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WATERSHED MANAGEMENT AT BHARANANGANAM PANCHAYATH OF KOTTAYAM DISTRICT,INDIA

ALEENA B[1], ANAGHA ELSA JOSE[2], ANJALY KV[3], RADHIKA RADHAKRISHNAN[4], DR.K.J.GEORGE[5]

[1,2,3,4] UG Scholar, St. Joseph's College of Engineering and Technology Palai, Kerala
[5]Professor ,Department of Civil Engineering ,St. Joseph's College of Engineering and Technology, Palai, Kerala

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Abstract: Watershed management is the process of preparing and implementing plans, programs, and projects to maintain and improve the sustainable allocation of its resources and the watershed functions that affect the plant, animal, and human communities within it. As a natural entity, watersheds reflect soil, geological, water, and vegetation interactions by providing a common final product flow or stream flow, and the net impact of these interactions on that product. The basic elements for the development of our environment and our country are soil, water and biodiversity. High population densities, improper use of resources and unnatural development work put a strain on the environment. This project deals with the identification and distribution of water resources in the Bharananganam Panchayath of Kottayam district. This study aims to integrate various plans and methods for the proper management and protection of Panchayath water resources. By conducting surveys, visiting sites, and with the help of QGIS software, collect maps of specific areas to which resources have been allocated. The overall balance between the demand and availability of water resources on the premises is analyzed by conducting a water budgeting. This study provides suggestions for appropriate design proposals to properly guide and conserve the water resources.

1. INTRODUCTION

1.1 General Background

Watershed management protects the quality of water and other natural resources by implementing land use and water management practices to comprehensively control the use of water and other natural resources in river basins. And a term used to describe the process of strengthening. It is managed. Opportunities to reduce water pollution In this task, pollution reduction and appropriateness are achieved by determining resources or addressing other pressing environmental issues, prioritizing these opportunities and adopting appropriate river basin management plans. We aim to identify timeframes for resource allocation and habitat improvement. It is located in Bharananganam Panchayat in the Kottayam district. These issues, which pose the greatest risk to human health, specific resources, or the desired use of resources, can be a top priority for management and mitigation.

1.2 OBJECTIVE AND SCOPE

This project aims to manage and protect the water resources of the area with appropriate design proposals that may include the construction of dams and barriers. Infrastructure improvements, including more frequent maintenance or inadequate storm water treatment system upgrades or replacements of municipal storm water systems, and identification and elimination of illegal connections to municipal storm water systems.

Include various plans to secure the population's water demand. Reduction of paved areas and other impermeable surfaces, especially near water bodies and wetlands. Zoning and subdivision regulations include reducing land cover / impermeable cover, reducing road width, encouraging cluster and less impactful development, limiting land turbulence such as grading and land reclamation, and increasing development setbacks. Can be revised to address the issue of. Reduce flood impacts through proper river system analysis and acquisition, green road planning, and establishment of vegetation buffers along water bodies and wetlands.

Identify other suitable household practices for homeowners and landowners (promoting the use of grass-covered buffers adjacent to water bodies and wetlands, with lawn areas and fertilizers applied to them. Reduce the amount of chemicals). Identify and evaluate opportunities for unstructured flood control efforts. Improve waste management, pollution control and measures rather than land leveling. 3. Hydraulic engineering and irrigation and drainage engineering need to work together effectively in leveling projects to adapt measures that apply to the local situation and the natural shape of the original river within the catchment area. The purpose of this study is to achieve an overall balance between the demand and conservation of the site's water resources. Take appropriate measures for the sustainable and proper use of water resources, including the water balance of the area, for the purpose of determining the availability of water in the area.

2. LITERATURE REVIEW

Bo-WeiLiu, Ming-HuangWang (2020) [1] implemented green infrastructure practices for sound watershed management. Water management in different countries around the world provides a comprehensive understanding of international movements for sound watershed management. Pioneer countries are using green infrastructure applications to improve resilience to climate change by adopting adaptive solutions and mitigating sources of pollution. This paper provides an overview of the implementation of green infrastructure using examples of bioretention in urban development and ecosystem conservation. By applying data from other studies, excellent techniques for bioretention and improved soil stability have been established. Injecting rainwater semi-directly with the biosheath is two ways to maintain bioretention function to reduce peak flow. Previous studies have reported maximum pollutant reduction efficiency with bioretention, including 99% phosphorus, 82% nitrate, 92% heavy metals, and 96% suspended solids. Finally, a final profit analysis of green infrastructure was carried out from an ecological, economic and social perspective.

