being averaged

In this method, daily rainfall should be measured and calculated for 10-day units in the month. This is shown in Table 1. This calculation should be done for all the years considered. It is better to use data from rain gauges available within the Panchayat. If such rain gauges are not available, data from the nearest gauging station can be used. A minimum of 10 year data shall be used.

Total rainfall for each 10-day unit shall be added with the rainfall during the corresponding period for all the ten years and average taken, as shown in Table 2. 10 years' average rainfall for each 10-day unit can be calculated as per Table 2.

Table 1
Month wise calculation of rainfall of a year

Year :		
Month		**Total Rainfall in mm**
June	1st 10 days	
	2nd 10 days	
	3rd 10 days	
July	1st 10 days	
	2nd 10 days	
	3rd 10 days	
August	1st 10 days	
	2nd 10 days	
	3rd 10 days	
September	1st 10 days	
	2nd 10 days	
	3rd 10 days	
October	1st 10 days	
	2nd 10 days	
	3rd 10 days	
November	1st 10 days	
	2nd 10 days	
	3rd 10 days	
December	1st 10 days	
	2nd 10 days	
	3rd 10 days	
January	1st 10 days	
	2nd 10 days	
	3rd 10 days	
February	1st 10 days	
	2nd 10 days	
	3rd 10 days	
March	1st 10 days	
	2nd 10 days	
	3rd 10 days	
April	1st 10 days	
	2nd 10 days	
	3rd 10 days	
May	1st 10 days	
	2nd 10 days	
	3rd 10 days	

Table 2
Month wise calculation of average rainfall of 10 years

Month		Average Rainfall (R) of 10 years in mm
June	1st 10 days	Eg : Average rainfall for a period of 10 years from 2013 = (1st 10 days 2013+ 1st 10 days 2014+ 1st 10 days 2015+ 1st 10 days 2016+ 1st 10 days 2017+ 1st 10 days 2018+ 1st 10 days+ 2019+ 1st 10 days 2020+ 1st 10 days 2021 + 1st 10 days 2022) / 10
	2nd 10 days	
	3rd 10 days	
July	1st 10 days	
	2nd 10 days	
	3rd 10 days	
August	1st 10 days	
	2nd 10 days	
	3rd 10 days	
September	1st 10 days	
	2nd 10 days	
	3rd 10 days	
October	1st 10 days	
	2nd 10 days	
	3rd 10 days	
November	1st 10 days	
	2nd 10 days	
	3rd 10 days	
December	1st 10 days	
	2nd 10 days	
	3rd 10 days	
January	1st 10 days	
	2nd 10 days	
	3rd 10 days	
February	1st 10 days	
	2nd 10 days	
	3rd 10 days	
March	1st 10 days	
	2nd 10 days	
	3rd 10 days	
April	1st 10 days	
	2nd 10 days	
	3rd 10 days	
May	1st 10 days	
	2nd 10 days	
	3rd 10 days	

4.2 Calculation Of Water Availability

4.2.1. Calculation Of Surface Water availability

Available source of water is rainfall. This will be divided between surface water and ground water.Out of the 44 rivers in Kerala, 41 rivers flow towards the west and join the Lakshadweep Sea and 3 rivers flow to the east and become tributaries of the Cauvery River system. These rivers (more than 15 km long) are short, and their basin areas are comparatively very small. According to the empirical estimates made by Kerala Public Works Department (PWD) the total stream flow from all the 44 rivers is 78,041 Mm^3, of which the contribution from the catchments in Kerala is 70,323 Mm^3 and the State's utilizable quantity is 42,772 Mm^3 (PWD, 1974). The annual yield values of rivers have not been re-estimated after 1974 by considering the reservoirs that have been created and the changes in land use and climate that have taken place thereafter.

Apart from rivers, there are several traditional sources of water in Kerala. CWRDM (1988) has identified 236 perennial springs in the State, of which about 20% is being utilized. CWRDM (1989) has also identified 910 ponds and tanks in Kerala with a minimum water-spread area of 0.5 ha. There are also five lakes in the State, of which three (Vembanad, Ashtamudi and Sasthamcotta) have been declared as Ramsar sites.

