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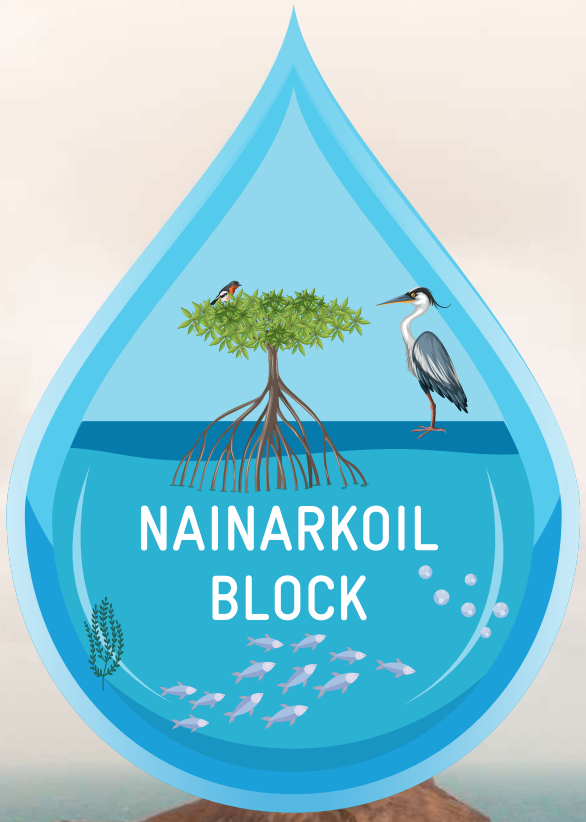
Ministry of Jal Shakthi

WATER SECURITY AND CLIMATE ADAPTATION IN RURAL INDIA



SUSTAINABLE DEVELOPMENT GOALS

Block Level Composite Water Resources Management Plan under Mahatma Gandhi NREGS

District Rural Development Agency, Ramanathapuram &
WASCA, GIZ, New Delhi

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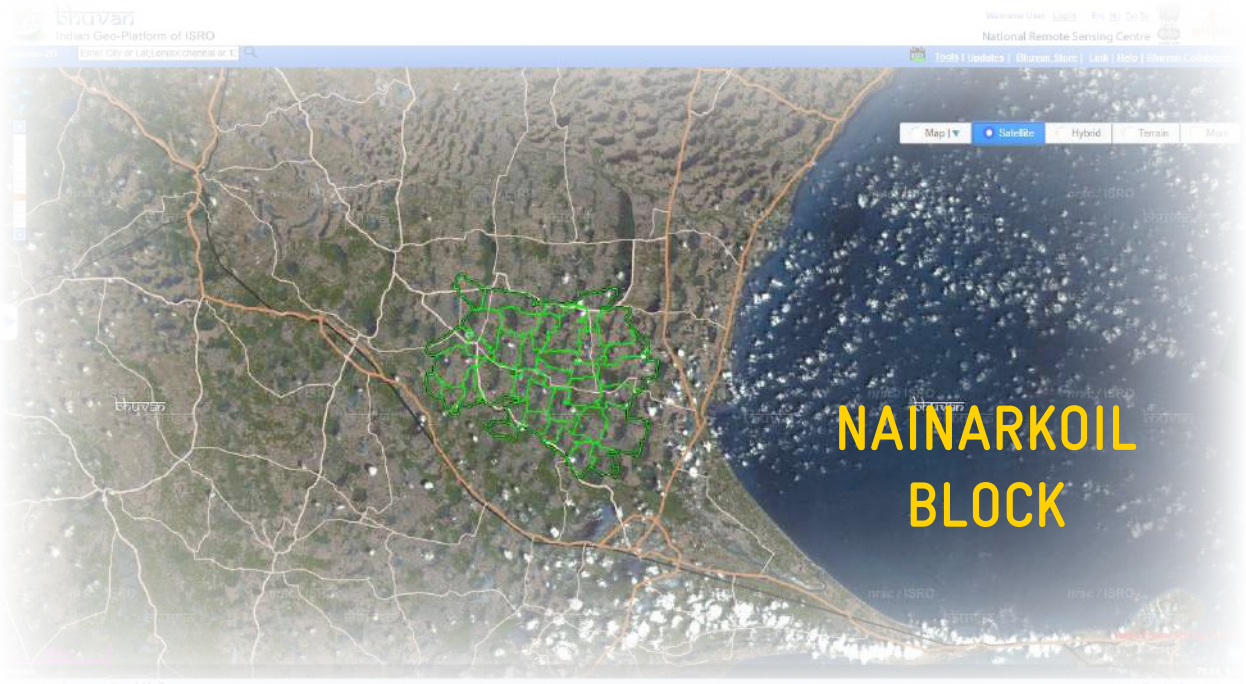
WATER SECURITY AND CLIMATE ADAPTATION IN RURAL INDIA



Block Level Composite Water Resources Management Plan under Mahatma Gandhi NREGS

District Rural Development Agency, Ramanathapuram &
WASCA, GIZ, New Delhi

FOREWORD

Thiru. Praveen P. Nair, IAS
Director of Rural Development
and Panchayat Raj

Tamil Nadu government is implementing the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) by assuring adequate and accessible wage employment while simultaneously creating productive individual and community assets to fulfil the infrastructure and livelihood needs of the people in rural areas. The Government intends to prioritise the strategies under this scheme to focus on creating Climate Resilient Villages and individual income generating assets and works in the coming years in a convergence model.

> "Close to 10 lakh NRM and Non- NRM works are identified, verified, approved by Gram Panchayat"

There will be a reorientation of priorities under MGNREGS with livelihood promotion and poverty alleviation as goals in addition to Natural Resource Management, asset creation and agriculture development. The approach to Natural Resource Management will be on a saturation mode with GIS based planning. The impact of each intervention will be maximised through convergence.

In this context, implementation of Water Security and Climate Adaptation (WASCA) a technical cooperation project GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH) Indo-German Technical Cooperation project in Tamil Nadu is of paramount importance. WASCA is being implemented in Tiruvannamalai and Ramanathapuram district.

The project focused on GP level planning driven by scientific data, climate information, climate risk, climate vulnerability assessments & ranking, watershed approach, water budgeting (Ground and surface water), land use, agriculture, livestock, soil parameters and GIS thematic maps. A Composite Water Resources Management Planning (CWRMP) frame works is adopted. The GP level works thus identified are mapped to climate vulnerabilities, SDG goals and its Indicators, Intended Nationally Determined Contributions (INDC) for climate Change. This mapping exercise is unique and first of its kind in the country for a plan at GP level.

This approach helped to complete 1,289 GP level plans in holistic way for a period of three years. Close to 10 lakh NRM and Non- NRM works are identified, verified, approved by Gram Panchyat. Out of the shelf

of projects, in the year 2021-22 FY, 2,80,000 works are uploaded in NREGA soft GIS planning portal. This is one of the largest number of works uploaded by any district or state for the current financial year.

Under WASCA four major interventions are being undertaken in pilot districts.

1.	Development of Public and Common lands
2.	Development of Agriculture and allied activities
3.	Development of Rural Infrastructure Management
4.	Development of Climate Resilience Measures

Under the leadership of District Collector, Additional Collector (Development), Engineers of District Rural Development Agencies (DRDA), line departments and GP office bearers the implementation of approved works from WASCA are discussed during monthly district level convergence meetings.

The present Block report is a synthesis of all GPs in the Block discussed in detail on four major heads, Socio-Economic, Climate, Water and Agriculture the key for any rural development. The Block level CWRM book will help the GP, Block officers and Gram Panchayats in planning, implementing works in holistic manner, reducing water scarcity in the district.

I take this opportunity to thank GIZ, the technical partners, District WASCA resource Centres for their continued effort to work with DRDA and State RDPR for making MGNREGS more integrated.

"The block level CWRM book will help the GP, Block officers and Gram Panchayats in planning, implementing works in holistic manner, reducing water scarcity in the district"

Thiru. Praveen P. Nair, IAS
Director of Rural Development
and Panchayat Raj

FOREWORD

Rajeev Ahal
Director,
NRM & Agroecology, GIZ India

The Block Level, Composite Water Resources Management Plan is an unique initiative of District Rural Development Agency, Tiruvannamalai & the Indo German project on Water Security and Climate Adaptation in Rural India (WASCA) implemented by GIZ. This is the culmination of three years of efforts by the project team and government officials, assisted by knowledge partners and a myriad of departments. At the national level, this process is anchored in the Ministry of Rural Development and supported by National Water Mission, Ministry of Jal Shakti.

> **Block level report uses strong scientific data and analysis using GIS and statistical data to develop a medium-term picture of water**

The state government of Tamil Nadu, with core support from Director Thiru. Praveen Nair I.A.S., Department of Rural Development and a host of water related departments, under the active leadership of the District Collector, Thiru. B.Murugesh, I.A.S., has embarked on this strategic response to the strong crisis of water security which is affected by climate change that we are increasingly witnessing. This Block level report uses strong scientific data and analysis using GIS and statistical data to develop a medium-term picture of water and climate and their interactions. These have driven a scenario projection, to respond to which key thrust areas of actions, with their inherent strategies and resultant activities have been brought together into a plan that will work to change this possible reality.

As humans, we have to plan to avert the future potential disasters and capture latent opportunities, using the human, technical and financial resources available to us. As wise humans, we should do it strategically to not only adapt to that reality, but to initiate actions that help to mitigate that possible future also along with.

The Block report focuses on sustainable water resource management, as it is the true driver for all development in a natural resource dependent rural livelihood scenario. The climate actions initiated not through

separate climate funds, but by leveraging existing public programmes and schemes, such as Mahatma Gandhi NREGA, to act now and decisively.

We sincerely hope that this innovative Block Level plan is not only a success for itself but shows that way how the state government can plan for all of its …. Blocks!

We look forward to its success!

Rajeev Ahal
Director,
NRM & Agroecology, GIZ India

MESSAGES

Thiru. S.S Kumar
Additional Director (MGNREGS),
RD&PR

The Mahatma Gandhi National Rural Employment Guarantee Scheme in Tamil Nadu focuses on Natural Resources Management, Grey Water Management, Farm Ponds in individual lands, afforestation and plantations in community areas, water harvesting and conservation measures. To implement works in saturation mode, it is important to have holistic plans prepared in every Gram Panchayat.

GIZ technical cooperation project on Water Security and Climate Adaptation (WASCA) being implemented in Tiruvannamalai and Ramanathapuram district is an example of holistic GP plans considering the land, water, soil, geology and social aspects.

> **Water Security and Climate Adaptation (WASCA) is an example of holistic GP plans considering the land, water, soil, geology and social aspects**

Through District level GIS resource centres, GIZ with the partners MSSRF build capacity of Block, GP level technical officers of Rural Development Department in completion of 1,289 GP plans. In preparation of GP level plans, Nationally approved Comprehensive Water Resources Management (CWRMP) framework is adopted along with Bhuvan NRSC ISRO GIS platform.

Total 3,00,000 works identified through CWRM are uploaded in NREGA Soft. The works focused on treatment of all-natural drainage lines, rejuvenation of traditional waterbodies, afforestation, trench cutting, gully plugs, recharge-shaft, farm ponds, check dams, farm bunds, soak pits etc. These works identified through GIS planning are verified on ground and approved by Gram Panchayat.

The Block level report provides the details of the parameters used for preparing plans, analysis of the situation, works for over coming the short term and long-term goals of climate resilience and productive assets. This report will be useful for all functionaries implementing MGNREGS.

Thiru. S.S Kumar
Additional Director (MGNREGS),
RD&PR, Government of Tamil Nadu

MESSAGES

Thiru R. Harikrishnan
Cheif Engineer,
MGNREGS, RD&PR

Water Security and Climate Adaptation (WASCA) a bilateral project of Ministry of Rural Development (MoRD) (MGNREGS), Ministry of Jalsakthi (National Water Mission) and GIZ (German Corporation for International Cooperation GmbH) started in the year 2019-20 and for next three years.

In our state, Centre for Climate Change and Disaster Management (CCCDM-Anna University) has conducted the scoping study based on 18 Vulnerability parameters (Socio-economic, agriculture, water and climate parameters) and identified the most vulnerable two districts for project implementation. The two districts are Tiruvannamalai in Northern Tamil Nadu and Ramanathapuram South coastal aspirational district. For implementing WASCA project Composite Water Resource Management (CWRM) Plan is used.

> "Whole planning process followed a bottom-up approach in identifying appropriate actions based on scientific analysis"

The CWRM plans assessed both the supply and demand for water using data pertaining to land resources, climate parameters, catchment areas, soil, surface runoff, agriculture and prepared a water budget. Besides, it has identified a set of key water actions for the development of public and common land, agriculture and allied activities and rural infrastructure. The whole planning process followed a bottom-up approach in identifying appropriate actions based on scientific analysis. I consider such decentralized level of planning is necessary in ensuring water security in the context of increasing climate change impacts.

Thiru R. Harikrishnan
Cheif Engineer,
MGNREGS, RD&PR

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ABBREVIATIONS AND ACRONYMS

A - D

%
Percentage

^{0}C
Degree Celsius

AR
Assessment Report

CCB
Contour Continuous Bunds

CCCDM
Centre for Climate Change and Disaster Management

CRM
Climate Resilient Measures

CuM
Cubic Meter

CVI
Climate Vulnerability Index

CWRM
Composite Water Resource Management

CWRMP
Composite Water Resource Management Plan

DEM
Digital Elevation Model

D - G

DLSC
District Level Steering Committee

DLT
Drainage Line Treatment

DRD&PR
Department of Rural Development & Panchayat Raj

EC
End Century

ET
Evapo-transpiration

FPO
Farmer Producer Organization

FY
Financial Year

GIS
Geographical Information System

GIZ
Deutsche Gesellschaft für Internationale

Govt.
Government

GP
Gram Panchayat

GW
Ground Water

H - K

ha
Hectare

ha.m
Hectare Meter

HH
Households

ICAR
Indian Council for Agriculture Research

IMD
Indian Meteorological Department

INR
Indian Rupees

IPCC
Intergovernmental Panel on Climate Change

IWRM
Integrated Water Resources Management

Kharif crop
Sown in Monsoon and harvested close to Autumn

km
Kilometer

KML
Keyhole Markup Language

L - M

LULC
Land use and land cover

Max
Maximum

MCM
Million Cubic Meter

MC
Mid Century

Mahatma Gandhi NREGA
Mahatma Gandhi Rural Employment Guarantee Act

Mahatma Gandhi NRGES
Mahatma Gandhi Rural Employment Guarantee Scheme

Min
Minimum

mm
Millimeter

MoEFCC
Ministry of Environment, Forest and Climate Change

MoJS
Ministry of Jal Shakti

MoRD
Ministry of Rural Development

m
Meters

N - P

NAPCC
National Action on Climate Change

NARP
National Agricultural Research Project

NADEP
Nadepkaka

NDC
Nationally Determined Contributions

NEM
North-East monsoon

NGO
Non-Governmental Organization

NITI
National Institution for Transforming India

No.
Number

NRM
Natural Resource Management

NRSC
National Remote Sensing Centre

NWC
National Water Commission

PWD
Public Works Department

R - S

Rabi crop
Sown in winter and harvested in monsoon

RDPR
Rural Development & Panchayat Raj

RF
Reserve Forest

RTRWHS
Roof top rain water harvesting structures

RWHS
Rain Water Harvesting System

SAPCC
State Action Plan on Climate Change

SC
Scheduled Caste

SDG
Sustainable Development Goal

SDMA
State Disaster Management Authority

SDMRI
Suganthi Devadasan Marine Resources Institute

SECC
Socio Economic and Caste Census

S - W

SHG
Self Help Group

SLSC
State Level Steering Committee

ST
Scheduled Tribe

SWM
South-West monsoon

SW
Surface Water

TN
Tamil Nadu

UN
United Nations

WASCA
Water Security and Climate Adaptation

WCWH
Water Conservation and Water Harvesting

வான்நின்று உலகம் வழங்கி வருதலால்
தான்அமிழ்தம் என்றுணரற் பாற்று

குறள் - 11

The genial rain ambrosia call
The world but lasts while rain shall fall

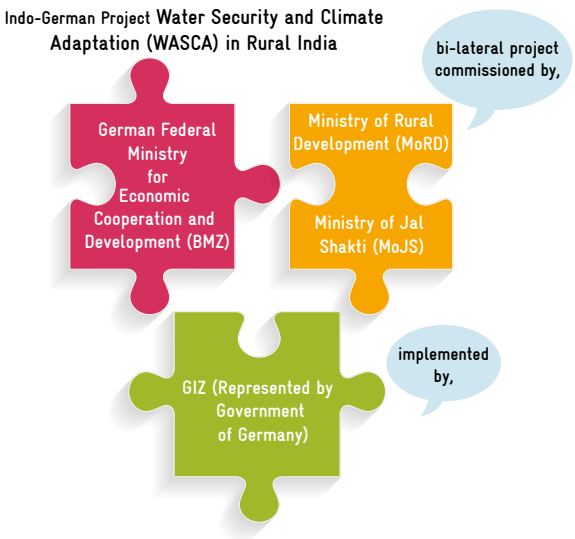
Thirukkural - 11

EXECUTIVE SUMMARY

> "Aims to improve water resource management with respect to water security and climate adaptation"

Water security is one of the most alarming issues and key challenges that the world is facing today given the rapid changes in climate. India is not an exception and is facing a similar challenge. Water security is of prime concern especially in the rural areas due to scarce resources and a high dependency on natural resources. To mitigate the ill effects of climate change and focus on efforts to improve water resource management requires a thorough understanding of all key issues. Climate change adaptation and water security strategies have to be evolved with the help of technical knowledge and integrated into the development planning processes across the Nation, State and local level, for holistic and sustainable impacts.