Leah L. Bremer, Christopher A. Wada (2021) [2] created a framework for linking land cover and water balance models to prioritize watershed investment. 1) Protection of primary forest from conversion to non-primary forest and 2) of basin management activities in terms of specific complex land cover and hydrological modeling to quantify the cumulative recovery benefit of 50 years of recovery. Hydrological studies characterizing relative effectiveness Distribution of primeval forests in non-primitive grasslands. The highest priority areas of primary forest conservation (80th percentile of profit) are designed to prevent the loss of excessive recycling efforts at 48,600 m3 municipal facilities and businesses with a hectare of replenishment over 50 years. Incorporating a land cover change model (rather than assuming that all areas are equally vulnerable to invasion) shifts to low-to-medium elevation methic forest areas and is invasive. The risk of invasion by canopy species is highest. Cloud forest areas at high risk of conversion to non-conventional grasslands or bare land. Restoration of primary forests is expected to recover more than 88,900 m3 per hectare in 50 years in areas of highest priority for significant fog turbulence, but less recovery in areas of less fog turbulence. Also note this study provides a framework for prioritizing investment in forest conservation and restoration for groundwater recharge in a way that explains both the threat of transformation and changes in water flow. Frameworks and results are available to current administrators and can be updated as new eco-hydrological data become available. The results also provide comprehensive insights into the link between watershed management and groundwater recharge, especially in other areas where islands and species invasion threaten watersheds and groundwater is the main source of water.

QiangXu, ChenGuo (2021) [3] conducted a GLC project with bidirectional impacts on soil erosion. The impact of land use on space and time erosion is relevant. In this study, two types of land use management methods were applied to the Loess Plateau. The GullyLandConsolidation (GLC) and Land Consolidation (LC) projects. Spatial distribution, spatiotemporal development, and soil erosion susceptibility maps were analyzed by spatial analysis, statistical methods, and frequency ratio (FR) models based on soil erosion that occurred between 2010 and 2019. The results showed that the implementation of the GLC project could have two impacts on soil erosion. First, much of the slope erosion was caused by slope excavation in the GLC basin. Second, the amount and extent of gully erosion was effectively controlled by hydraulic engineering. In addition, the irrational hydraulic engineering of LC projects can cause widespread soil erosion. Three aspects of engineering optimization measures for the GLC project were proposed. 1. This project requires different measures, especially those at the top of the slope, so it is necessary to reduce slope excavation and implement various slope safety measures. .. 2.2. For drains within a 1.2km radius of Gully Head, more attention should be paid to soil and water protection measures than site leveling. As a new approach to land use management, our results show that little is known about the impact of GLC projects on soil erosion, and our results provide specific guidance for the next scenario. Can be provided. However, both in-situ and out-of-habitation water harvesting structures caused slight changes in overall water yields under climatic scenarios. We conclude that by implementing an in-situ rainwater harvesting structure, we can increase green water without reducing blue water.

Perrine Hamel, Leah L. Bremer (2020) [6] reviewed how hydrological information is used in watershed management programs. Investing in watershed services programs promises the protection and restoration of ecosystems and water resources. Although the design and implementation of such programs often involves hydrological modeling and monitoring, the role of hydrological information in meeting the needs of program managers remains unclear. In the Camboliou basin in Brazil, we examined the value of hydrological modeling and monitoring from two aspects. Scientific reliability and the use of knowledge generated in the design, implementation and evaluation of watershed management programs. They use a combination of semi-structured interviews, focus groups, and water modeling at different levels of data availability to provide information that improves models and data availability builds reliability and helps decision makers. I checked when it could be offered. Model sophistication and data availability improved the reliability of hydrological information, but did not affect actual program design decisions. Hydrological monitoring data was important for model calibration and high resolution land use and cover data. This study suggests that hydrological modeling and monitoring efforts need to be determined by identifying how hydrological data influences decision making.

Naseer Ahmed Abbasi, Manuel Esteban Lucas-Borja (2019) [4] investigated numerous dams around the world. Dams are a widespread and effective soil and water conservation structure around the world. This review provides an overview of the use of dams for soil and water management and runoff control, with examples from the literature, based on field measurements from four continents. Over 150 years of research have shown that dams are a landmark in civil engineering around the world. Of all engineering structures, dams are probably the most iconic torrent barrier. They have been used for centuries and can be found all over the world. Over the last few hundred years, people have become increasingly aware of the desirable benefits of dams, including: B. Land development, environmental improvement, agricultural production, canyon stability improvement, and severe flood mitigation. Optimal size, location and type have had a significant impact on the efficiency of dams in the basin. In addition, dams have been shown to be useful tools for controlling soil erosion and floods at the catchment level, both theoretically and practically. This paper helps policy makers extend dam projects to all erosive areas.