Table 3
Runoff Coefficient (C) for various types of vegetation

Type of vegetation	Runoff coefficient C
Woodland and forests	0.30-0.50
Grassland	0.30-0.42
Agricultural Land	0.50-0.72
Urban Land	0.60-0.80

To determine the runoff potential of a Panchayat, we have to use the formula:

$$Q = C \times A \times R$$

where, R = average rainfall, as calculated in Table 2,
C = run off coefficient and
A = area of the Panchayat.

Calculation of Total Runoff coefficient C

$$C = \frac{(C_F \times A_F) + (C_A \times A_A) + (C_B \times A_B) + C_I \times A_I)}{A}$$

Where,

A = Area of the panchayat

C_F = Run off coefficient of forest

A_F = Total area of forest

C_A = Run off coefficient of agriculture

A_A = Total area of agriculture

C_B = Run off coefficient of land used for residential purposes

A_B = Total area of land used for residential purposes

C_I = Run off coefficient of land used for all other purposes

A_I = Total area of land used for all other purposes

50% of the total water availability is set aside to meet the water requirement of forest flora and fauna, non-irrigated cropland and other vegetation and ecological needs. Hence, the surface water available for the first 10 days = $\frac{\text{total water availability}}{2}$

Audience : Water budget inauguration

Table 4
Surface water runoff Potential (SWP)

Month		Average rainfall (R)	A x R x C
June	1st 10 days		
	2nd 10 days		
	3rd 10 days		
July	1st 10 days		
	2nd 10 days		
	3rd 10 days		
August	1st 10 days		
	2nd 10 days		
	3rd 10 days		
September	1st 10 days		
	2nd 10 days		
	3rd 10 days		
October	1st 10 days		
	2nd 10 days		
	3rd 10 days		
November	1st 10 days		
	2nd 10 days		
	3rd 10 days		
December	1st 10 days		
	2nd 10 days		
	3rd 10 days		
January	1st 10 days		
	2nd 10 days		
	3rd 10 days		
February	1st 10 days		
	2nd 10 days		
	3rd 10 days		
March	1st 10 days		
	2nd 10 days		
	3rd 10 days		
April	1st 10 days		
	2nd 10 days		
	3rd 10 days		
May	1st 10 days		
	2nd 10 days		
	3rd 10 days		

4.2.2. Calculation of Groundwater Availability

The annual replenishable groundwater resource and the net groundwater availability in Kerala are estimated as 6620 Mm^3 and 6030 Mm^3 respectively (CGWB, 2011). The present gross groundwater draft for all uses in the State is computed as 2810 Mm^3. Of this, the domestic and industrial drafts account for 37.6% (1500 Mm^3) and irrigation accounts for 62.4% (1300 Mm^3). The district-wise stage of groundwater development in the State ranges from 17% in Wayanad district to 61% in Palakkad and 71% in Kasaragod districts, with a State average of 47%. Out of the 152 revenue blocks in the State assessed for groundwater potential and draft, one block (Chittur) is categorized as over-exploited, 3 blocks (Kasaragod, Malampuzha and Kodungalloor) as critical, and 22 blocks as semi-critical (CGWB, 2011).

Traditionally, most people in Kerala depend on homestead open wells for domestic purposes, and this has resulted in a high density of open wells in the State. Even in urban areas, more than 50% of the people depend on dug wells for their daily water needs. A study conducted by CWRDM revealed that there are about 69.5 lakh wells in Kerala. The density of wells per km^2 ranges from 320 to 950, 200 to 400 and 18 to 330 respectively in the lowlands, midlands and highlands of the State (CWRDM, 2006). Another unique and traditional water abstraction structure known as surangams are in use in the Kasaragod district of Kerala (CWRDM, 1991). These are basically horizontal wells / tunnels dug through the Laterite hill slopes, from the periphery of which water flows out by gravity usually into an open pit/ tank/ pond.