The Indo-German Project "Water Security and Climate Adaptation in Rural India" (WASCA), is a bi-lateral project commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) in partnership with the Ministry of Rural Development (MoRD) and Ministry of Jal Shakti (MoJS) and implemented by GIZ (Represented by Government of Germany). This project aims to improve water resource management with respect to water security and climate adaptation with an effort to establish a framework for integrating water perspectives into planning and implementing adaptation actions that promotes climate resilience. It is implemented under technical cooperation from BMZ-GIZ with implementation under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA/S) and National Water Mission (Catch the Rain Campaign) under MoRD, MoJS respectively. In Tamil Nadu State, the project is jointly implemented by the Department of Rural Development & Panchayat Raj, (DRD&PR) Government of Tamil Nadu, Chennai and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.



Initially WASCA Tamil Nadu conducted a preliminary state level scoping study on the State's Rural Water Security using the 18 vulnerable indicators, which covered four important and interconnected parameters/areas of Climate extremities, water resource, agriculture and socio-economic at the District level. Based on the outcomes of the assessment, Tiruvannamalai and Ramanathapuram districts were given priority by the State Level Steering Committee headed by the Additional Chief Secretary, RD&PR in November 2019 for implementing the WASCA. These 18 indicators were further studied at the Gram Panchayat (GP) level integrating the Composite Water Resource Management (CWRM) and MGNREGA/S approach to identify the key problems and propose key actions for implementation in each district.

With focus on water-related climate action and integrated water resource management (IWRM) principles, the project WASCA aims to significantly contribute towards Sustainable Development Goals for ensuring efficient, sustainable, and inclusive water outcomes. Implementation of key water actions also support the National Water Mission, one of the eight missions under the National Action Plan for Climate Change (NAPCC) to achieve their objective of promoting basin level IWRM. It also explored possible contributions towards the larger goals of Nationally Determined Contribution's (NDC) of climate adaptation through its work on improving water efficiency in agriculture and allied sectors and ecosystem development. The State and District Steering Committee approved the process during May 2020 and the whole progress was jointly accomplished with research organizations and key sectoral experts in February 2021.

Subsequently, the District Collector, Tiruvannamalai, entrusted preparing Block level reports of water security and climate adaptation for each Block. This Block level report is intended for all planners and managers responsible for addressing issues of adaptation in natural resource management and water-dependent economic sector and for those who provide support to achieve a coherent and strategic response to adaptation planning. This report also helps all stakeholders involved to understand the issues related to water security in the context of climate change in rural areas and actions through Mahatma Gandhi NREGS and the need for convergence with concerned line departments.

Block level report is intended for all planners and managers responsible for addressing adaptation in natural resource management and water-dependent economic sector

This report is structured with nine complete chapters

1

The First chapter outlines the generic demographic, socio economic and hydrological aspects of the Block

2

The Second chapter addresses water security through the lens of changing climate. The past and future climate change scenarios are discussed along with climate risks. The 18 vulnerability indicators used in WASCA TN's scoping study are summarized and analysis on Block level vulnerability assessment are briefed

3

The Third chapter elaborates the process of CWRM approach and its framework along with categorization of GPs, collection and analysis of spatial and non-spatial data of climate, water, agriculture and socioeconomic areas

4

The Fourth chapter discusses the Intergovernmental Panel on Climate Change (IPCC) vulnerability assessment and GP vulnerability scores based on the degree of vulnerability through sensitivity and adaptive capacity in 4 areas

5

The Fifth chapter explores key water actions under Mahatma Gandhi NREGA convergence and its proposed actions as developments in public and common land, agriculture and allied sectors, rural infrastructures and climate resilient measures

6

The Sixth chapter sketches the projected outcomes of planning and development in public and common land, agriculture and allied sectors, rural infrastructures and its linkage with NDC and SD goals

7

The Seventh chapter provides the process of GP plan implementation, its integration in to Mahatma Gandhi NREGA soft and about NRM and Non NRM works progress

8

The Eight chapter provides model case study on one micro-watershed and GP from the Block to illustrate how CWRM planning processes unfolds into analysis, results and impacts from macro-watershed to the lowest planning unit GP

9

The Ninth chapter concludes with the significance of Block level study and recommendations

துப்பார்க்குத் துப்பாய துப்பாக்கித் துப்பார்க்குத்
துப்பாய தூஉம் மழை

குறள் - 12

The rain begets the food we eat
And forms a food and drink concrete

Thirukkural - 12

CHAPTER 1

1 ABOUT THE BLOCK

Nainarkoil Block of Ramanathapuram District lies between 9°24'54.968"N to 9°36'32.245"N latitude and 78°38'45.722"E to 78°51'41.807"E longitude. This Block is surrounded by R S Mangalam, Ramanathapuram, Bogalur and Paramakkudi Blocks (Figure 1.1). The total geographical area of Block is 27,297 ha (272.97 Km^2). Administratively, this Block has 37 Gram Panchayats with 113 hamlets.

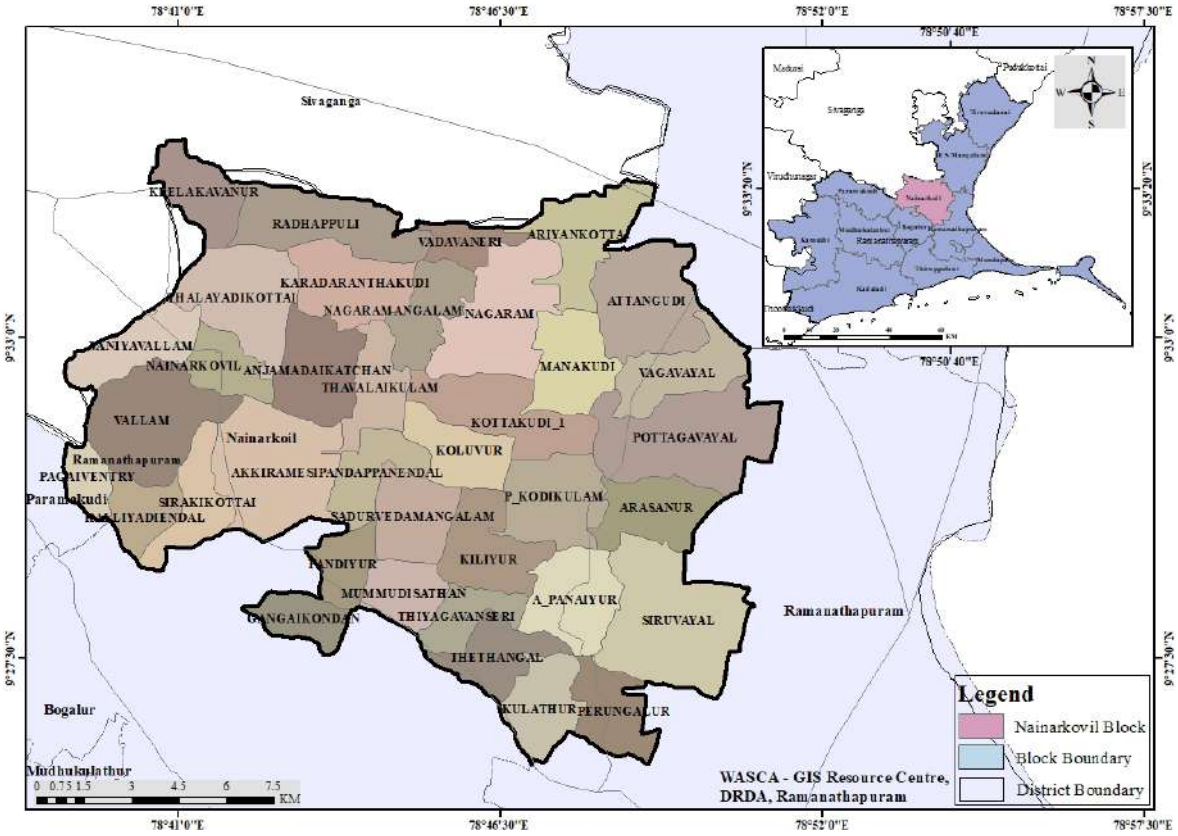


Figure 1.1. Nainarkoil Block and it's environ

According to Census 2011, the population of the Block is 48,358. The population density of the Block is 187 per Km^2 which is much lower than the District (331Km^2) and the State's density (555 Km^2). There is an increase of 5.96% in population, observed since 2001; the population growth rate is very low. The proportion of sex ratio is 1012 females for 1000 males. The average literacy rate of this Block is 72.25 % which is almost equal to the national average (72.98%). The male literacy rate is high (83.60%) than female literacy rate (61.11%). The range of literacy gap is high in this Block when compared to Other Blocks in Ramanathapuram district. Vulnerable population, Scheduled Castes and Scheduled Tribes accounted for 21.96 % of the total population.

Economically, this rural Block is one of the backward Block with low socio-economic condition. According to the State Planning Commission, Government of Tamil Nadu's Human Development Report – 2017, 45.63 % families are in below poverty line (BPL). The % of BPL families are very high in this Block. Agriculture and allied activities are main occupation in this Block. Dry Chilli is the dominant crop both under irrigated and rainfed conditions with 55.27% of the crop area being cultivated by Dry Chilli, followed by Paddy. Other pulses, Coconut, Jowar, Cotton, Maize and other plantation crops are cultivated in small areas. The Block has 14 Milk societies with 3.7 lakh liters of milk being produced.

> The proportion of sex ratio is 1012 females for 1000 males.

> The average literacy rate of this Block is 72.25 % which is almost equal to the national average (72.98%).

> 55.27% of the crop area being cultivated by Dry Chilli

Hydrologically, Nainarkoil Block lies in Vaigai and Pambar Kottakkaraiyar basin and Lower Vaigai and Kottakkaraiyar sub basins. Vaigai River flows through the Block. Lower Vaigai (4), Kottakkaraiyar macro-watersheds cover the Block and has 64 micro-watersheds. (Figure 1.2). Situated in rain shadow area, Ramanathapuram District has an extraordinary tank irrigation system which was built hundreds of years ago. The tanks were designed in such a way that the outflow from one tank would serve as the inflow for the next tank after it has reached its capacity, allowing the excess water to flow out into the next tank.

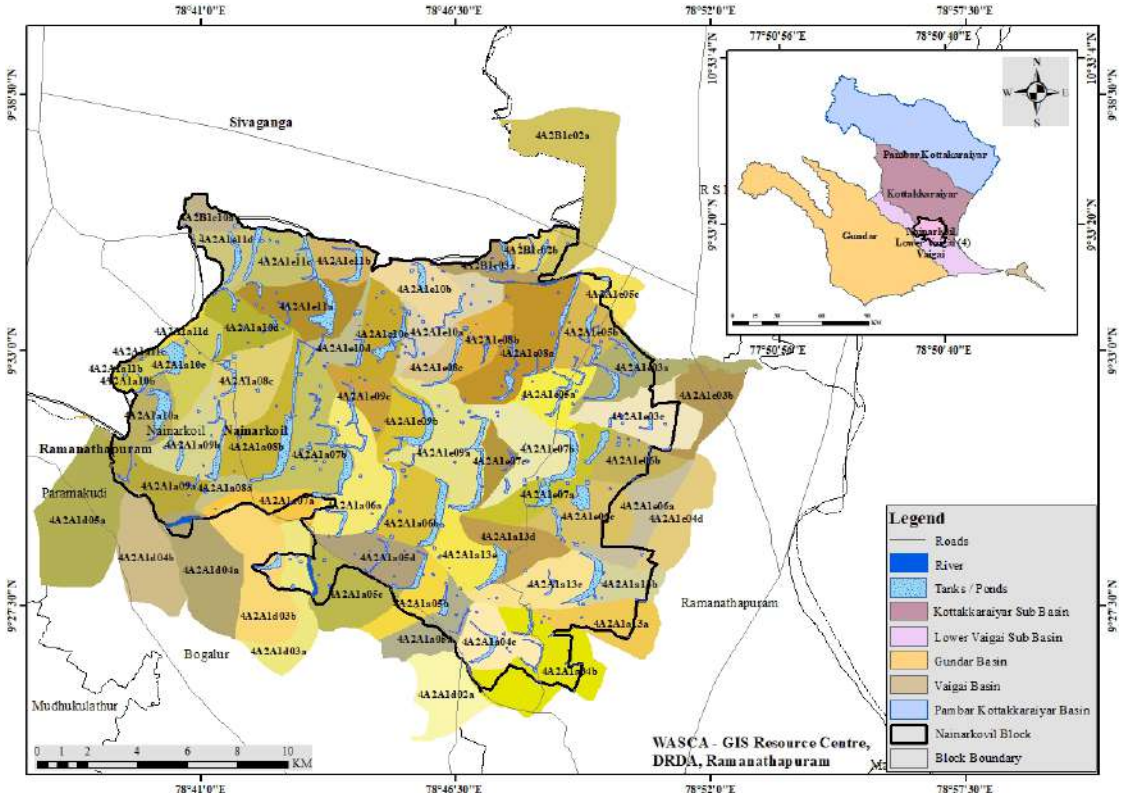


Figure 1.2. Watersheds – Nainarkoil Block

Water harvesting structures 'Ooranis' also play a huge role in groundwater conservation and recharge, guaranteeing availability of safe drinking water and useful for farmers who do not have water source for irrigation or find it expensive. There are a total of 99 tanks: 47 Ex-zamin MI tanks, 7 panchayat MI tanks, 45 PWD tanks (Vaigai basin) in this Block (Human Development Report 2017). Figure 1.3 shows the spatial distribution of water bodies in this Block. One firka viz., Kiliyur covers the Block, and is safe in ground water development (CGWB's ground water assessment report 2017).