GebrekidanWorku, AmareBantider (2020) [5] have developed alternatives to watershed management that can ensure optimal benefits in climate change adaptation under various climate scenarios. Climate scenarios were developed using statistically biased multi-model ensemble averages and RCP4.5 and RCP8.5 emission scenarios. The hydrological impact of climate change was assessed using a multi-gauge calibrated and validated soil and water assessment tool (SWAT) model. Watershed management alternatives were prioritized using multiple-criteria decision analysis, which compares watershed management criteria with alternatives through analytic hierarchy process. The results showed consistent reductions in precipitation, surface runoff, and total water yield under all climate and climate impact scenarios. Stormwater harvesting structures were the highest priority watershed management option to reduce the effects of climate change. More than half of the Jemma basin is very well suited for on-site water harvesting in baseline and future climatic scenarios. The observed terrace and expected in-situ rainwater harvesting structures significantly reduced surface runoff ($p < 0.05$), thereby significantly increasing soil moisture under baseline and future climatic scenarios. rice field. However, both in-situ and out-of-habitation water harvesting structures caused slight changes in overall water yields under climatic scenarios. We conclude that implementing an in-situ rainwater harvesting structure can increase green water without reducing the blue water scenario. However, both in-situ and out-of-habitation water harvesting structures caused slight changes in overall water yields under climatic scenarios. We conclude that by implementing an in-situ rainwater harvesting structure, we can increase green water without reducing blue water.

3. METHODOLOGY

3.1. CONDUCTS DETAILED SURVEY OF THE AREA

Visits the waterbodies, drainages and all the plots in the watershed and conducts a detailed survey of the area. Boundaries, geographical location, major waterbodies and drainage maps of selected area are determined. Surveys are conducted to determine the water shortage in the surrounding regions and present water table.

A questionnaire is prepared to conduct the survey. The survey was conducted to get the details about the water shortage problem faced during the summer season, lowering of well water level, whether bore well is used for meeting the water requirements during dry season and will enquire about the presence of any rainwater harvesting methods opted in the house. It helps to determine the variation of water in their wells during monsoon and summer seasons.

3.2.APPLICATION OF QGIS SOFTWARE

Geographic Information Systems (GIS) technology has played critical roles altogether aspects of watershed management, from assessing watershed conditions through modeling impacts of human activities on water quality and to visualizing impacts of other management scenarios. QGIS is that the best GIS tool within the free and open-source software (FOSS) community.

3.3.PREPARE MAPS FROM COLLECTED DETAILS

With the help of QGIS Software geomorphology map, land use map, soil map, Geology/Structure maps are obtained. With the collected details and data and maps from Panchayath, slope map, base map, watershed map, village map and contour map of area is prepared.

3.4.WATER BUDGETING IN THAT AREA

A water budget could be a measure of the quantity of water entering and also the amount of water leaving a system. It's how to guage all the sources of supply and therefore the corresponding discharges with relevancy a basin or aquifer. It's a basic tool that may be wont to evaluate the occurrence and movement of water through the natural environment. to take care of a balance within the ecological system, one must account for the incoming (source of water) and outgoing (water losses within the system) water resources. A water budget is also accustomed manage development of water resources within an area, and to make sure a sustainable supply of water over time.

3.5.DETAILED STUDY AND ANALYSIS OF COLLECTED DATA

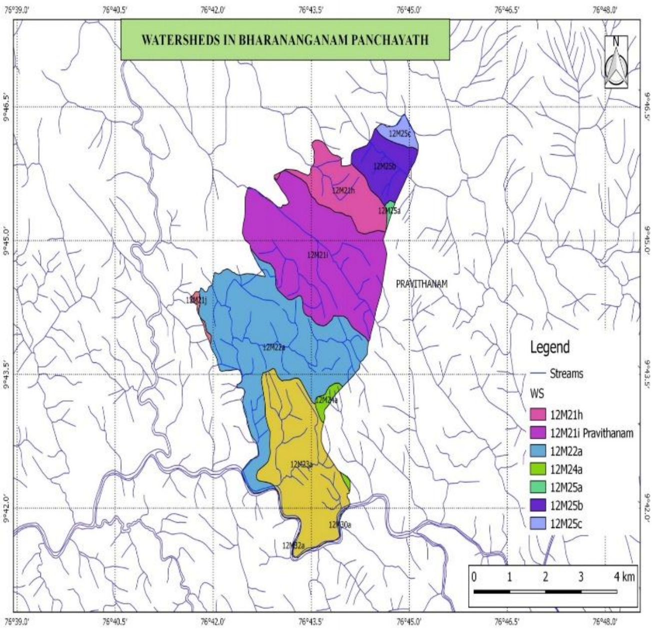
All the collected details are examined in detail and evaluate the need of an effective watershed management in the Panchayath. Based on the detailed study of all the collected information will propose effective watershed management practices.