Annual Groundwater recharge = 0.06 x A x R.

Where, A=Area of grama panchayat.

R=Rainfall availability of 10 days (average of 10 years)

90% of the total groundwater recharge can be used by us. Hence, groundwater available for the first 10 days = total groundwater recharging x 0.9

Table 5
Calculation of water availability

Month	Decade	Average Rainfall of 10 years in m (1)	Total surface runoff potential Q in Million m^3 (Q=CxAxR) (2)	Utilizable Surface Runoff in Million m^3[50%(Q)] (3)	Groundwater potential in Million m^3 (0.06x R x A) (4)	Utilizable Ground water (Million m^3) [90%(4)] (5)	Total water available (Million m^3) [(3) +(5)]
June	I						
	II						
	III						
July	I						
	II						
	III						
August	I						
	II						
	III						
September	I						
	II						
	III						
October	I						
	II						
	III						
November	I						
	II						
	III						
December	I						
	II						
	III						
January	I						
	II						
	III						
February	I						
	II						
	III						
March	I						
	II						
	III						
April	I						
	II						
	III						
May	I						
	II						
	III						

4.3. Demand Calculation

4.3.1. Per Capita Domestic Demand

Table 6
Following rates per head per day are considered as minimum for domestic and non-domestic needs.

Communities with population up to 10,000	70 to 100 liters
Communities with population 10,000 to 50,000	100 to 125 liters
Communities with population above 50,000	125 to 200 liters

Where the entire supply of a town is given through street "stand- post", and where wells exist in addition, 45 liters per head per day may be taken.

IS Code (IS 1172:1993) can be referred for the domestic demand calculation. The requirements regarding water supply, drainage and sanitation for residences shall assume that minimum supply of 135 litres per head per day is assured, together with full flushing system (IS: 1172).

Domestic Demand Calculation

Domestic Demand Calculation = Per Capita Demand x Population

Table 7
Calculation of domestic demand

Population (1)	Daily requirement (litre/day)		10 days requirement (cubic metre) [(3) × 10]/1000 (4)
	For one (2)	Total [(1) × (2)] (3)	
	135		
Total			

4.3.2. Agricultural Demand

Data should be collected from agriculture department. Details of area currently having irrigation facilities and area which is likely to be irrigated in the next 10 years are also to be considered.

Gross Irrigation Demand = C_A x ET_c per 10 day / μ

Where, C_A = Crop Area (collect data from concerned Agriculture Officer)

ET_c= Crop Evapotranspiration

μ = Efficiency

(μ = Surface irrigation- 50%, Sprinkler irrigation- 60% and Drip irrigation- 70%)

ET_c can be calculated by

$ET_c = ET_0 \times K_c$

Where, ET_0 = Reference crop evapotranspiration

K_c = Crop coefficient

Net Irrigation Demand = C_A x ET_c per day

Table 8
Reference crop evapotranspiration (ET_0) for different agro ecological units (mm/decade)

Month	Decade	ET_0
June	I	38
	II	35
	III	35
July	I	35
	II	35
	III	35
August	I	35
	II	36
	III	37
September	I	37
	II	38
	III	40
October	I	39
	II	38
	III	38
November	I	38
	II	37
	III	37
December	I	36
	II	36
	III	38
January	I	38
	II	40
	III	41
February	I	45
	II	49
	III	52
March	I	53
	II	52
	III	48
April	I	49
	II	47
	III	46
May	I	44
	II	43
	III	40

CROP COEFFICIENT (K_c) OF DIFFERENT CROPS

Table 9
Crop coefficient (Kc) of annual / seasonal crops

Sl. No	Crop	Crop coefficient (K_c)			Source
		Initial	Middle	Late	
1	Rice	1.1	1.3	1.05	FAO (1998)
2	Tapioca	0.30	0.80	0.30	
3	vegetables	0.50	1.00	0.8	
4	Banana	0.50	1.10	1.00	
5	Chilies	0.60	1.05	0.90	