GROUND WATER LEVEL OF THIS BLOCK

SAFE - <70%	Kiliyur

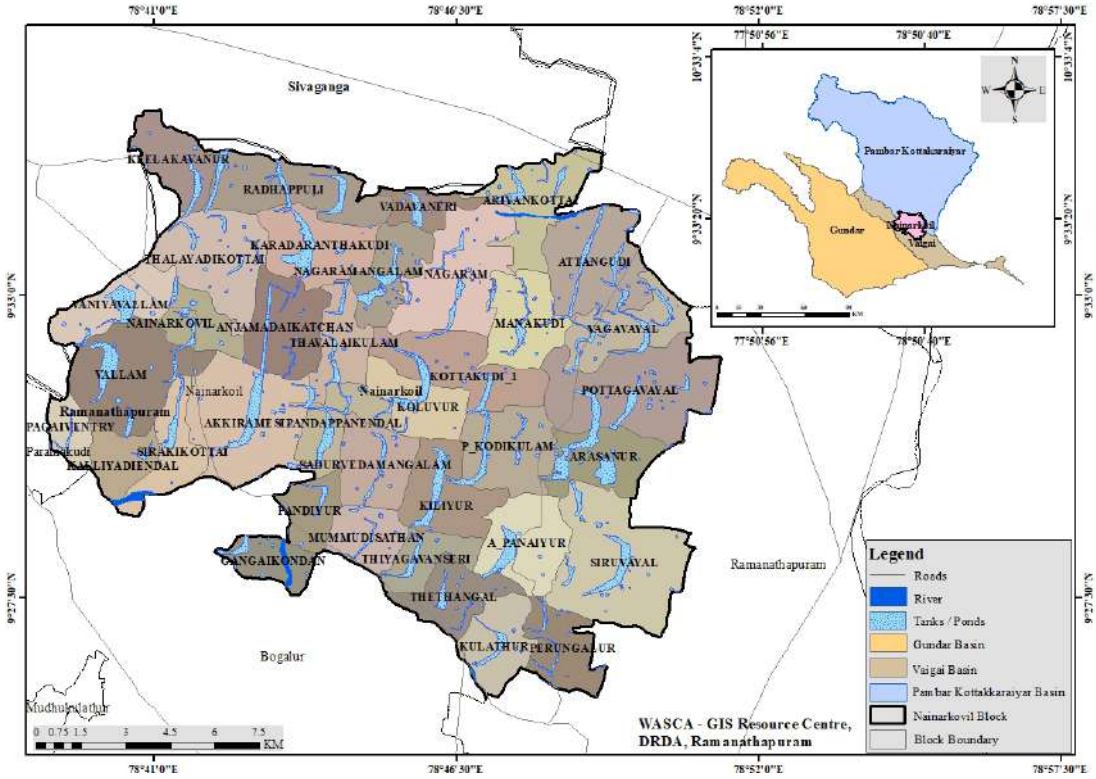
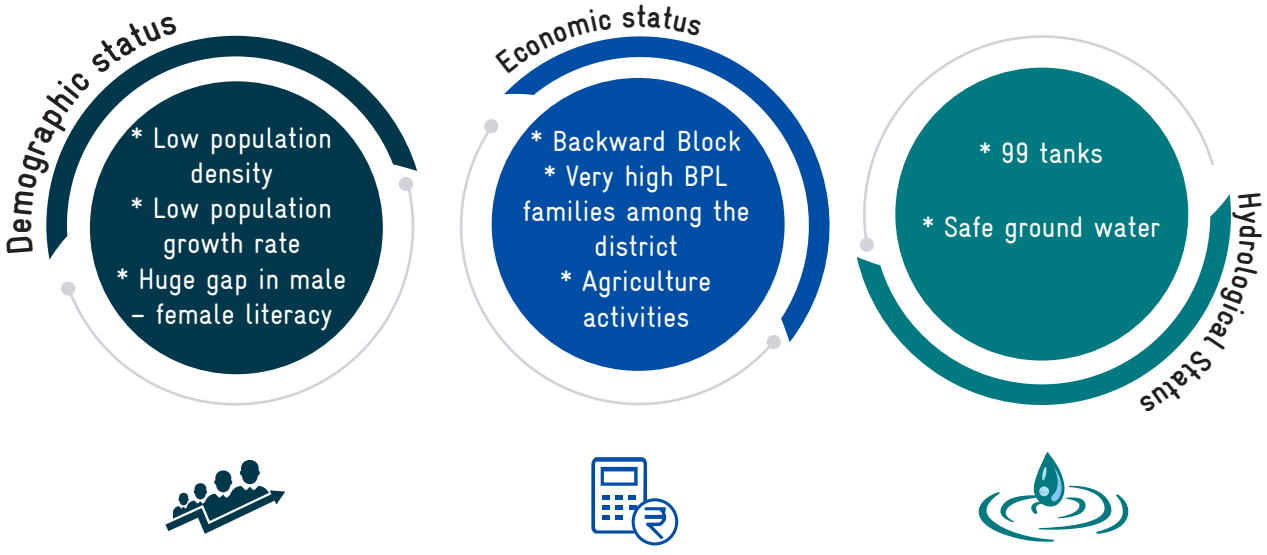


Figure 1.3. Spatial distribution of waterbodies



விண்இன்று பொய்ப்பின் விரிநீர் வியனுலகத்து
உள்நின்று உடற்றும் பசி

குறள் - 13

Let clouds their visits stay, and dearth
Distresses all the sea-girt earth

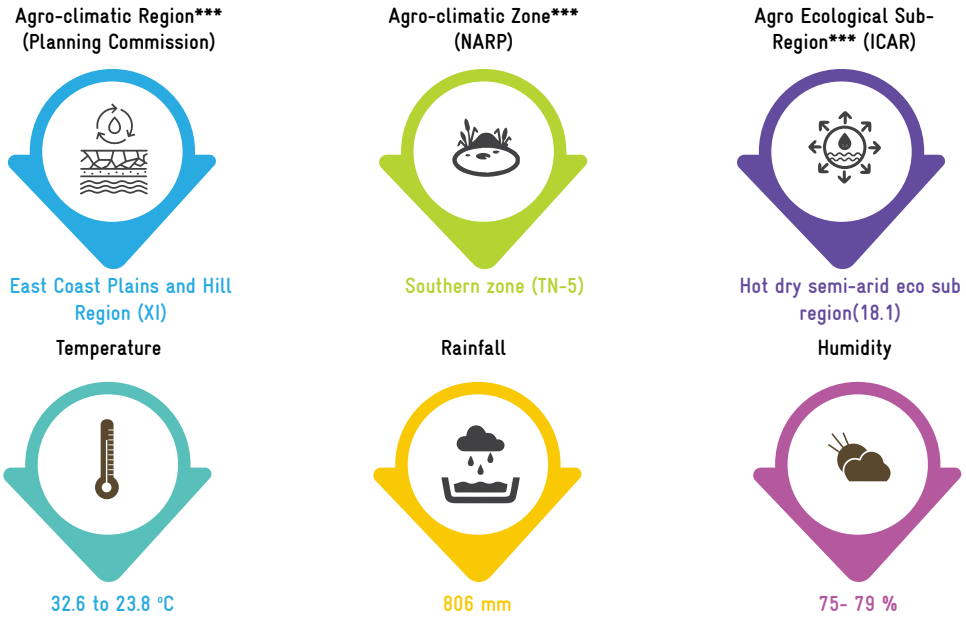
Thirukkural - 13

CHAPTER 2

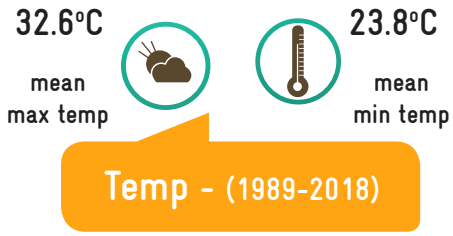
2 CLIMATE AND WATER SECURITY

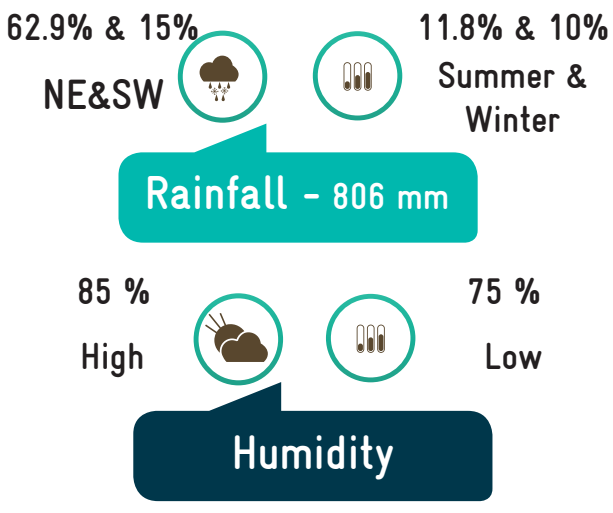
Water has always been a contentious subject in this region. This semi-arid region is classified as southern agro-climatic zone of State and East coast plains and Hills region according to the agro climatic regional classification of planning commission. The general climate description of this region is given below (Table 1).

TABLE 1. GENERAL CLIMATE DESCRIPTION



In general, this semi-arid region has dry and hot weather. The mean maximum temperature is 32.6°C and mean minimum temperature is 23.8°C during the last 30 years (1989-2018) (IMD). In summer months the maximum temperature goes up to 45°C for a few days. The monthly average temperature characteristic during June 2018 to May 2019 is shown in Figure 2.1.





The annual rainfall of this region is 806 mm (IMD) which is less than the State's average rainfall. Normally this region receives major rainfall from North East Monsoon (NEM) (October to December) followed by South West Monsoons (SWM) (June to September), and during winter and summer months. NEM contributes a maximum of 62.9 % (507.4mm) of the total annual rainfall and SWM contributes 15% (121.7mm). This region normally receives rainfall during summer (March to May) and winter (January, February) months also. Summer rainfall accounts for 11.8 % (95.5mm) and winter season accounts for 10% (82.2mm) of the annual

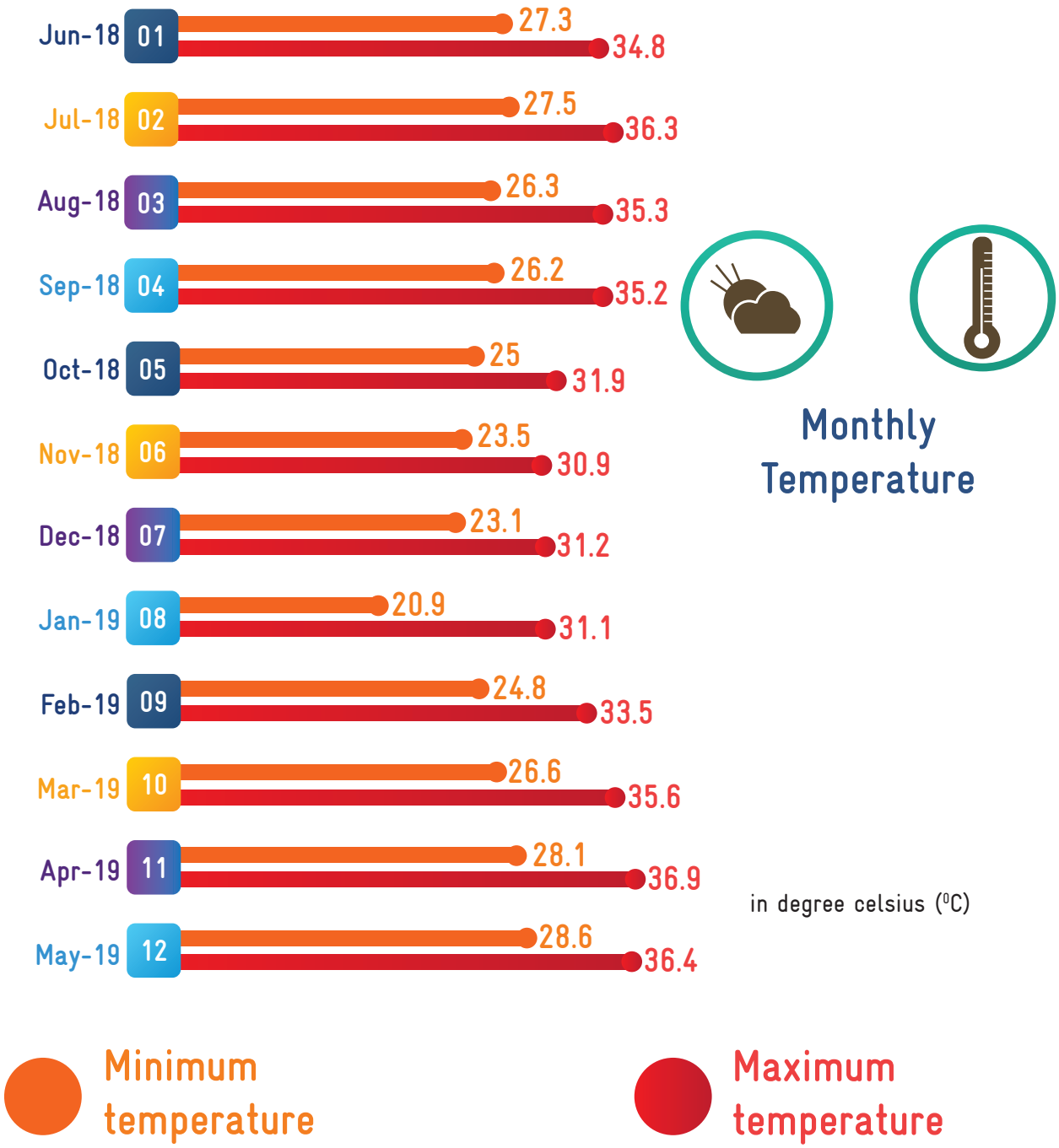


Figure 2.1. Monthly average maximum and minimum temperature

rainfall (WRIS, GoI) (Figure 2.2). The average annual rainfall days are 107 days in which a majority of 84 days are from NEM. Next to NEM, summer months have major rainy days of 10 days followed by 9 days in SWM and 4 days in winter months. The onset of NEM rainfall starts in the first week of October and ceases during the fourth week of December. In general, the humidity percentage ranges between 75% to 79%. The highest relative humidity percentage of 85% is recorded during the month of November and the lowest relative humidity percentage of 75% is recorded during the month of May in this southern zone.

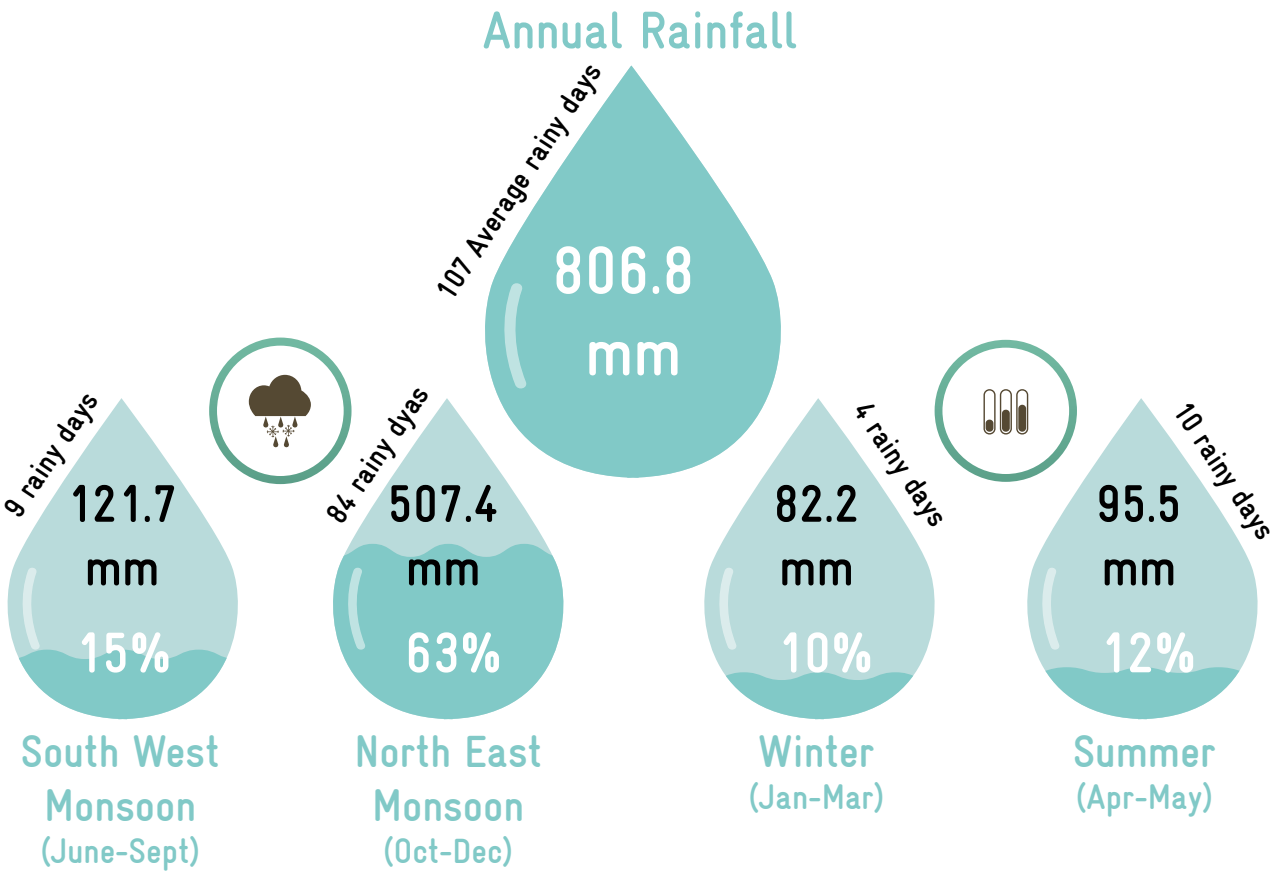


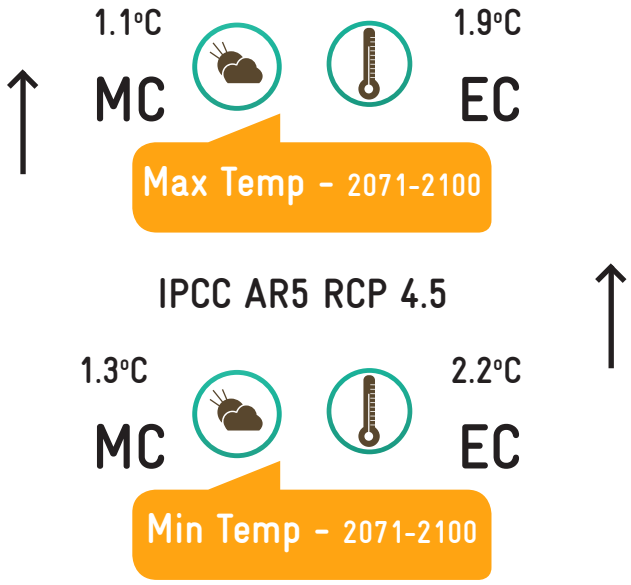
Figure 2.2. Season wise distribution to annual rainfall

In recent decades, the world has witnessed significant changes in its climate. These changes include increase in average temperature, variations in the rainfall intensity and its frequency. This region is also no exception, and 1.4°C and 0.4°C increase in maximum and minimum temperature was observed during 1951 to 2015 (IMD). The rainfall variability is also well observed. During 1951 to 2015, 18 deficient rainfall years (below normal rainfall) were recorded. The deficient rainfall years are highest among the rest of the districts of Tamil Nadu. Since this region is heavily dependent on NEM monsoon rains alone, the consecutive deficient rainfall leads to severe drought. As rainfall is the major source for determining water storage, existing water resources, major and minor tanks fail with deficient rainfall years.