3.6.DESIGN PROPOSALS/MANAGEMENT PLANS

The best opportunities for water conservation lie in the control of the portion of precipitation which is normal runoff. Retaining surface water on the land surface for a extended time increases the quantity of water entering the soil.

4.RESULTS

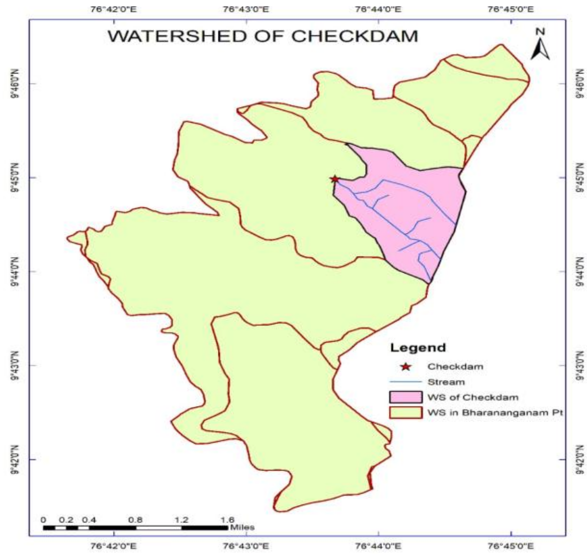
4.1 QGIS MAPPING



There are mainly five watershed areas in Bharananganam panchayat and each of these is denoted by different colour in the map being prepared with application of QGIS software. Through this map the boundaries of each watershed area can clearly identified and analyzed. The five watershed areas are denoted below;

IDAPPADY WATERSHED	12M32a
CHOONDACHERRY WATERSHED	12M22a
PRAVITHANM WATERSHED	12M21i
ULLANAD WATERSHED	13M21h
KAYYOOR WATERSHED	12M25b

Among these we have covered the area of pravithanm watershed and conducted the studies.



The location of the Pemanal check dam is being plotted in this map. The watershed area can also be identified in this map being plotted.

4.2WATER BUDGETING

WATER DEMAND

4.2.1.DOMESTIC WATER DEMAND

As per 2011 census report population of Kottayam district is 1974551.While referring previous reports population growth rate is about 2%.But as per the reports of Bharananganam Panchayath population is 15848, which is less than the population growth rate of the district. As per data ,water required for domestic purpose is shown in the table below.

Table 4.1.Domestic Water Demand

YEAR	2022	2030	2050
Population	16000	16450	17084
Water Demand (M.C.M)	0.7949	0.8105	0.8418

4.1.2.CROP WATER DEMAND

4.1.2.1.CROPS UNIT WATER REQUIREMENT

Table 4.2.Crops Unit Water Requirement

CROP	UNIT WATER DEMAND (CUM)
Paddy	9293
Coconut	1493.27
Banana	2682.60
Vegetables	545
Tapioca	2921.25
Other tubers	6830.769
Spices	5465.573
Rubber	457.64

Amount of water required for crops as per existing farming practices and water required in future if cultivation area is expanded and crop rotation is practiced is shown below.

Table 4.3.Crop Water Demand

CROP	AREA(HECTARE)	WATER DEMAND (M.C.M)
Paddy	1	0.009293
Coconut	275	0.41065
Banana	69	0.1851
Vegetables	12	0.00654
Tapioca	20	0.058425
Other tubers	39	0.2664
Spices	61	0.3334
Rubber	1173	0.53682
		1.806453

SAMPLE CALCULATION:

Crop water demand = Area * unit water demand

Water demand for paddy = 1* 9293= 0.009293 M.C.M

Table 5.4.Area where more cultivation can be expanded

CROP	AREA (HECTARE)	WATER DEMAND M.C.M	
		2030	2050
Paddy	1	0.009293	0.009293
Coconut	275	0.41065	0.41065
Banana	69	0.1851	0.1851
Vegetables	12	0.0190806	0.0190806
Tapioca	20	0.058425	0.058425
Other tubers	39	0.2664	0.2664
Spices	61	0.3334	0.3334
Rubber	1173	0.53682	0.53682
		1.8189936	**1.8189936**

4.1.3.LIVESTOCK WATER DEMAND

4.1.3.1.LIVESTOCK UNIT WATER DEMAND

Table 4.5.Unit Water Demand

LIVESTOCK	WATER DEMAND (cum)
Cow	9.124
Buffalo	14.963
Goat	2.0065
Other animals	2.0074
Hen	0.0127
Broiler	0.12774

While comparing with State, number of livestock in BharananganamPanchayath is decreasing every year. Data regarding existing number of livestock and their water demand is shown below.

Table 4.6.Data regarding existing number of livestock

LIVESTOCK	2022	WATER DEMAND (M.C.M)
Cow	868	0.00792
Buffalo	11	0.0001646
Goat	1066	0.002139
Other animals	189	0.0003794
BIRDS		
Hen	6508	0.00008313
Broiler	19320	0.002468
		0.0139023

SAMPLE CALCULATION:

Livestock water demand = number * unit water demand

Water requirement of cow = 868* 9.124 = 0.00792 M.C.M

While referring to present situation, there is no variations in the number of livestock. So there will not be change in future livestock water demand.

Table 4.7. Livestock Water Demand

YEAR	2022	2030	2050
Livestock water demand (mcm)	0.0139023	0.0139023	0.0139023

5.1.4.INDUSTRIAL WATER DEMAND

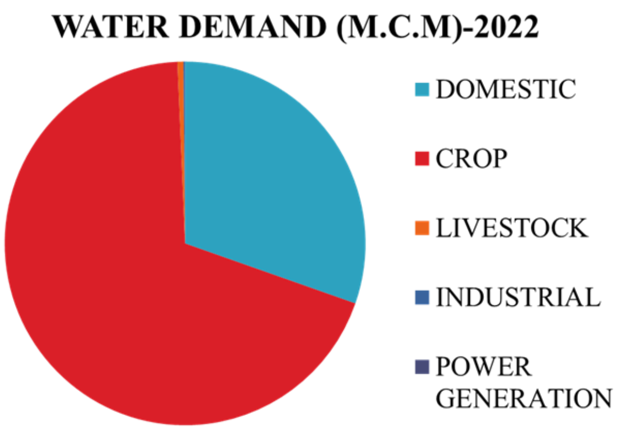
Industrial units are comparatively less in Bharananganam Panchayath, however Rubber sheet manufacturing industries are located at various parts of Panchayath. Water is needed for these units. A 2% increase is expected in the number of industries.Table 8.8. Industrial Water Demand

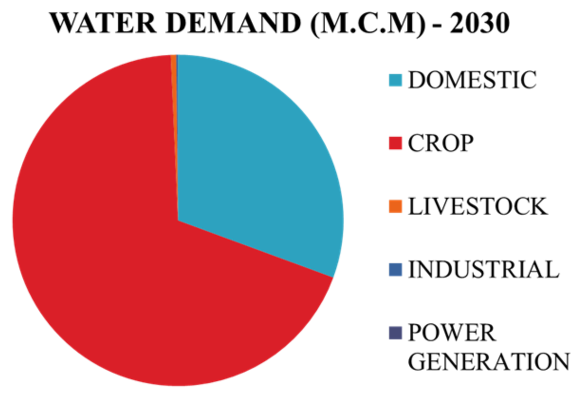
YEAR	2022	2030	2050
Industrial water demand (mcm)	0.0039	0.004536	0.005976

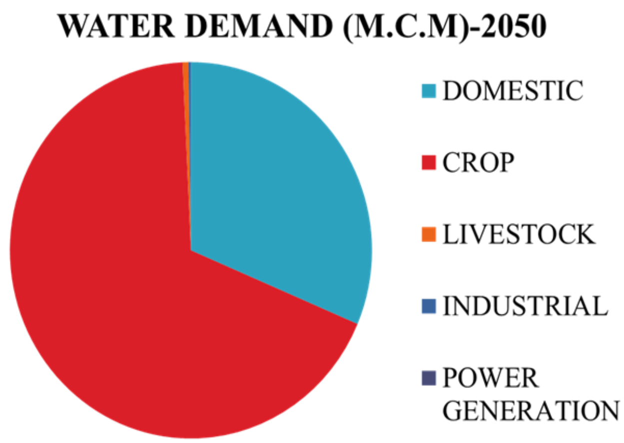
5.1.5.WATER FOR POWER GENERATION

As there is no power generation related projects in Bharananganam Panchayath water is not needed in this sector.