Table 10
Crop coefficient (K_c) of perennial crops

Sl. No	Crop	Crop coefficient (K_c)	Source
1	Coconut	0.75	CPCRI (1967)
2	Arecanut	0.94	CPCRI (1982)
4	Mango	0.90	FAO (1998)
5	Pepper	0.70	CWRDM (1997)

Table 11
Crop Coefficient (K_c) of mixed crops

Sl. No	Crop	Crop Coefficient (K_c)	Source
1	Coconut (Coconut-Arecanut-Pepper)	0.78	CWRDM (1997)
2	Arecanut (Coconut-Arecanut-Pepper)	0.36	
3	Pepper (Coconut-Arecanut-Pepper)	0.07	
4	Nutmeg (Coconut-Nutmeg)	0.87	
5	Coconut (Coconut-Nutmeg)	0.83	

If K_c for a particular crop is not available in the above tables, take a closer value from the table. For example, for tree crops K_c value of coconut or arecanut can be taken or consult agriculture officer for the K_c value.

Table 12
Crop wise calculation of water demand

Month	Decade	Paddy (first crop)	Paddy (second crop)	Paddy (third crop)	Tapioca	Vegetables	Banana	Chilli	Ginger	Coconut	Arecanut	Pepper	Rubber	Other crops
June	I													
	II													
	III													
July	I													
	II													
	III													
August	I													
	II													
	III													
September	I													
	II													
	III													
October	I													
	II													
	III													
November	I													
	II													
	III													
December	I													
	II													
	III													
January	I													
	II													
	III													
February	I													
	II													
	III													
March	I													
	II													
	III													
April	I													
	II													
	III													
May	I													
	II													
	III													

4.3.3. Animal Husbandry

The demand for water in animal husbandry sector is calculated as follows using the data obtained in Table 24.

Table 13

Calculation of water demand in animal husbandry sector

Sl No.	Domestic Animal/ Bird	Number (1)	Daily Water requirement Lit/day		Water requirement for 10 days (cubic metre) [(3)×10]/1000 (4)
			For one unit (2)	Total [(1)×(2)] (3)	
1	Cow		250		
2	Buffalo		250		
3	Goat		2		
4	Dog		0.5		
5	Rabbit		0.05		
6	Chicken		0.2		
7	Duck		0.2		
8	Others				
TOTAL					

4.3.4. Industrial Demand

The demand for water in industrial sector is calculated as follows using the data obtained in Table 25.

Table 14

Calculation of water demand in industrial sector

Sl. No	Water requirement	Number (1)	Daily water requirement (litre/day)		Water requirement for 10 days (cubic metre) [(3)×10]/1000 (4)
			For one unit (2)	Total [(1)×(2)] (3)	
1	10 litres to 200 litres		100		
2	201 litres to 1000 litres		600		
3	1001 litres to 5000 litres		3000		
4	5001 litres to 10000 litres		7500		
5	10001 litres to 20000 litres		15000		
6	20001 litres to 50000 litres		35000		
7	50001 litres to 100000 litres		75000		
8	Above 100000 litres				
TOTAL					

4.3.5. Public Institutions

The demand for water in public institution sector is calculated as follows using the data obtained in Table 26.

Table 15

Calculation of water demand in public institution sector

Sl. No	Water requirement	Number (1)	Daily water requirement (litre/ day)		Water requirement for 10 days (cubic metre) [(3)×10]/1000 (4)
			For one unit (2)	Total [(1)×(2)] (3)	
1	10 litres to 200 litres		100		
2	201 litres to 1000 litres		600		
3	1001 litres to 5000 litres		3000		
4	5001 litres to 10000 litres		7500		
5	10001 litres to 20000 litres		15000		
6	20001 litres to 50000 litres		35000		
7	50001 litres to 100000 litres		75000		
8	Above 100000 litres				
TOTAL					

4.3.6. Private Institutions

The demand for water in private institution sector is calculated as follows using the data obtained in Table 27.