The continuous assessment reports of Intergovernmental Panel on Climate Change (IPCC) cautioned that the changes in climate have a key role in intensifying and triggering extreme events, such as floods, droughts, heatwaves, and tropical cyclones, which are all likely to increase in the future also.

Recent IPCC Assessment Report 6 (AR 6) outlines that climate changes will increase in all regions of the globe over the coming decades and that even with 1.5°C of global warming, there will be increasing heat waves, longer warm seasons, and shorter cold seasons – which will become more intense at 2°C of warming.

Climate projection based on global climate models indicated that there would be 1.1°C increase in maximum temperature in mid-century (MC) period (2041-2070) and 1.9°C increase in end-century (EC) period (2071-2100) from the baseline scenario under RCP 4.5 climate scenario in this region. The minimum temperature would increase nearly 1.3°C and 2.2°C during MC and EC periods. Average annual rainfall for IPCC AR5 RCP4.5 scenarios is projected to increase about 1 percent towards MC to EC period.



The observed and projected climate changes will have serious impacts in the areas of :

* surface and ground water availability
* water quality
* soil moisture
* evapo-transpiration
* sea water intrusion

* 1.4°C increase in maximum temperature during 1951-2015
* 0.4°C increase in minimum temperature during 1951-2015
* 1.5°C increase in max temp during 2041-2070 (RCP4.5)
* 1.9°C increase in max temp during 2071-2100 (RCP 4.5)

Being a water scarce and drought prone region coupled with saline ground water, the changes in climate pose severe threats to dependent sectors such as agriculture and allied activities, industry, and livelihoods of people, particularly the vulnerable sector.

2.1 CLIMATE RISKS

Increasing temperatures, fluctuating rainfall patterns and its extremities creates shorter rainy seasons and longer dry seasons making the river basins more vulnerable. This District experiences frequent droughts, cyclones, floods, and storm surges. Being a coastal district, sea level rise is also a distressing issue under the changing climate scenario.

* Frequent Droughts
* Cyclones
* Flood inundation

Drought

Generally, this rain shadow region has a prolonged dry climate. Majority of the lands are rain fed which depends on monsoons especially NEM. Thus, frequent and consecutive monsoon failures (less than 40% of normal rainfall) coupled with the erratic behavior of the monsoon makes the District more vulnerable to droughts. This District experiences drought once in 3 years which impacts the ground water levels, reservoir levels, crop conditions, and soil moisture. Sandy soils in the region are more prone to severe drought. The District experienced consecutive droughts in recent decades particularly in 2003, 2009, 2016, 2017 and 2019. All parts are affected by drought and its consequences are large areas of crop losses and drinking water scarcity.

Cyclones

A tropical cyclone is a multi-hazard weather phenomenon, as it leads to heavy rainfall, gale wind and storm surge during the landfall. The winds, heavy rainfall and storm surge associated with the cyclone results in flooding of coastal areas, erosion, saline intrusion, loss of life, property, belongings, disruption of communication facilities, damages to agricultural and plantation crops and livestock etc., Being a coastal region, this District faces hazards due to cyclone forms in the Bay of Bengal. The 1964 Rameswaram cyclone was regarded as one of the most powerful storms to ever strike India on record and the worst to hit the District. In recent years, some of the tropical cyclones such as Burevi (2020), Gaja (2018) cyclones had its impacts here. This District also experiences storm surges exceeding 6m above the concurrent sea level.. Ministry of Earth Science, Govt. of India, prepared Cyclone hazard proneness of districts based on frequency of total cyclones, total severe cyclones, actual/estimated maximum wind strength, Probable Maximum Storm Surge (PMSS) associated with the cyclones and Probable Maximum Precipitation (PMP). The report indicates Ramanathapuram District is highly prone to cyclones. (Cyclone warning in India, IMD, and March 2021).

Flood

Though it is a low rainfall region, it experiences heavy rain and floods during deep depressions/cyclones form in the Bay of Bengal. State Disaster Management Authority (SDMA), Government of Tamil Nadu has identified 39 locations of Ramanathapuram District as flood vulnerability of medium category (inundation of water from 2 to 3 feet) based on past events (Ramanathapuram District Disaster Management Plan 2020-2021). Kangaikondan in Gangaikondan GP is one vulnerable location with medium flood vulnerability in Nainarkoil Block.

Sea level rise

Sea level rise (SLR) is one of the greatest challenges of the low-lying coastal regions of the world. Recent Intergovernmental Panel on Climate Change (IPCC) 2021 report cautioned that the average rate of SLR was 1.3mm/yr. (1901-1971) and rose by 03.7mm yr. (2006-2018), and it would continue to rise to 2 m by the end of the Century under a very high emissions scenario (SSP5-85 low confidence) (IPCC, 2021). IPCC cautions that coastal areas will get continued SLR throughout the 21st century, contributing to more frequent and severe coastal flooding in low-lying areas and coastal erosion. This coastal region will also face sea level rise and future SLR projection studies indicate that there would be 4.51 cm (low range)/ 7.21cm (medium range) increase for the year 2025 and it would be 30.29 (low range), 49.10 cm (medium range) under IPCC AR5-RCP 4.5 scenario (CCCDM, Anna University). In Ramanathapuram district, about 180 coastal habitations are identified for coastal vulnerability based on their distance from sea shore, soil erosion, and saltwater intrusion (Ramanathapuram District Disaster Management Plan 2021-2022). There are no habitations with coastal vulnerability in Nainarkoil Block.

2.2 WASCA CLIMATE VULNERABILITY INDICATORS

During 2019, WASCA TN conducted preliminary State level scoping study on the State's rural water security through the lens of climate and identified climate and water security hotspots/potential geographical areas for project demonstration through scientific criteria, jointly with the Centre for Climate Change and Disaster Management (CCCDM), Anna University. The vulnerability of a region to the climate depends on several intrinsic factors such as physical, social, economic, and environmental conditions. On the basis of the ground reality and accurate observations, WASCA TN study proposed 18 indicators to reflect the State's rural water security through four interconnected CWRM areas viz., climate extremities, water resources, agriculture and socio-economic to assess the climate-water vulnerability at the District level (Table 2).

TABLE 2. BIOPHYSICAL AND SOCIO-ECONOMIC INDICATORS USED IN VULNERABILITY ASSESSMENT

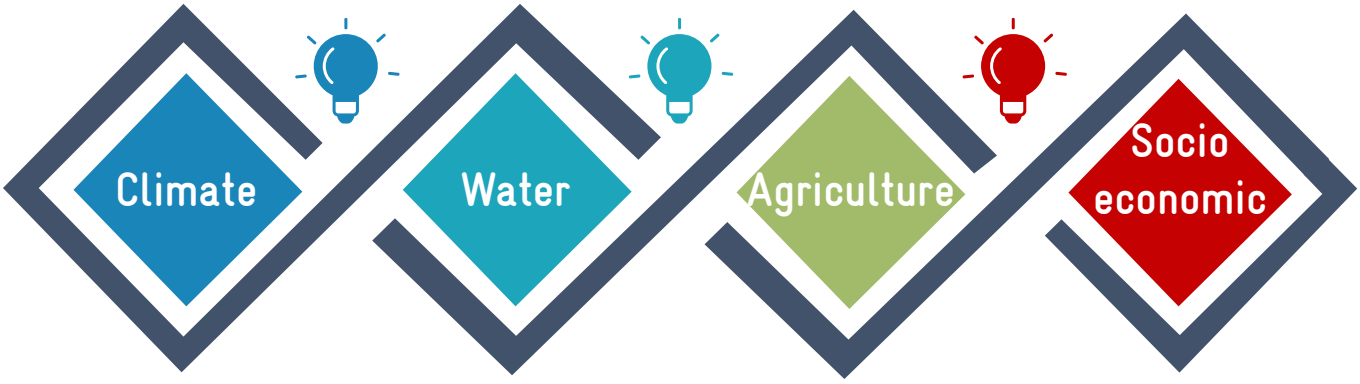
CWRM	Indicators of Rural water security vulnerability	Indicators label	Linked SDG
Climate	Changes in max temperature (^{O}C)	C1	Goal 13
	Changes in min temperature (^{O}C)	C2	
	Changes in rainfall (%)	C3	
	Excess rainfall years	C4	
	Deficient rainfall years	C5	
Water	Ground water extraction (%)	W1	Goal 6
	Ground water Recharge (m^3)	W2	
	Surface water availability (mm)	W3	
	Water gap (mcm)	W4	
	% of contamination	W5	
Agriculture	Rainfed area (%)	A1	Goal 15
	Cropping intensity (%)	A2	Goal 2
	Soil moisture (Kg/m^2)	A3	Goal 15
	Evapo-transpiration (Kg/m^2)	A4	
Socio-economic	Rural proportion (%)	S1	Goal 2
	Multidimensional poverty index	S2	Goal 1
	Source of drinking water within premises in rural (%)	S3	Goal 6
	Marginal farmers land holdings (%)	S4	Goal 1

Data for these 18 biophysical and socio-economic indicators were collected at the District level and categorized into exposure, sensitivity and adaptive capacity for the analysis. The vulnerability ranking was given based on IPCC protocol of vulnerability assessment methodology. Based on the analysis, Tiruvannamalai and Ramanathapuram Districts were selected by the State Level Steering Committee headed by the Secretary RD&PR in Nov 2019 for implementing the WASCA. Subsequently, all the key water actions, CWRM planning and implementation works were envisaged for the above two Districts through these influencing indicators collectively under four CWRM areas viz. climate, water, agriculture and socio-economic.

2.3 COMPREHENSIVE ANALYSIS OF BLOCK LEVEL VULNERABILITY

WASCA TN has progressed towards Block level climate vulnerability mapping in order to strengthen water resources and build context specific climate resilient models at GP level. The 18 vulnerability indicators at District level under four areas via climate, water, agriculture and socio-economic are further explored at the GP level through Composite Water Resource Management (CWRM) approach by GIZ, Department of Rural Development (Mahatma Gandhi NREGS), National Water Mission, Tamil Nadu along with three technical partners of WASCA project Viz., MS Swaminathan Research Foundation (MSSRF), Sugandhi Devadasan Marine Resources Institute (SDMRI), Prime Meridian and key sectoral experts. Based on the national level workshop on WASCA for GIS based planning using IWRM principles, a Composite Water Resources Management plan framework was customized to suit to Tamil Nadu State's conditions, including climate vulnerability as per the scoping study recommendations, Major CWRM parameters were thus identified under four areas via climate, water, agriculture and socio-economic for advancements towards actions. The major parameters identified at Block level (Table 3) are collected both from primary and secondary sources and analyzed statistically and geospatially.

TABLE 3. MAJOR PARAMETERS IDENTIFIED FOR BLOCK LEVEL VULNERABILITY ASSESSMENT



Climate	Water	Agriculture	Socio economic
Drought, Locations based on past disasters and vulnerability	Watershed and drainage network, traditional water bodies, canal networks, irrigation facilities, catchments area wise available runoff, ground water and surface water utilization, ground water status, ground water availability, evapo-transpiration losses, and water demand for drinking, agriculture and livestock, water quality, sea water mixing and salinity	Land resources, land use under different categories, catchment area, means of water extraction, irrigation methods, crop details, status of soil resources including macro and micro nutrients, soil physical condition, soil moisture, and livestock details	Area, population, gender, vulnerable population and household, details of MGNREGA job seekers, drinking water sources and grey water generation

ஏரின் உழாஅர் உழவர் புயலென்னும்
வாரி வளங்குன்றிக் கால்

குறள் - 14

Unless the fruitful shower descend
The ploughman's sacred toil must end

Thirukkural - 14

CHAPTER 3

GRAM PANCHAYAT PLANNING IN MAHATMA GANDHI NREGS

3 GRAM PANCHAYAT PLANNING IN MAHATMA GANDHI NREGS

WASCA, GIZ has evolved a GP based CWRM planning approach for facilitating convergent planning under Mahatma Gandhi NREGA as per the recommendations of National Level Workshop organized by MoRD, MoJS, GIZ along with State Rural Development Department of WASCA implementing states in February 2020. While developing the framework, inputs from all the relevant stakeholders including communities, public institutions, civil society, research organizations, and private agencies were taken into consideration. Both the Annual Master Circular issued by MoRD during 2021-22 and the Annual Planning Circular issued in September 2020 focused on developing GIS based planning in all Gram Panchayats. The planning exercise for Mahatma Gandhi NREGS will be a part of the convergent planning exercise for the Ministry. The thrust is on planning for works related to Natural Resource Management (NRM), agriculture and allied activities and livelihood related works on individual lands leading to sustainable livelihoods as well as provisioning of livestock shelters for the individual households. The NRM related works under Mahatma Gandhi NREGS shall be taken up in convergence with Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), Integrated Watershed Management Programme (IWMP) and Command Area and Water Management (CAD&WM) schemes for better outcomes of the water conservation and water harvesting measures. Technical inputs for planning shall be drawn from the technical resources available in the District under Mahatma Gandhi NREGS, CSO partners and other line department agencies. In case of planning for NRM works, the technical inputs will be drawn from the joint pool of technical personnel of IWMP in Watershed Cell cum Data Centre (WCDC), Mahatma Gandhi NREGS unit, Water Resource Department and the Agriculture Department. The technical inputs relating to Excavation, Renovation & Modernization (ERM)/ water bodies may also be sought from Regional Office of Central Ground Water Commission (CWC). The Gram Panchayats, while deliberating and finalizing prioritization of shelf of projects, will keep in perspective the macro and micro-watersheds of 500-1000 hectares that often comprise of 1-10 Gram Panchayats.

Special focus is given to vulnerable households and communities and are considered while preparing estimates for anticipated demand, list of works on individual lands, and list of other works that provide direct individual benefits. The Convergent Planning Exercise shall make use of automatically included and deprived Households of SECC to ensure full coverage of poor and vulnerable households. Infrastructure built under Mahatma Gandhi NREGS leads to increased water availability for irrigation, groundwater recharge, increased agricultural production, and carbon sequestration. The Ministry of Environment, Forest and Climate Change recognizes Mahatma Gandhi NREGA as one of the 24 key initiatives to address the problem of climate change, while simultaneously improving the livelihoods of the poor, particularly the 'Category A' activities, which are public works relating to Natural Resource Management. Planning and design of works under Mahatma Gandhi NREGS should take into account, impacts of climate change in order to ensure resilience of vulnerable rural communities and make the benefits sustainable in the long run.

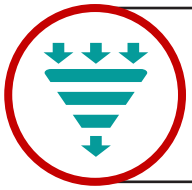
262 Total Kinds of works in Schedule-I of Mahatma Gandhi NREGA

182 Kinds of works relate to NRM alone

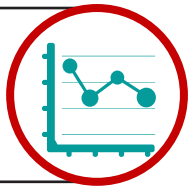
164 Kinds of works related to Agriculture & allied works

85 Water related works out of NRM

In pursuance of Schedule-I of Mahatma Gandhi NREGA, 262 kinds of works/ activities have been identified as permissible works, of which 182 kinds of works relate to NRM alone and out of the 182 NRM works, 85 are water related. 164 of the total works are related to Agriculture and allied works. The works taken up under Mahatma Gandhi NREGS should change from taking up individual, standalone works in a typical 'relief works mode' to an INRM perspective. Planned and systematic development of land and harnessing of rainwater following watershed principles should become the central focus of Mahatma Gandhi NREGS work across the country to sustainably enhance farm productivity and income of poor people. Even the works on private lands should be taken up following the principles of watershed management in an integrated manner. To facilitate evidence based scientific NRM planning process, Technological support shall be taken from National Remote Sensing Centre, ISRO for identification and holistic planning of permissible works to be taken up in the watersheds using GIS Technology (BHUVAN). The GIS plans shall be comprehensive ones incorporating all eligible works under Mahatma Gandhi NREGS and the same shall be implemented in a phased manner. Section 22 of the Annual Master Circular provides the key steps for GIS based planning.