GRAPHICAL REPRESENTATION OF WATER DEMAND







5.2.WATER AVAILABILITY

Water availability in Bharananganam Panchayath from major water sources are shown below: Table 5.10.Water Availability

Sl.No	Source	Length (m)	Width (m)	Height (m)	Capacity (cum)
1	Allappara Pond	20	10	4	800
2	EzholickalCheckdam	500	4	1	1000
3	Kuzhalkinar Jn Checkdam	400	5	1.2	1200
4	OdichukuthibhagamCheckdam	400	6	1	1200
5	PemanalChekdam	400	5	1.5	1500
6	Paambaarakunnu VCB	500	4	1.5	1500
7	Areeykakunnu Colony Pond	7	5	2	70
8	Mangara Panchayath Pond	15	10	5	750
Total			8260		
Availability for 300 days			2478000		
Total			**2.478 (M.C.M)**		

SAMPLE CALCULATION:

Capacity of checkdam = Length * Width * Height/2

Capacity of Ezholickalcheckdam= 500 * 4 * 1 =1000 cum

Capacity of pond = Length * Width * Height

Capacity of Allappara Pond = 20 * 10 * 4 =800 cum

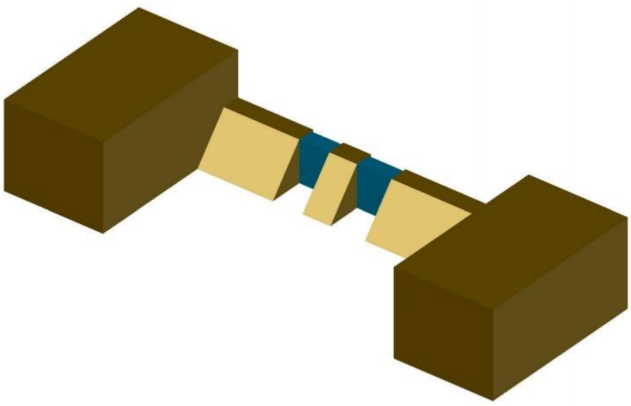
5.3.ANALYSIS

Table 5.11.Analysis

Water Availability	2.478 (M.C.M)
Water Demand	2.61885 (M.C.M)

We can find that there exists a gap between water availability and water demand which is expected to increase in future. So there is a need for proper watershed management in Bharananganam Panchayath.

CHECK DAM DESIGN



In pemanal, the existing check dam has inefficiency in its purpose due to deterioration and lack of proper working structure. During rainy season when the water overflows the solid waste gets accumulated in the checkdam resulting in poor functioning of its designed purpose. Based on our survey we had designed a model to reconstruct the checkdam considering the site. The figure shows the 3D view of model being designed for reconstruction. It has a width of 5m and a height of 1.5m.

6. CONCLUSION

Our study area Bharanaganam panchayat is really enriched with biodiversity and landscape. Eventhough the small streams dry up in summer, due to the flow of Meenachil river through this panchayat the presence of ample quantity of water could be identified. But during summer season many of these water resources dry up. Many designs and structures for the proper management of water resources are there in the watershed areas of the panchayat. Mainly there are five watershed areas in the panchayat and we have reach out to the Pravithanam watershed. In Pravithanam we have visited and analyzed the efficiency of all the structures being designed to perform the functions of water resource management. The structures include ponds, check dams, VCB's etc…Following are the conclusion drawn up from the studies;

- We have identified areas which require proper management of water resources on the basis of watershed. By conducting water budgeting we were able to figure out the availability of water in the panchayat and it enables us to adopt suitable workplan designs for the efficient management of resources.

- By conducting surveys among the local inhabitants in the area we have identified the necessity for a proper resource management. We have spotted an area which is Pemanal check dam situated in 3rd ward of Bharananganam panchayat, which has the need for a renovation for the existing check dam structure for better utilization and increasing the availability of water to the local inhabitants.

- By proper analysis we have planned a model for the check dam design which can be incorporated to bring a change to the existing one for the better efficiency and usage to the inhabitants in the watershed area. In addition, determination of the boundaries of the streams and removal of the accumulated silt and debris will ensure greater water conservation.

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