Table 16

Calculation of water demand in private institution sector

Sl. No	Water requirement	Number (1)	Daily water requirement (litre/ day)		Water requirement for 10 days (cubic metre) [(3)×10]/1000 (4)
			For one unit (2)	Total [(1)×(2)] (3)	
1	10 litres to 200 litres		100		
2	201 litres to 1000 litres		600		
3	1001 litres to 5000 litres		3000		
4	5001 litres to 10000 litres		7500		
5	10001 litres to 20000 litres		15000		
6	20001 litres to 50000 litres		35000		
7	50001 litres to 100000 litres		75000		
8	Above 100000 litres				
TOTAL					

4.3.7. Tourism

The demand for water in tourism sector is calculated as follows using the data obtained in Table 28.

Table 17

Calculation of water demand in tourism sector

Sl. No	Month	Number of tourists (1)	Daily water requirement (litre/ day)		Water requirement for 10 days [(3)×10]/1000 (4)
			For one unit (2)	Total [(1)×(2)] (3)	
1	June		135		
2	July		135		
3	August		135		
4	September		135		
5	October		135		
6	November		135		
7	December		135		
8	January		135		
9	February		135		
10	March		135		
11	April		135		
12	May		135		
TOTAL					

4.3.8. Total Water Demand

Total water demand is calculated by taking the overall sum of the total demand for domestic, commercial, agricultural, industrial, animal husbandry, tourism, public institution and private institution.

Table 18
Calculation of total water demand

Month	Decade	Commercial	Agricultural	Industrial	Animal husbandry	Tourism	Domestic	Public Institution	Private Institution	Others	Total
June	I										
	II										
	III										
July	I										
	II										
	III										
August	I										
	II										
	III										
September	I										
	II										
	III										
October	I										
	II										
	III										
November	I										
	II										
	III										
December	I										
	II										
	III										
January	I										
	II										
	III										
February	I										
	II										
	III										
March	I										
	II										
	III										
April	I										
	II										
	III										
May	I										
	II										
	III										

5. Data Collection

Most of the data required for water budget are available with the local bodies. Water Resources, Agriculture and Revenue Departments can supplement data under this section. Map of the Panchayat is also collected as part of general information.

Government of Kerala had constituted Technical Committees at the three tier Panchayat Raj institutions as part of Harithakeralam Mission. This is a multi-disciplinary committee with representatives from different stakeholder departments/agencies and local experts.

Grama Panchayath level Technical Committee (GPLTC)

- Vice Chairman - Planning Committee
- Chairperson - CDS
- Asst. Secretary - Grama Panchayat
- Agriculture Officer
- Village Extension Officer
- Assistant Engineer - Grama Panchayat
- Assistant Engineer - MGNREGS
- One expert in Watershed management activities
- Three experts from Water sector (Engineers and Scientists)
- Convenor - Assistant Engineer - Irrigation Department

Block Level Technical Committee (BLTC)

- Planning Committee Vice Chairperson
- Joint Block Development Officer
- Assistant Director, Agriculture
- Officer nominated by District Soil Conservation Office
- Hydrogeologist - Ground Water Department
- Range Officer - Forest Department
- Assistant Executive Engineer, Local Self Government
- Assistant Engineer - MGNREGS
- One expert in Watershed management activities
- Three experts from Water sector (Engineers and Scientists)
- Convenor - Assistant Executive Engineer - Irrigation Department

District Level Technical Committee (DLTC)

- District Planning Officer
- Executive Engineer, District Panchayat
- Principal Agriculture Officer
- JPC - MGNREGS
- Executive Engineers, Irrigation
- District Soil Conservation Officer
- District Soil Survey Officer
- District Officer - Ground Water Department
- One expert in Watershed management activities
- Three experts from Water sector (Engineers and Scientists)
- District Coordinator - Harithakeralam Mission
- Convenor - Executive Engineer - Minor Irrigation

These committees were put in charge of water budgeting exercise after providing trainings. The committees shall check the authenticity of the data collected, before uploading it into the format.