The Geographical Information System (GIS) plans shall be comprehensive ones incorporating all eligible works under Mahatma Gandhi NREGS and the same shall be implemented in a phased manner.

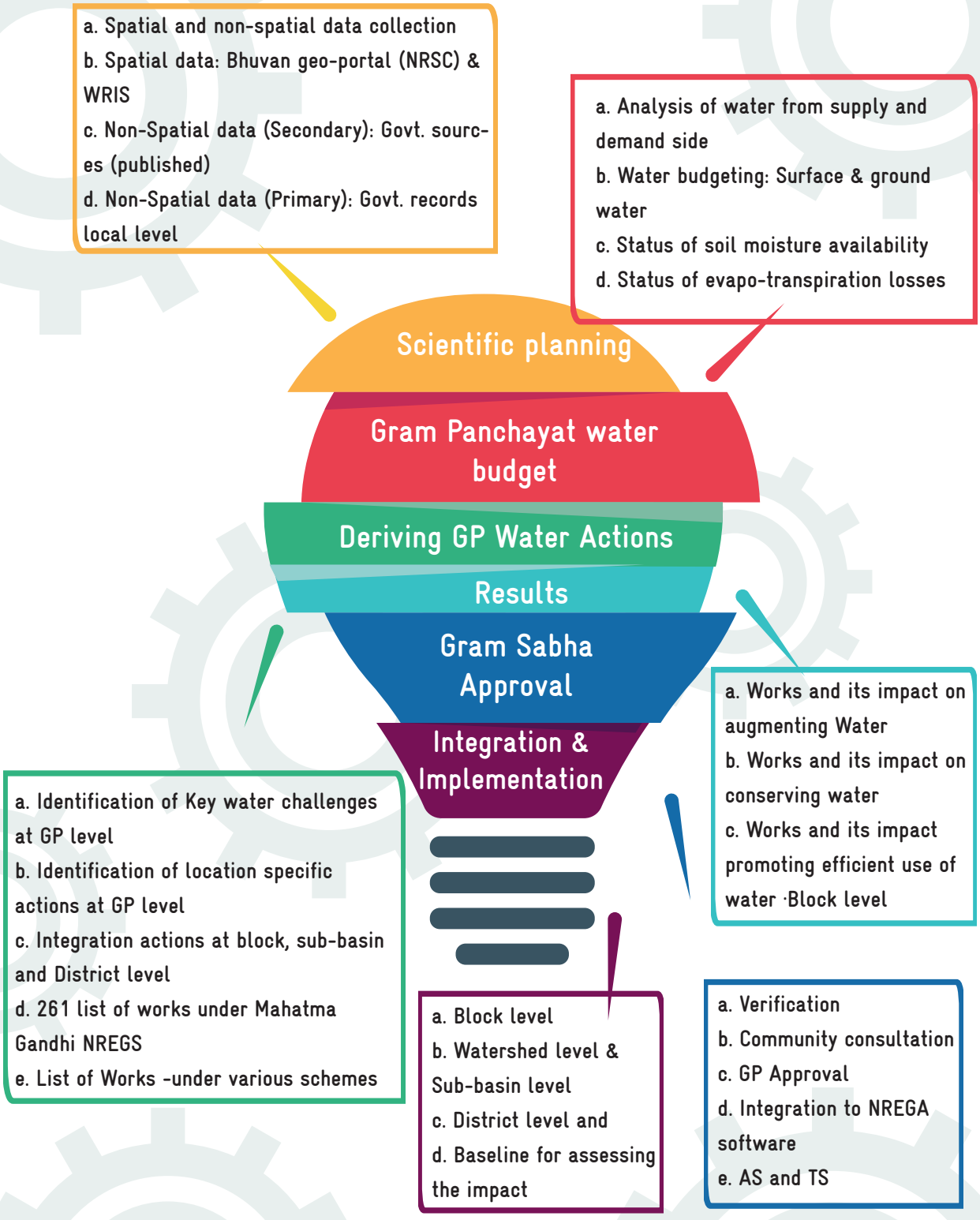


3.1 COMPOSITE WATER RESOURCE MANAGEMENT APPROACH

CWRM approach for Water Security and Climate Adaptation uses simple scientific tools that can help Block or GP level officer to organize, analyze and prepare a draft plan for participatory discussion at the Gram Panchayat level. This approach involves analyzing key water challenges using both non-spatial and geo-spatial data in GIS (Geographical Information System) coupled with extensive ground truth verification. The non-spatial data includes socio-economic, climatic, hydrological, edaphic and agricultural areas which are concurrently used for analysis along with the spatial data obtained from remote sensing in GIS platform. It starts with mapping of the administrative (habitations/panchayat/ revenue village, Block/taluk), agro-ecological (regional and sub-regional, climatic and agricultural zonation's) and hydrological (drainage points/watersheds/sub basin) units keeping Gram Panchayat as the lowest unit of planning and execution. Following this, a detailed socio-economic profile was mapped covering male/female population, proportion of SC and ST population, vulnerable households, access to employment in Mahatma Gandhi NREGS and proportion of works carried out in the village through amount of budget utilized as well as actual works completed. The climatic parameters including maximum and minimum temperature, season-wise rainfall and rainy days, evapo-transpira-

tion and soil moisture are used to understand the climate related issues. Lastly, Land use, watersheds, drainage networks and surface runoff, existing water supply and storage systems, water management for the key sectors and water demand are assessed to prepare the water budget for the GP (Box 1).

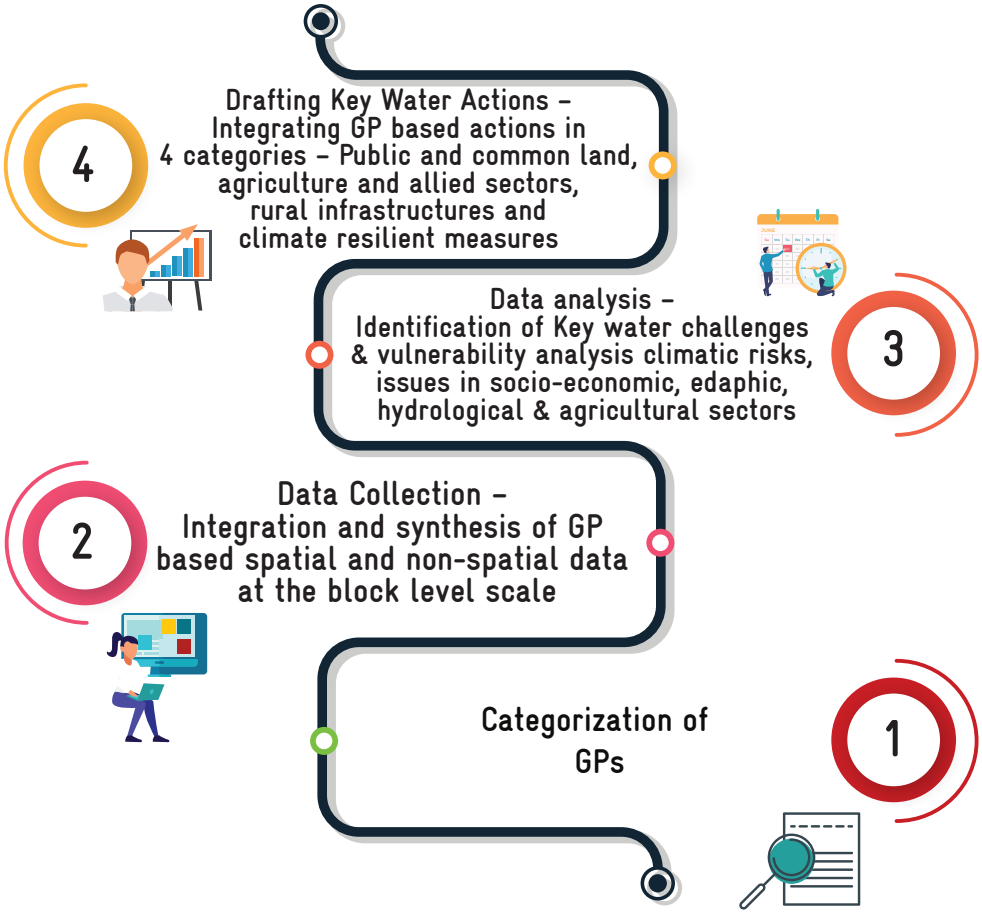
BOX 1. MAJOR COMPONENTS INVOLVE IN CWRM PLANNING WORKOUTS



Such a comprehensive analysis in preparing the water budget integrating ground water, surface water through runoff from rainfall, evapo-transpiration and soil moisture helps to identify potential areas of action to augment the water resources in public and common land, agriculture and allied sectors and rural infrastructure dimensions. The analysis also helps to understand the areas of interest and appropriate climate resilient measure as an adaptive measure to the emerging climate change scenarios. The water challenge linked water actions are the key to developing the perspective plan for the water secured GPs, and serve as shelf of projects. The shelf of projects are again mapped with the available schemes and financial plans for execution, adopting convergence and inter-sectoral principles. In the execution process the District level technical and administrative teams are involved in planning, monitoring and evaluation in terms of outcome/impact mapping. In the execution stage, the approach of saturation of works, planning at watershed approach (ridge to valley), and convergence is some of the key aspects which needs attention for tangible outcomes in both Natural Resource Management as well as livelihoods.

The District WASCA resource centers established in the project area, facilitates this whole process for planning and implementation. This comprehensive and integrated approach has been accepted nationally and by state governments as a comprehensive and climate adapted planning approach for water security. The whole process has been categorized in to four stages – pre planning, planning, review and verification and integration and approval (Box 2).

STEPS INVOLVED IN BLOCK LEVEL ANALYSIS THROUGH CWRM APPROACH



This integrated approach has been accepted by National, State, and District Level Steering Committees headed by Additional Chief Secretary RD&PR and District collector respectively in the project area of Tamil Nadu government as a comprehensive and climate adapted planning approach for water security under Mahatma Gandhi NREGS and National Water Mission.

BOX 2. STAGES OF CWRM PLANNING PROCESS

PRE-PLANNING STAGE

1. Categorizing GPs for planning as per Mahatma Gandhi NREGS guidelines
2. Human resource and capacity building at administrative levels for planning facilitation
3. Capacity Building of State, District level officers towards implementing the Mahatma Gandhi NREGS
4. Building District specific CWRM framework and indicators suitable to the terrain and geography
5. Identification of Phases for pre pilot GPs for planning (4 GP Plans per Block) as per DLSC and SLSC

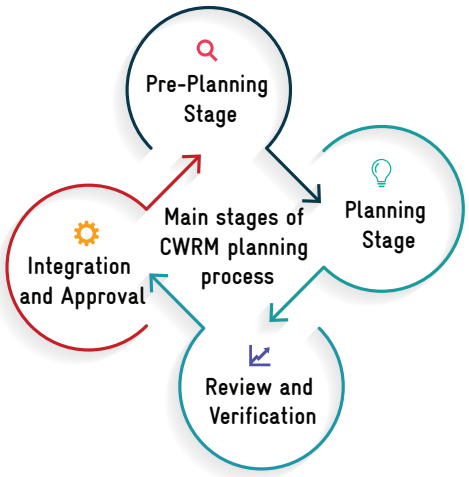
PLANNING STAGE

1. Collection on Non-Spatial statistical data as per MoRD guidelines and CWRMP
2. Collection of Spatial as per MoRD guidelines and CWRMP
3. Water Budget Estimation (as per CWRMP guidelines)
4. Conducting district specific studies on Ground Water Assessment as per CWRM
5. Inclusion on Non-NRM activities under Mahatma Gandhi NREGS with CWRMP
6. Identification of Key Water Challenges - CWRMP
7. Identification of Key Water Actions -CWRMP

FOUR LEVELS OF CWRM PLANNING UNDER WASCA

1. DEVELOPING PLANS AT LOWEST ADMINISTRATIVE LEVEL: GP LEVEL PLANS

2. INTEGRATING GP LEVEL PLANS AT BLOCK LEVEL



FOUR LEVELS OF CWRM PLANNING UNDER WASCA

3. INTEGRATING GP PLANS AT WATERSHED AND SUB-BASIN (CATCHMENT) LEVEL ON NRM

4. INTEGRATING GP PLANS TO DEVELOP WASCA DISTRICTS CWRM PLANS

INTEGRATION AND APPROVAL

1. Preparation of Integrated plans (at Block, Watershed levels)
2. District Level WASCA Plan
3. Approval at GP level for preparation of Labour budget using CWRM frame work outcomes
4. Approval of District plan at DLSC as per above recommendations of GP level
5. Submitting approved District WASCA plan from DLSC to SLSC for financing and convergence

REVIEW AND VERIFICATION

1. Matching spatial data as per Mahatma Gandhi NREGA- MoRD guidelines on GIS based planning
2. Field Verification, GP level Meetings for inclusion in labour budget 2021-22
3. Approvals of verified works at GP by the Block and GP level officers implementing Mahatma Gandhi NRGES
4. Integrating verified, approved works into NREGA soft (MORD NIC Portal) for mainstreaming WASCA
5. Regular review on progress at each level

3.2 CATEGORIZATION OF GPs

The CWRM uses both spatial and non-spatial data for developing GP level plans. Most of the non-spatial data are available at the revenue village level. To synchronize planning at GP level, keeping data availability and administrative boundaries for GIS planning, the GP's of the Block are categorized based on revenue village boundaries, for collecting and organizing the datasets. Based on the above factors, five different types of GPs are classified as Type I, II, III, IV and V. The description of categorization of GP's is given in Annexure 1. Details of categorization of GPs in Nainarkoil Block is tabulated in Table 4.

TABLE 4. CATEGORIZATION OF NAINARKOIL BLOCK GPs

NUMBER OF GP	GP TYPE	NAME OF THE PANCHAYAT
25	GP and revenue village data and boundary match (Type-I)	A. Panaiyur, Anjamadai, Arasanur, Ariyankottai, Kiliyur, Attangudi, Kottakudi, Koluvur, Manakudi,Kullathur, Mummudisathan, Thavalaikulam,Pottagavayal, Sadurvedamangalam, P.Kodikulam, Vagavayal, Vallam, Thalayadikottai, Thenthangal, Pandiyur, Perungalur, Nagaramangalam,Nagaram, Siruvayal, Thiyagavanseri
7	Having more than one GPs in one Revenue Village (Type-II)	Vaniyavallam, Nainarkoil, Radhappuli, Keelakavanoor, Siraikottai, Pagaivendri, Kalliyadiyendai
1	One GP is falling under more than Type 1 one Revenue Village (Type III)	Padappanendal
4	GPs having more than one GP, one Revenue Villages data, boundary (Type-IV)	Karadaranthakudi, Vadavaneri, Gangaikondan, Akkiramesai

3.3 DATA COLLECTION – SPATIAL & NON SPATIAL

The CWRM planning framework has four vulnerability areas, integrating both non-spatial and spatial parameters with 18 indicators based on the IWRM and climate adaptation principles. The planning process comprises of the following dimensions in a scientific and organized manner to prepare a meaningful plan at the lowest administrative unit i.e. GP plans.

SPATIAL DATA

The spatial datasets are supportive evidence to understand the existing conditions and issues in the area/ region. Considering the spatial datasets such as morphology, ground water potential, slope terrain, erosion, Land Use and Land Cover (LULC), waste land, salt and erosion affected lands, drainage lines, and slope will play a significant role in contributing to preparation of the most appropriate and suitable science-based decision plans towards holistic development of the region, emphasized with the water actions. The use of different spatial data to assess and confirm the key water challenges along with the non-spatial data is discussed below.