5.1. General Details

(Data has to be collected from departments like Revenue, Agriculture and Irrigation. Map of the area has to be collected from the Panchayath.)

Table 19
General details

1	District	
2	Block	
3	Panchayath	
4	Area (Sq. Km)	
5	Population (Local residents)	
6	Population (Guest Workers)	
7	Landuse	
7.1	Forest land (as per revenue documents) - Sq. Km	
7.2	Agricultural land (area with more than 50 percent cultivated area) - Sq. Km	
7.3	Residential area (more than 50 percent is used for buildings, roads, etc.) - Sq. Km	
7.4	Industrial area (Sq.Km)	
7.5	Unused fallow land (Sq. Km)	
7.6	Cultivable fallow land (Sq. Km)	
7.7	Others (Sq. Km)	

5.2. Details Of Water Availability

5.2.1 Rainfall (Data has to be collected from the nearest rain gauge stations)

Table 20
Rainfall availability (in mm)

Year												
Month		Rainfall in mm										Total
		Days										
		1	2	3	4	5	6	7	8	9	10	
June	First10 days											
	Second10 days											
	Third10 days											
July	First 10 days											
	Second 10 days											
	Third 10 days											
August	First 10 days											
	Second 10 days											
	Third 10 days											
September	First 10 days											
	Second 10 days											
	Third 10 days											
October	First 10 days											
	Second 10 days											
	Third 10 days											
November	First 10 days											
	Second 10 days											
	Third 10 days											
December	First 10 days											
	Second 10 days											
	Third 10 days											
January	First 10 days											
	Second 10 days											
	Third 10 days											
February	First 10 days											
	Second 10 days											
	Third 10 days											
March	First 10 days											
	Second 10 days											
	Third 10 days											
April	First 10 days											
	Second 10 days											
	Third 10 days											
May	First 10 days											
	Second 10 days											
	Third 10 days											

5.2.2. Water supply to and from the panchayat (Data has to be collected from the Irrigation department & Water Authority.)

Table 21

Calculation of water supply to and from the panchayath

Year								
Month		Water supply to the Panchayath						
		Source	Quantity	Source	Quantity	Source	Quantity	Total
June	First10 days							
	Second10 days							
	Third10 days							
July	First 10 days							
	Second 10 days							
	Third 10 days							
August	First 10 days							
	Second 10 days							
	Third 10 days							
September	First 10 days							
	Second 10 days							
	Third 10 days							
October	First 10 days							
	Second 10 days							
	Third 10 days							
November	First 10 days							
	Second 10 days							
	Third 10 days							
December	First 10 days							
	Second 10 days							
	Third 10 days							
January	First 10 days							
	Second 10 days							
	Third 10 days							
February	First 10 days							
	Second 10 days							
	Third 10 days							
March	First 10 days							
	Second 10 days							
	Third 10 days							
April	First 10 days							
	Second 10 days							
	Third 10 days							
May	First 10 days							
	Second 10 days							
	Third 10 days							

Year								
Month		Water supply from the Panchayath						
		Source	Quantity	Source	Quantity	Source	Quantity	Total
June	First10 days							
	Second10 days							
	Third10 days							
July	First 10 days							
	Second 10 days							
	Third 10 days							
August	First 10 days							
	Second 10 days							
	Third 10 days							
September	First 10 days							
	Second 10 days							
	Third 10 days							
October	First 10 days							
	Second 10 days							
	Third 10 days							
November	First 10 days							
	Second 10 days							
	Third 10 days							
December	First 10 days							
	Second 10 days							
	Third 10 days							
January	First 10 days							
	Second 10 days							
	Third 10 days							
February	First 10 days							
	Second 10 days							
	Third 10 days							
March	First 10 days							
	Second 10 days							
	Third 10 days							
April	First 10 days							
	Second 10 days							
	Third 10 days							
May	First 10 days							
	Second 10 days							
	Third 10 days							

5.3. Details Of Water Requirement

5.3.1 Water requirement for commercial establishments

(To be prepared on the basis of data collected from the local self government and through field data collection)

Table 22

Water requirement for commercial establishments

Sl. No	Water Requirement	Number of establishments
1	10 litres to 100 litres	
2	101 litres to 200 litres	
3	201 litres to 500 litres	
4	501 litres to 1000 litres	
5	1001 litres to 2000 litres	
6	2001 litres to 5000 litres	
7	5001 litres to 10000 litres	

Sl. No	Water Requirement	Number of establishments	Quantity of water(L)
8	Above 10000 litres (the exact water requirement of such establishments should be recorded separately)		
9			
10			
11			
12			
13			

5.3.2 Water requirement for Agricultural activities

Table 23

Water requirement for agricultural sector

Sl. No	Crop	Area (hectare)		
		Total	Irrigation facilities available	Irrigation facilities required
Annual / Seasonal crops				
1	Paddy (first crop)			
2	Paddy (second crop)			
3	Paddy (Third crop)			
4	Tapioca			
5	Vegetables			
6	Banana			
7	Chili			
8	Ginger			
	Other crops			
Perennial crops				
1	Coconut			
2	Arecanut			
3	Mango			
4	Pepper			
5	Rubber			
	Other crops			

5.3.3 Water Requirement for Animal husbandry

Table 24
Water requirement for animal husbandry sector

Domestic animals / birds

Sl. No	Category	Number
1	Cow/ Bull	
2	Buffalo	
3	Goat	
4	Pig	
5	Dog	
6	Rabbit	
7	Chicken	
8	Duck	

Other domestic animals / birds

Sl. No	Category	Number	Water requirement per day (L)
1			
2			
3			
4			
5			
6			
7			

5.3.4 Water Requirement for Industrial establishments (data has to be collected from the Directorate of Industries and Commerce and from field work)

Table 25

Water requirement for industrial sector

Sl. No	Water Requirement	Number of establishments
1	10 litres to 200 litres	
2	201 litres to 1000 litres	
3	1001 litres to 5000 litres	
4	5001 litres to 10000 litres	
5	10001 litres to 20000 litres	
6	20001 litres to 50000 litres	
7	50001 litres to 100000 litres	

Sl. No	Water Requirement	Number of establishments	Quantity of water(L)
8	Above 100000 litres (the exact water requirement of such establishments should be recorded separately)		
9			
10			
11			
12			

5.3.5 Water requirement for Public Institutions

(Office, Schools, etc.)

Table 26

Water requirement for public institution sector

Sl. No	Water Requirement	Number of establishments
1	10 litres to 200 litres	
2	201 litres to 1000 litres	
3	1001 litres to 5000 litres	
4	5001 litres to 10000 litres	
5	10001 litres to 20000 litres	
6	20001 litres to 50000 litres	
7	50001 litres to 100000 litres	

Sl. No	Water Requirement	Number of establishments	Quantity of water(L)
8	Above 100000 litres (the exact water requirement of such establishments should be recorded separately)		
9			
10			
11			
12			

5.3.6 Water requirement for Private Institutions (auditoriums, hospitals, restaurants, etc)

Table 27

Water requirement for private institution sector

Sl. No	Water Requirement	Number of establishments
1	10 litres to 200 litres	
2	201 litres to 1000 litres	
3	1001 litres to 5000 litres	
4	5001 litres to 10000 litres	
5	10001 litres to 20000 litres	
6	20001 litres to 50000 litres	
7	50001 litres to 100000 litres	

Sl. No	Water Requirement	Number of establishments	Quantity of water(L)
8	Above 100000 litres (the exact water requirement of such establishments should be recorded separately)		
9			
10			
11			
12			

5.3.7 Water requirement for Tourism (data has to be collected from tourist destinations having entrance fee and resorts and hotels)

Table 28

Water requirement for tourism sector

Month	Number of tourists from outside the panchayath
June	
July	
August	
September	
October	
November	
December	
January	
February	
March	
April	
May	

6. Water Budget

Reliability of water budgeting results depend on the integrity of the data used for this exercise. Authenticity of the data should be checked by the technical committees. It would be ideal to have data from different sources for comparison and field verification, as much as possible. Efficiency of the irrigation systems is a factor that may affect the results.