NON SPATIAL DATA

- Characterization of catchment landscapes based on the ten-fold land use classification to know available land area in both public and individual land ownership and its current position in terms of available area and use, its links with surface runoff as good, average and bad runoff

- Watershed based analysis is to understand the hydrological and administrative boundaries. This aids in understanding the profile and condition of the watershed at macro or micro level for planning relevant water actions

- Soil characteristics including the macro and micro nutrient status, physical quality of the land using pH values and textural soil quality to understand its permeability, infiltration and water holding capacity which are crucial for soil moisture content

- The agriculture and livestock datasets help in understanding the quantum of water requirement of the key crops and type of cropping systems adopted, number and type of different livestock resources and its water requirement vis-a-vis its linkage to livelihoods of the vulnerable population in the village

- Grey water generation at GP level to understand the quantum of grey water available and existing methods of its use. This information is essential to plan effective strategies for recycle and reuse

- Water budgeting at GP level to demonstrate the sector wise water demand and available water through the traditional water harvesting and storage bodies and the potential runoff that can be conserved through appropriate actions on the supply side. The difference between demand and supply at the GP level helps the communities to understand the gap and practice the necessary water actions

ASSESSMENT OF GROUND WATER QUALITY AND SEA WATER INTRUSION

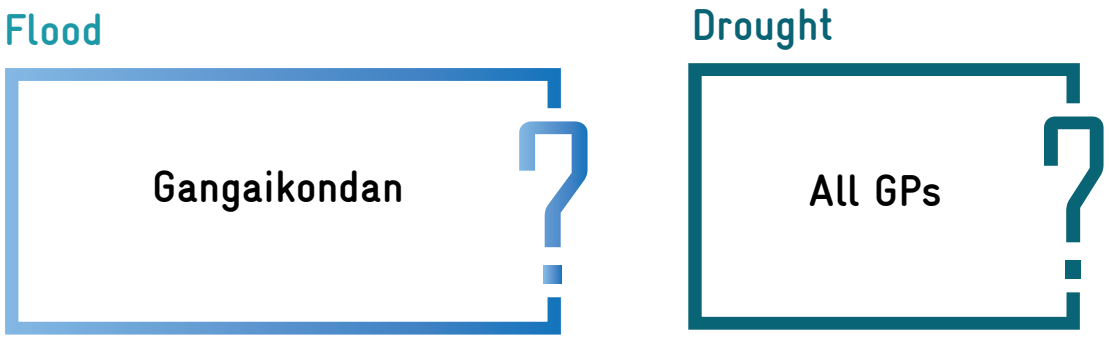
The vulnerability of the groundwater quality, seawater intrusion in the aquifers were assessed and spatially mapped for Ramanathapuram District. The water quality samples were collected from 380 locations throughout the District during pre-monsoon and post-monsoon season. The collected samples were analyzed using standard methodology for calculating Water Quality Index (WQI) and Seawater Mixing Index (SMI). This data helps to identify the suitability of water for domestic purpose and to detect the concentration of major ionic constituents in seawater at GP level.

Over all, data from 102 parameters were collected, out of which 16 parameters are from primary source, collected from GP administrative units by GPs officers, 65 parameters are from secondary source, collected from Govt. sources and authentic websites and the remaining 21 requisite parameters for water budgeting and grey water were calculated using standards/suitable methods or formulas. CWRM parameters and its data sources is attached in Annexures 3.1 to 3.3. The methods, formulas used for water budgeting is attached in Annexure 3.4 and for grey water generation in Annexure 3.5. The water quality standards and formula used are in Annexure 3.6.

3.4 CWRM PLANNING ANALYSIS – CLIMATE

All the CWRM parameters are intended at Block level. On the other hand, all the climate change observations and projections are at District or regional level. Current data at the Block level is not available at present. Hence, previous hydro-meteorological disasters are considered to denote the Block's flood and coastal vulnerability which was assessed by State Disaster Management Agency, 2020 is given in Table 5.

TABLE 5. CLIMATE RISKS AND VULNERABLE GP's



3.5 CWRM PLANNING ANALYSIS – WATER

For effective planning, the available traditional water storage and conveyance structures along with its supply and demand status for different sectors at the Block level is necessary. Both spatial and non-spatial data including details and status on watershed and drainage network, canal network, irrigation facilities, catchments area wise available runoff, conserved runoff, present ground water extraction, water demand for domestic, agriculture and livestock, ground water utilization for domestic, agriculture and livestock are collected from authorized open sources and analyzed at the Block level.

3.5.1 SPATIAL DATA

Spatial data of geomorphology, lineament, terrain, slope drainage network, surface waterbodies, ground water potential, and watershed were collected to understand the site-specific problems and together with non-spatial data, take decisions to draft scientific key water actions. Available Bhuvan source thematic spatial maps/website view was referred to understand, interpret and analyse the spatial parameters of the Block.

3.5.1.1 Geomorphology: Geomorphology deals with the scientific study of "landforms and landscapes, including their description, type, and genesis". Landform is the end product resulting from the interactions of the natural surface genesis and the type of rock. The scope of geomorphology was further expended with landform maps, which are widely used in various fields of hydrology, pedology, geoscience, urban and regional planning etc. Nainarkoil Block is engrossed with costal origin landform units (Figure 3.1). Costal landforms are further classified based on the landform age and its characteristics including biodiversity existence such as older deltaic plain, young coastal plain and coral reef. GP-wise detailed view of the landforms with area in percentage is shown in the illustration below. This fundamental information of landforms by its units will act as a critical input while identifying suitable sites for NRM activities under CWRM plan preparation.

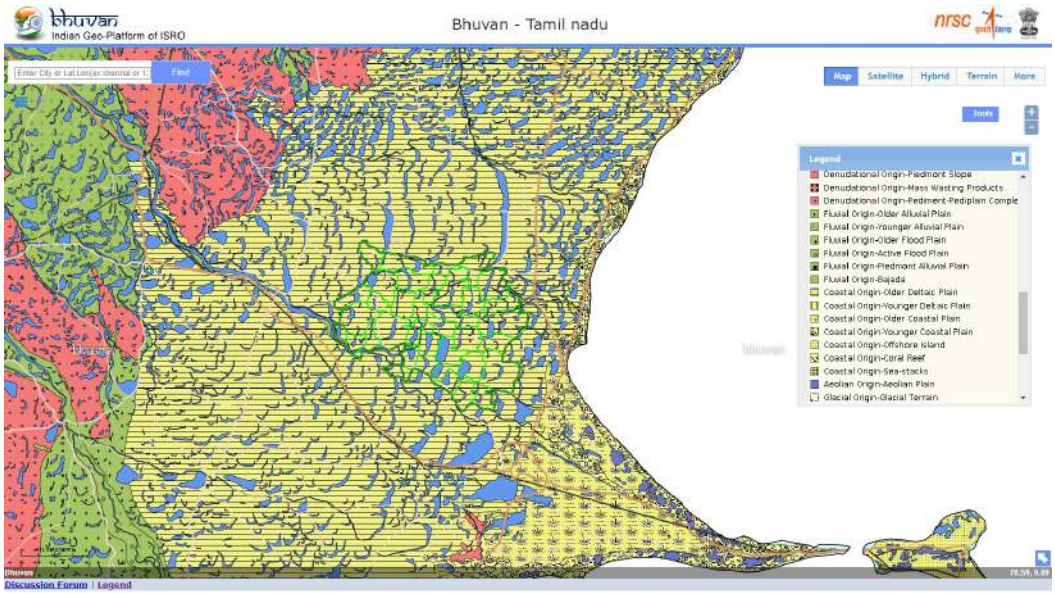


Figure 3.1. Geomorphology map

Landform unit	Area coverage in %	Gram Panchayat
Coastal Origin - Older Deltaic Plain		
	100%	A. Panaiyur, Akkiramesi, Anjamadaikatchan, Arasanur, Ariyankottai, Attangudi, Gangaikondan, Kalliyadiendal, Karadaranthakudi, Keelakavanur, Kiliyur, Koluvur, Kottakudi, Kulathur, Manakudi, Mummudisathan, Nagaram, Nagaramangalam, Nainarkoil, P Kodikulam, Pagaivendri, Pandappanendal, Pandiyur, Perungalur, Pottagavayal, Radhappuli, Sadurvedamangalam, Sirakikottai, Siruvayal, Thalayadikottai, Thavalaikulam, Thethangal, Thiyagavanseri, Vadavaneri, Vagavayal, Vallam, Vaniyavallam

3.5.1.2 Lineament: The lineament is also a lithological unit which reveals the hidden architecture of rock basement, representation of an underlying geological structure such as a fault, fracture (Figure 3.2). Lineament plays a significant role in identification of ground water and oil exploration sources. Lineament is represented with linear feature where two different landforms converge or diverges. This site allows water to percolate at a high rate. GP wise lineament type is illustrated in the table below. These observations are widely used to locate points of high-water flow especially in groundwater exploration.

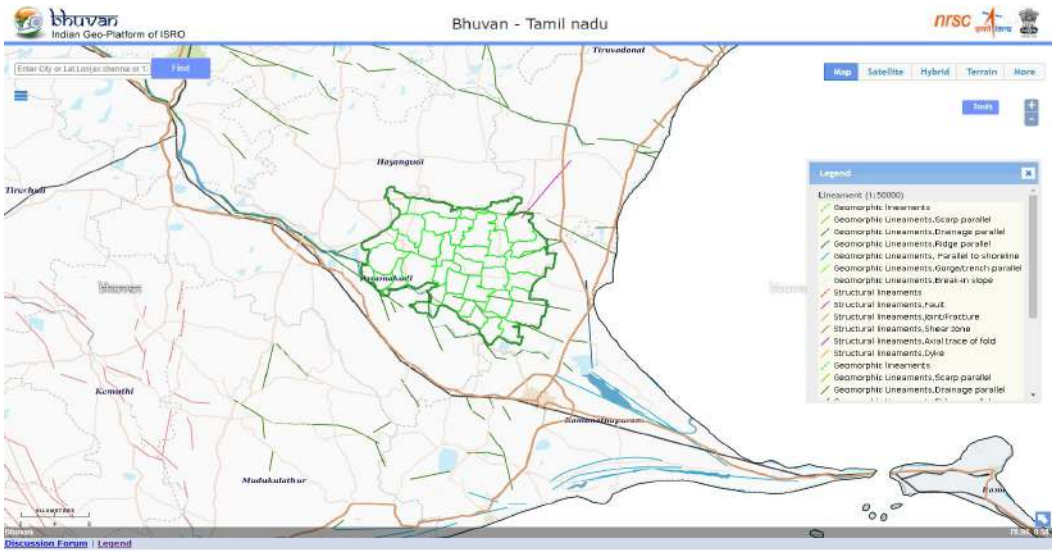


Figure 3.2. Lineament map

Lineament type	Gram Panchayat
Geomorphic lineaments, Drainage parallel	A. Panaiyur, Gangaikondan, Siruvayal, Thethangal, Thiyagavanseri, Pottagavayal Mummudisathan
Structural lineaments, Fault	Attangudi

3.5.1.3 Terrain: The terrain map gives information related to elevation from above sea level. A terrain of same range is noticed in the Block area at the available scale map (Figure 3.3). This map will be useful in identification of better sites suitable for proposing water and soil conservation related activities.

Figure 3.3. Terrain map

3.5.1.4 DEM: The DEM is the important element in the representation of the terrain and only one which determines relief forms such as valleys and hills, and the steepness or gentleness of slopes geometrically. The map plays a vital role in delineation of watershed and its units, used in planning and identifying recharge structures, farm ponds and construction of grey water drain network etc., (Figure 3.4).

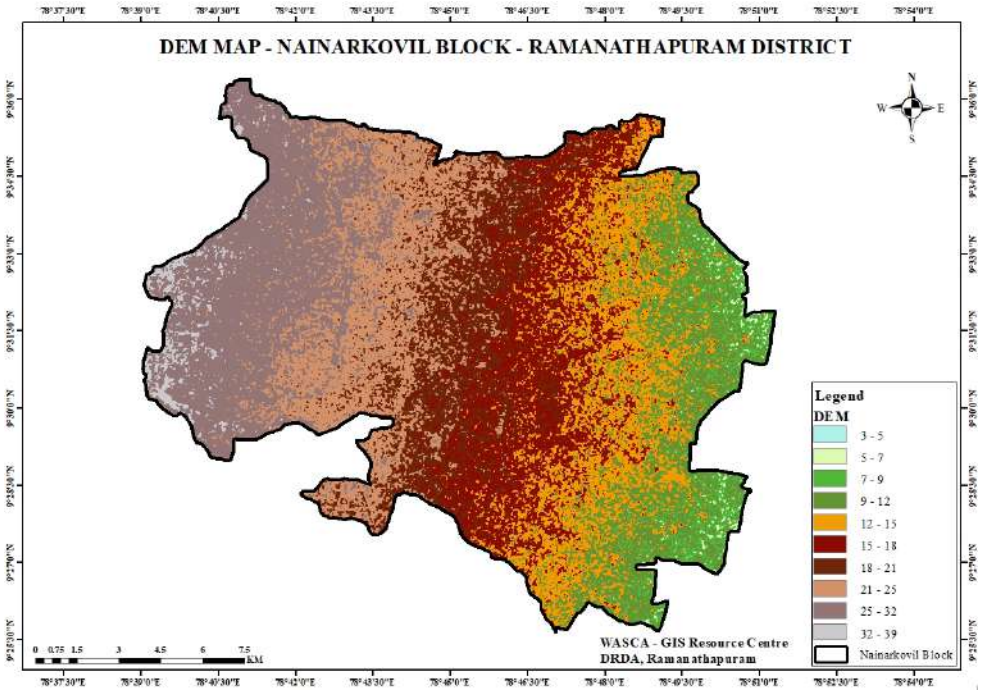


Figure 3.4. DEM map

3.5.1.5 Slope: The average slope of a terrain feature is calculated from contour lines on a topology map or DEM. Slope is typically expressed in percentage, angle, or in ratio. Slope map illustrates the measure of steepness or the degree of inclination of a feature relative to the horizontal plane. Very flat (0 - 1%) and flat (1 – 3 %) slope ranges are noticed in the Block (Figure 3.5). Details of GP-wise slope area in percentage is shown in the illustration below. Slope information plays a significant role in identification of soil eroded sites, depth profiles and also used in analysing / proposing soil conservation measures such as check dam, bunding land development, farm ponds etc.

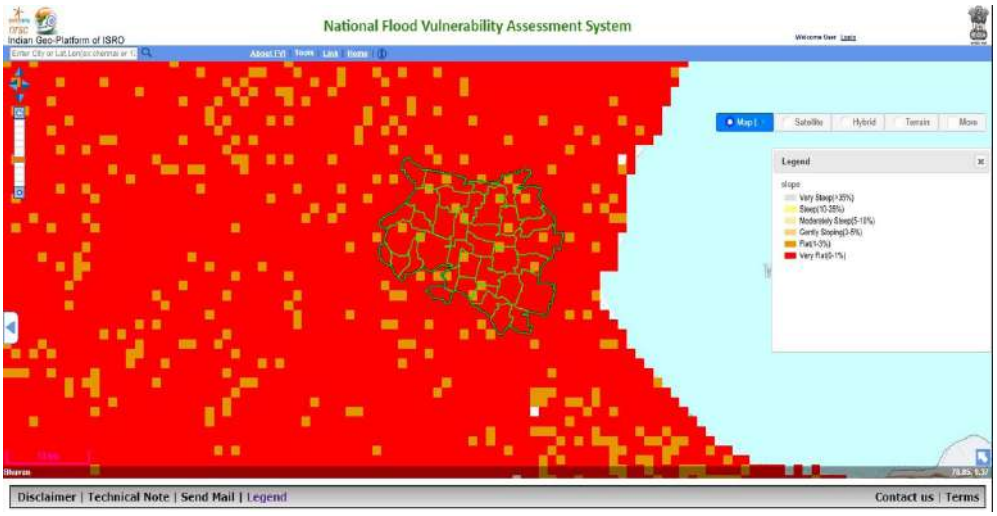


Figure 3.5. Slope map

Slope range	Area in %	Gram Panchayat
Very Flat (0-1%)	94%	A. Panaiyur, Anjamadaikatchan, Gangaikondan, Kalliyadiendal, Keelakavanur, Koluvur, Kulathur, Nainarkoil, Pagaivendri, Pandappanendal, Perungalur, Siruvayal, Thethangal, Vadavaneri, Vagavayal, Vaniyavallam - 100%, Akkiramesi, Kiliyur, Mummudisathan, Nagaramangalam, P Kodikulam, Pandiyur, Thalayadikottai, Thavalaikulam - 95%, Karadaranthakudi, Kottakudi, Nagaram, Thiyagavanseri, Vallam - 90%, Manakudi, Sadurvedamangalam - 85%, Attangudi, Radhappuli - 75%, Ariyankottai - 65%
Flat (1-3%)	18%	Arasanur, Pottagavayal - 80%, Ariyankottai - 35%, Attangudi, Radhappuli - 25%, Arasanur, Pottagavayal - 20%, Manakudi, Sadurvedamangalam - 15%, Karadaranthakudi, Kottakudi, Nagaram, Thiyagavanseri, Vallam - 10%, Akkiramesi, Kiliyur, Mummudisathan, Nagaramangalam, P Kodikulam, Pandiyur, Thalayadikottai, Thavalaikulam - 5%

3.5.1.6 Drainage Network : The drainage network pattern of a region is particularly dependent on the lithological characteristics, regional slope, structural control, climate condition etc. It is noticed that very less dense drainage network and lower order streams flowing towards Bay of Bengal (Figure 3.6). Drainage network is referred to while identifying suitable sites for soil and water conservation measures such as dams, ponds, bunding, restoration of gullied region etc.