Daily rainfall data from nearest gauging stations are used for calculations. However, in case gauging stations are far away, results may not be accurate. Irrigation Department has gauging stations for every block panchayat. Gauging is also done by local bodies and private estates. State Electricity Board is also maintaining gauging stations for their hydroelectric projects. In calculating demand for mixed crops, water requirement for each crop need not be taken.

Table 29

Water budget

Month	Decade	Total water available (Million m3)	Total water demand (Million m3)	Total water available - Total water demand (Million m3)	Surplus / Deficit
June	I				
	II				
	III				
July	I				
	II				
	III				
August	I				
	II				
	III				
September	I				
	II				
	III				
October	I				
	II				
	III				
November	I				
	II				
	III				
December	I				
	II				
	III				
January	I				
	II				
	III				
February	I				
	II				
	III				
March	I				
	II				
	III				
April	I				
	II				
	III				
May	I				
	II				
	III				

Note: The quantity of Utilizable Surface Runoff and utilizable groundwater will depend on the facilities available at the Panchayat to tap these resources. If the Panchayat is not having adequate facilities like check dams and canals appropriate to the locality to utilize the surface runoff, then they may not be able to utilize 50% of the total surface runoff. Then available surface runoff in the Panchayat should be used in the calculations. 90% of the ground water can be used but if Panchayat is not having facilities for extraction, utilisation of ground water will not be possible. Therefore, the water budget prepared can be used to plan creation of adequate facilities to utilise the available water. These interventions shall be appropriate for the locality.

7. Action Plan

Specific directions can be given on the possible interventions, based on the water budgeting exercise. For water scarce localities, local possibilities and peculiarities shall be considered for planning water conservation interventions. Status of the irrigation structures available shall be reviewed. Promoting agriculture in more areas shall be given priority. Selection of crops and seeds shall be scientific. In areas where water logging is preventing agriculture activities, improving the drainage system shall be given priority. Water re-use and re-cycling shall be promoted in Tourist centres. Technical committees shall formulate proposals based on the findings in the water budgets. Grama Panchayats can prioritise the activities and the Technical committee shall encourage convergence of all Departments/Agencies at the local body level.

Appendix

Structure of a Water Budget Report (Model)

1. Messages
2. Foreword
3. Preface
4. General Information
   i. Demography
   ii. Geography
   iii. Climate
   iv. Peculiarities of the locality
   v. Soil Series
   vi. Maps
   vii. Watersheds
5. Water sources
   i. Rivers
   ii. Streams
   iii. Ponds
   iv. Checkdams
   v. Quarries
   vi. Wells
   vii. Surangams
   viii. Eries
6. Water availability
   i. Rainfall
   ii. Water distribution to and from the Panchayath
7. Water Demand
   i. Commercial water demand
   ii. Industrial demand
   iii. Animal husbandry
   iv. Tourism
   v. Construction
   vi. Convention centres
   vii. Migrant labour camps
8. Water budget
   Tables, Graphs etc
9. Action Plan

Watershed plans already prepared for the Panchayath and Action Plan prepared for "Neeruravu" scheme under MGNREGS shall be considered. Local peculiarities and possibilities shall be considered.

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ജലബജറ്റ്
2023
ജലബജറ്റ്
റിപ്പോർട്ട്
കേരള സർക്കാർ
നവ കേരളം കർമ്മപദ്ധതി
കൊണ്ടോട്ടി ബ്ലോക്ക് പഞ്ചായത്ത്
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