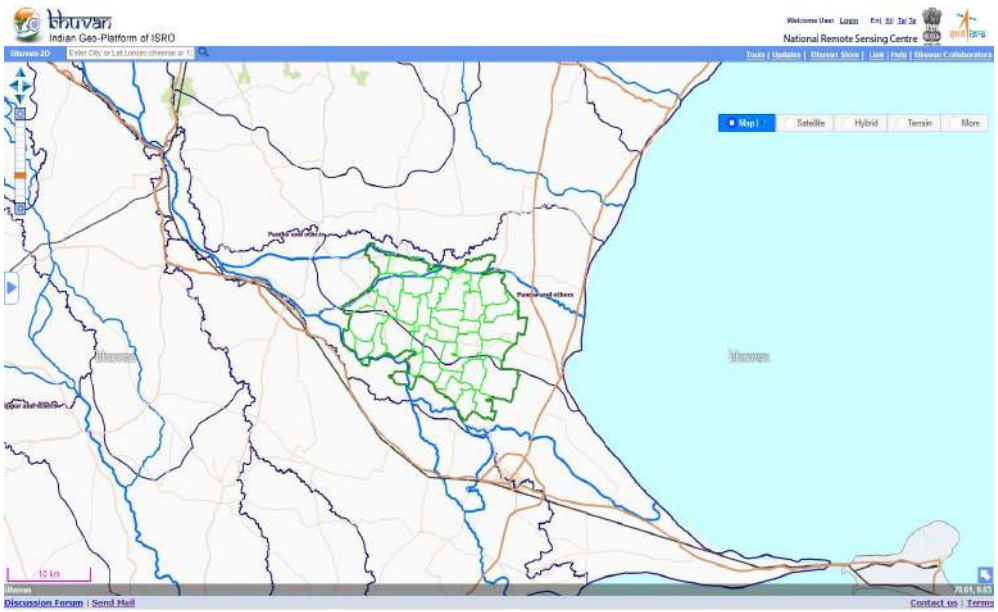


Figure 3.6. Drainage network

3.5.1.7 Watershed: Implementation of any water management measure requires a suitable hydrological unit. A properly delineated watershed forms a convenient hydrological unit for computation of water balance parameters and thus implementation of water management schemes. Also, in achieving a better sustainability in development mainly NRM at the grass root level, watersheds are recognized as viable and effective management units and adopted in most of the developmental programmes such as IWMP, MGNREGA etc. A watershed is the area/region of land where all of the water that falls in it and drains off goes into the common outlet. Nainarkoil Block watershed map is illustrated in Figure 3.7. Watershed is used for the interventions based on Ridge to Valley (R2V) concept and sequencing the plan accordingly. R2V approach intends to conserve each drop of rain water from ridge to a reasonable extent and it ensures the better surface water flow management and also aids in strengthening the durability of land, soil and water conservation structures in downstream.

Figure 3.7. Watershed map

3.5.1.8 Ground water perspectives: Ground water is one of the important natural resources in a semi-arid region like Nainarkoil Block. The ground water perspectives map is the integration of lithology, geomorphology, geological structures, hydro geomorphic datasets, which provides the required information related to ground water exploration and the probable ground water prospects. This map will help in identification of tentative locations for construction of recharge structures. In the Block area, ground water is available from 30 m (Figure 3.8). The GPs wise detail of GW prosperity is shown in the illustration below. This specific information will play a crucial role in identifying sites for recharge structures in order to address water scarcity issues in the Block.

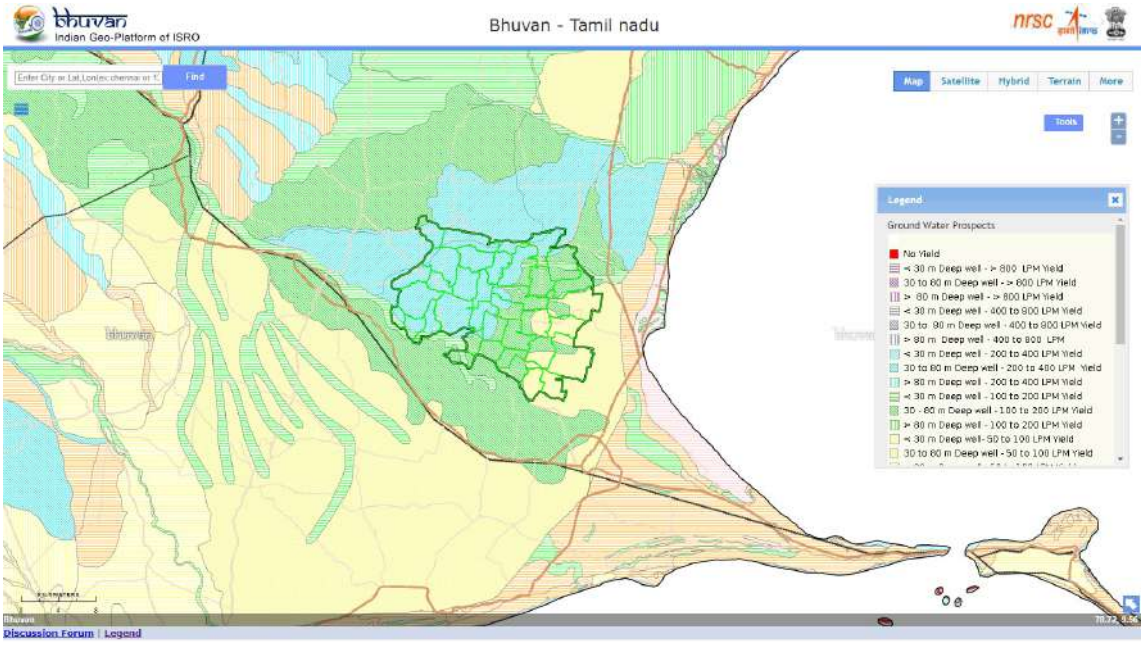


Figure 3.8. Ground water perspective map

Groundwater Prospects	Area in %	Gram Panchayat
<30 Deep Well-200 to 400 LPM Yield	77%	Akkiramesi, Vadavaneri, Nagaramangalam, Thavalaikulam, Anjamadaikatchan, Karadaranthakudi, Radhappuli, Thalayadikottai, Nainarkoil, Vaniyavallam, Vallam - 100%, Pandappanendal, Keelakavanur - 95%, Ariyankottai - 80%, Sirakikottai - 70%, Kalliyadiendal - 65%, Sadurvedamangalam, Nagaram - 60%, Pagaivendri - 50%, Koluvur - 45%, Kottakudi - 30%, Pandiyur, Attangudi - 15%
30-80m Deep well - 100 to 200 LPM Yield	64%	Mummudisathan, Manakudi, Kiliyur, Thiyagavanseri - 100%, Attangudi, Vagavayal - 95%, Gangaikondan - 90%, Kottakudi - 85%, Pandiyur - 75%, Koluvur - 55%, Sadurvedamangalam - 50%, Nagaram, P Kodikulam - 45%, A. Panaiyur - 40%, Pottagavayal - 30%, Siruvayal - 25%, Ariyankottai - 20%, Kulathur - 5%
30 to 80 m Deep well - 50 to 100 LPM Yield	71%	Perungalur - 100%, Kulathur - 95%, Arasanur, Siruvayal, Pottagavayal - 80%, P Kodikulam - 55%, A. Panaiyur - 40%, Thethangal - 25%
<30 m Deep well -100 to 200 LPM Yield	17%	Pagaivendri - 45%, Kalliyadiendal - 30%, Sirakikottai - 25%, Gangaikondan - 20%, Attangudi - 15%, Nagaram, Ariyankottai, Kottakudi, Pottagavayal - 5%

3.5.2 NON SPATIAL DATA

Water resource based non-spatial secondary data related to irrigation facilities such as canal, traditional waterbodies, water quality, demand and supply were collected from Govt. sources (Table 6). GP wise current water resources status and its supply and demand side are shown in Annexure 3.7.

TABLE 6. CWRM PARAMETER BASED WATER RESOURCES STATUS IN THE BLOCK

Canal Network	Extent
Canal Network (m)	
Length of Main Canal	1,21,450
Length of Minor Canal	6,628
Length of Distributaries	1,000
Water Courses (Field Channels)	36,854
Traditional Water bodies (No.)	
Tanks (PWD & Union) (No.)	71
Ooranis (No.)	282
Irrigation Facilities (ha)	
Tank Irrigation	3,570
Open & Tube Well Irrigation	9,140
Catchment Area wise Available Runoff (ha.m)	
Good Catchment Area	1,377
Average Catchment Area	379
Bad Catchment Area	2,034
Watershed and Drainage Networks	
Length of Natural Drainage Lines (m)	1,36,892
Number of Natural Drainage Lines (No.)	149
Number of micro-Watersheds (No.)	198
Water Demand	
For Humans (ha.m)	161
For Livestock (ha.m)	17
For Agriculture (ha.m)	13,988.8
GW Utilization for Drinking (%)	62.49
GW Utilization for Livestock (%)	62.68
GW Utilization for Agriculture. (%)	33.73
SW Utilization for Drinking (%)	37.51
SW Utilization for Livestock (%)	37.32
SW Utilization for Agriculture (%)	66.27

3.5.2.1 Existing Water Structures

The Block has structured traditional water storage units such as tanks and Ooranis. It is noticed that the Ooranis are more (282) than tanks (71) (Figure 3.9).

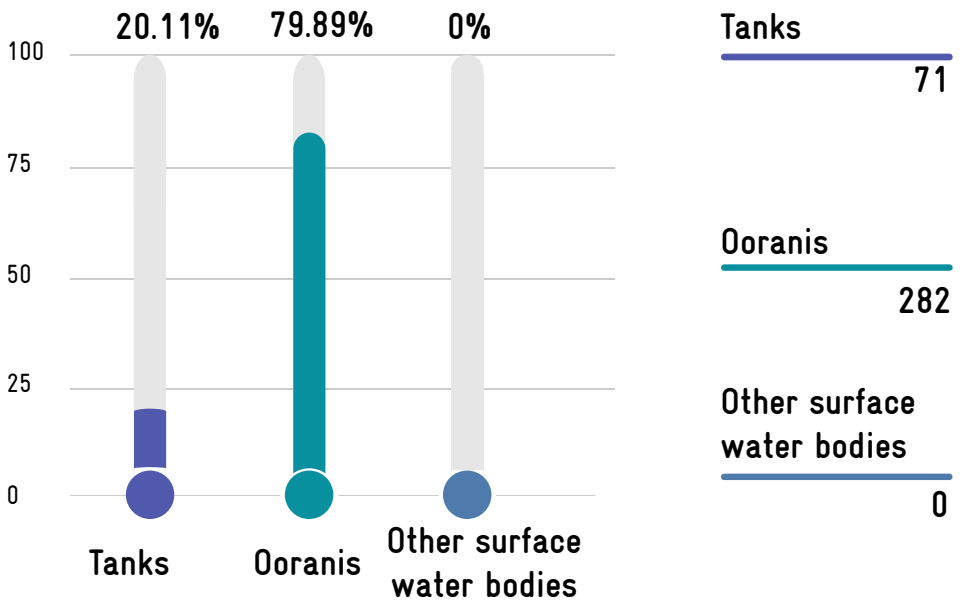


Figure 3.9. Traditional Waterbodies

3.5.2.2 Sources of Irrigation

The total area under irrigation in the Block is 12,709 ha, of which 71.9 % (9,140 ha) is irrigated through open/ tube wells and rest of 28.1 % 3,569.89 ha) through tank based irrigation (Figure 3.10).

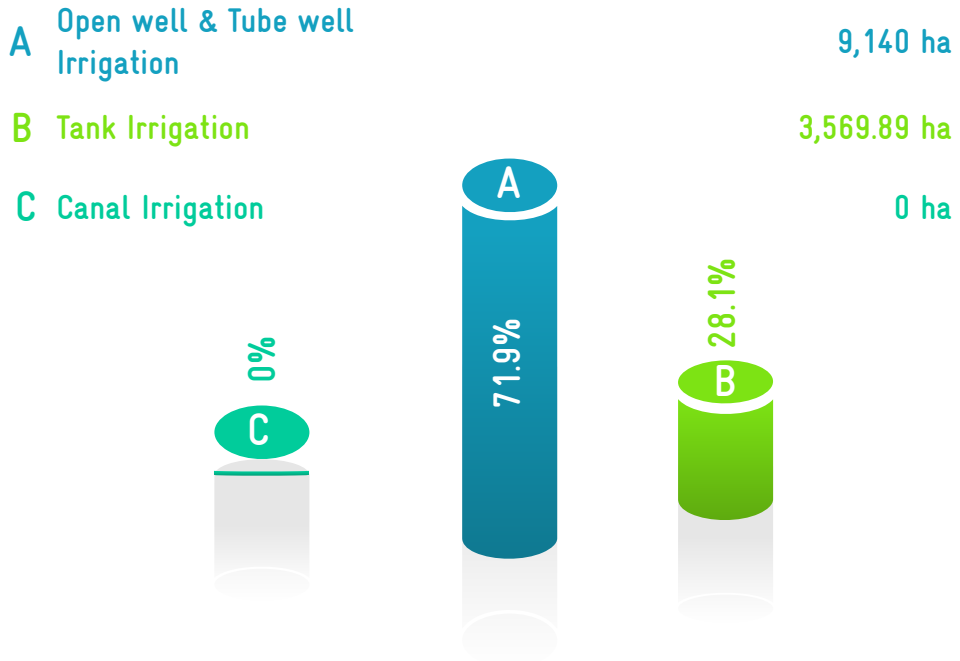


Figure 3.10. Irrigation sources

3.5.2.3 Available Run off

The total available runoff in the catchment area is 3,790.7 ha.m out of which highest of 53.66 % is from bad catchment area followed by 36.33 % from good catchment area and the remaining 10 % is from average catchment area. As the area has worse catchment area, the bad catchment runoff generated is more (Figure 3.11).

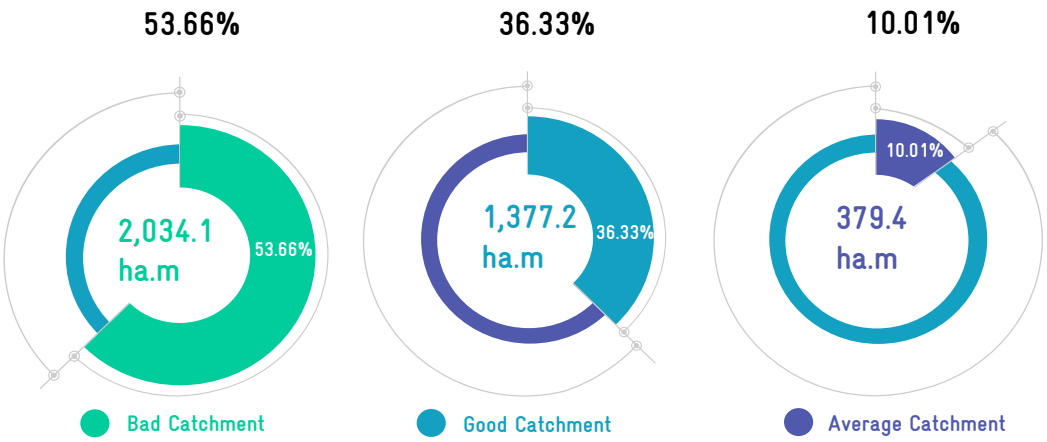
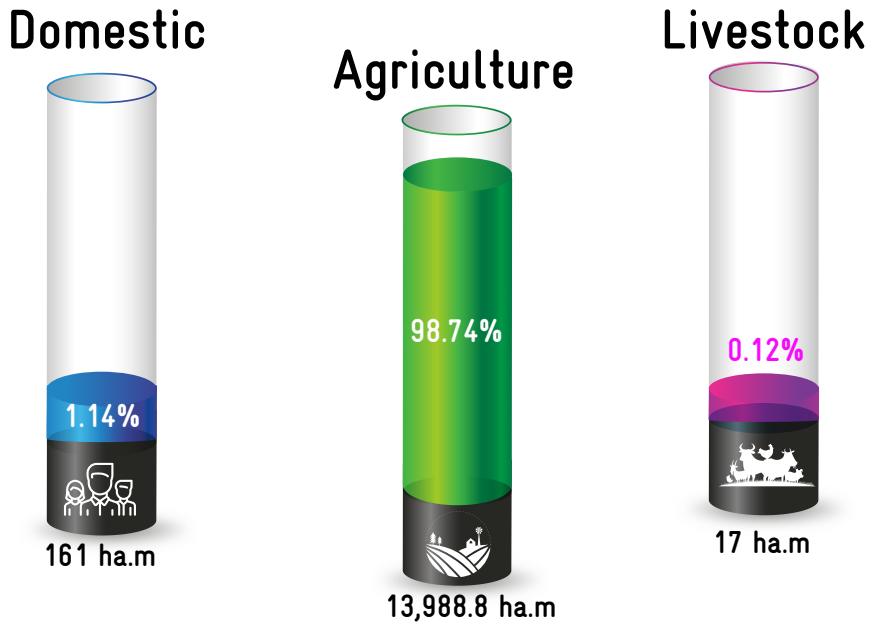


Figure 3.11. Runoff from catchments

3.5.2.4 Water Demand

The total demand for water including domestic, agriculture and livestock purpose is 14,167.24 ha.m. The highest demand is from the agriculture sector of 13,988.8 ha.m (98.74 %) followed by domestic use demand of 161 ha.m (1.14 %) and rest is from livestock.



Out of the total water demand, 62.49 % for domestic purpose, 62.68 % for livestock purpose is met through ground water while for 66.27 % for agriculture is met through surface water (Figure 3.12).

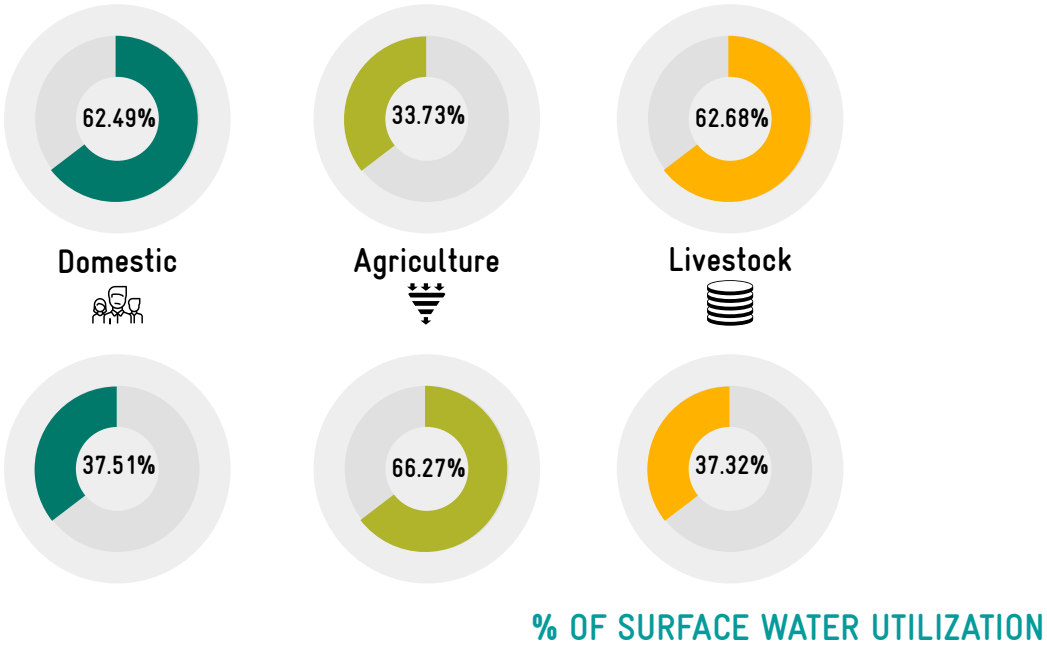


Figure 3.12. Sector-wise water utilization

3.5.3 ANALYSIS OF PHYSICOCHEMICAL PARAMETERS

Physicochemical parameters were assessed to understand their influence on nature of water through Water Quality Index (WQI), Seawater Mixture Index (SMI) and Salinity. To understand WQI and SMI, 33 water samples were collected across the Block area, out of which 18 samples were of open well water and remaining samples were from ground water (Figure 3.13)

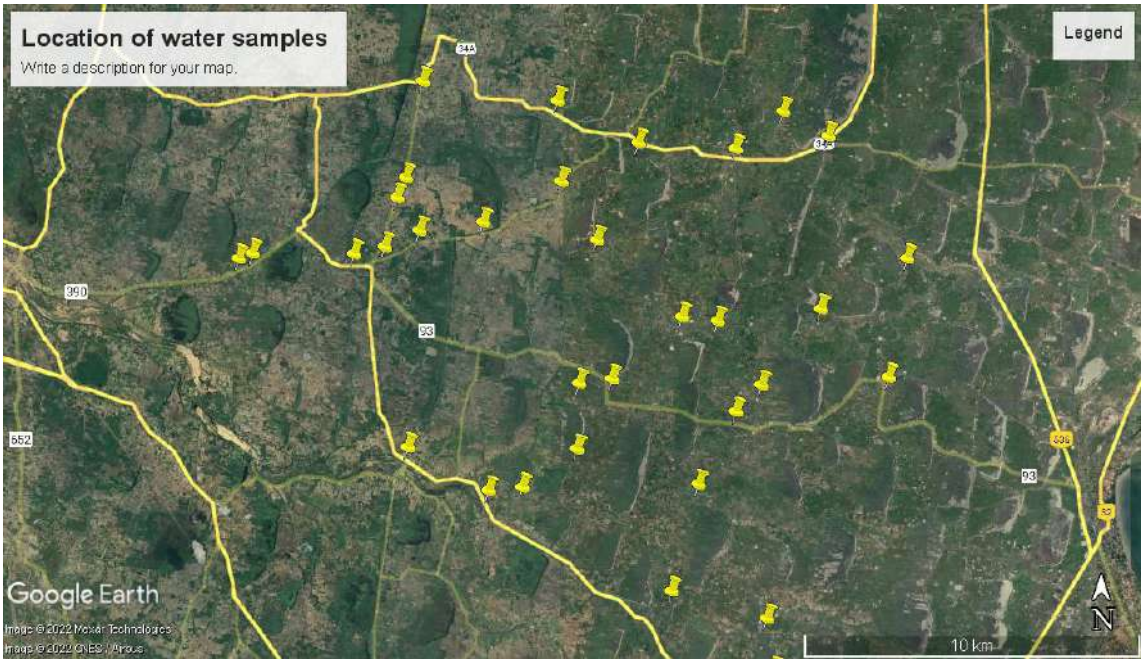


Figure 3.13. Location of water samples

3.5.3.1 Water Quality Index

The WQI is defined as a measure of rating that provides the composite influence of individual water quality parameter to overall water quality. WHO (2004) recommended ten parameters such as pH, TDS, HCO_3, Cl, SO_4, NO_3, Ca, Mg, Na and K to determine the water quality. The results showed that the average content of ions was as follows: Cl > TH >TA > Na > HCO_4 > Ca > Mg > CO_3 > $S0_4$ > NO_4 > K. The predominant hydro-chemical facies are Chloride (C) and total hardness (TH) while Potassium (K) is very less. The excellent water quality /suitable water for domestic purpose is found in 13 spots (blue colour in (Figure 3.14) over the Block area while very poor-quality water/ unsuitable water for domestic purpose with index value >300 is found in five spots. Buffer area of very poor sites falls under poor quality water of index zone ranging from 200 to 300. However, most of the area falls under good water quality zone of index value range of good to medium (50-100) (Figure 3.14). These zones act as inputs in identifying suitable sites to propose appropriate treatment measures. GP wise water quality during pre and post monsoons are attached in Annexure 3.8 and 3.9 respectively.

Physicochemical parameters	Cl	TH	TA	Na	HCO_4	Ca	Mg	CO_3	$S0_4$	NO_4	K
Average in mg/l	1,055.96	472.53	355.39	351.57	267.35	219.18	160.26	71.62	59.02	21.74	20.33

(TH = Total hardness, TA = Titratable acidity, Ca =calcium, Na= Sodium, Cl= Chloride, HCO_3=Bicarbonate, Mg= Magnesium, SO_4= Sulphate, NO_3= Nitrate, K= Potassium, CO_3= Carbonate)

EXCELLENT QUALITY	<50
GOOD QUALITY	50- 100
MEDIUM QUALITY	100- 200
POOR QUALITY	200-300
VERY POOR QUALITY	>300

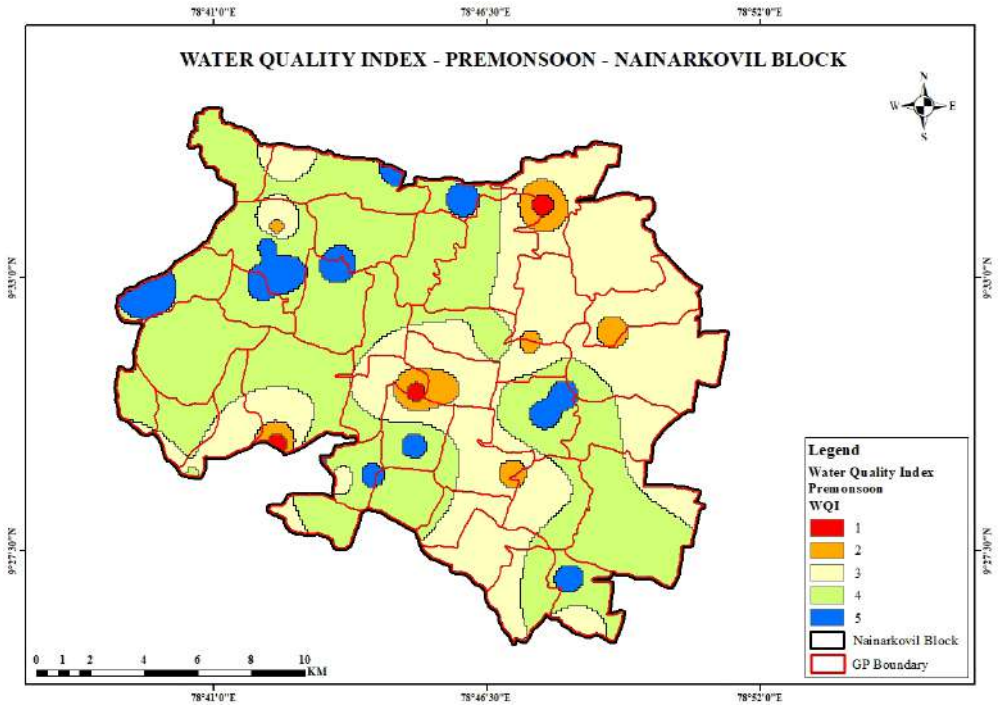


Figure 3.14. Water Quality Index

3.5.3.2 Seawater Mixing Index

SWI parameter is calculated based on mixing of major ionic constituents (Na, Cl, Mg, and SO4) of sea water to ground water during pre-monsoon season. The results show that the average content of ions was as follows: Na > Ca > Mg > S04. The predominant hydro-chemical facies are Sodium followed by calcium while sulphate is less. Geographically three spots were found with high SWI while three zones with less sea water mixed. However, most of the Block area falls under the index value range 1- 2 which is moderate (Figure 3.15).

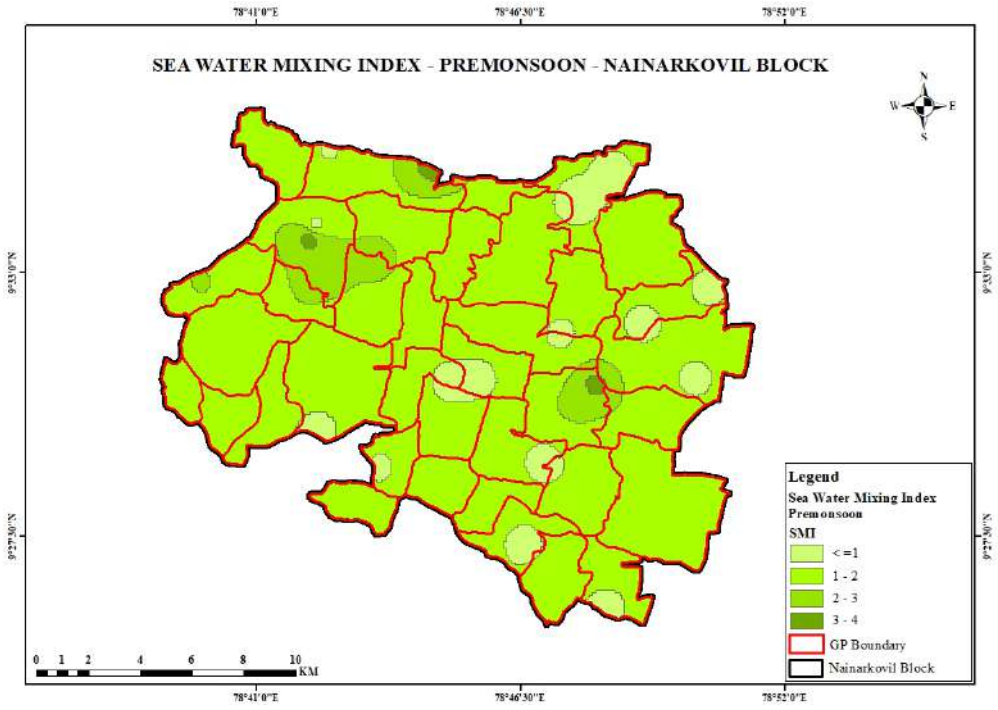


Figure 3.15. Seawater Mixing Index

3.5.3.3 Salinity

Seawater mix and salinity in the water are directly proportional, higher the sea water mix higher the salinity in the water (Figure 3.16).

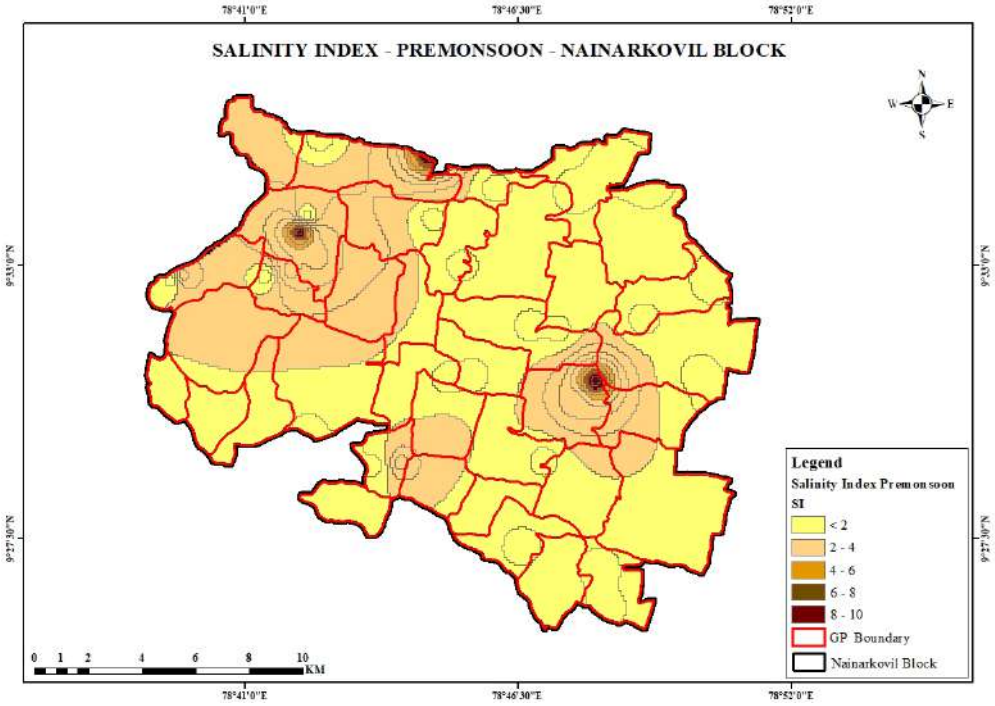


Figure 3.16. Salinity Index

3.6 CWRM PLANNING ANALYSIS- AGRICULTURE

Agriculture is the primary livelihood of the households in Nainarkoil Block followed by livestock resources. Considering water and monsoon patterns, the key agriculture factors such as soil, land, crop and livestock related parameters are employed in CWRM planning.

3.6.1 SPATIAL DATA

Bhuvan based spatial data for LULC, waste land, salt affected land, soil erosion and soil texture were taken into consideration to understand Nainarkoil Block's problems in order to draft scientific key water actions.

3.6.1.1 Soil texture: The soil consistency of particle size is distinguished through soil texture types, especially determined by the amount of sand, silt or clay. The Block has diverse soil types and predominant in vertisol and alfisol. With reference to soil texture, the proportion of fine and fine loamy types are dominant across the Block (Figure 3.17). Soil texture helps in determining the properties of the soil such as water holding capacity, permeability, soil workability and also the ability of plants to grow. This data will help in proposing relevant conservation measures for natural resources.

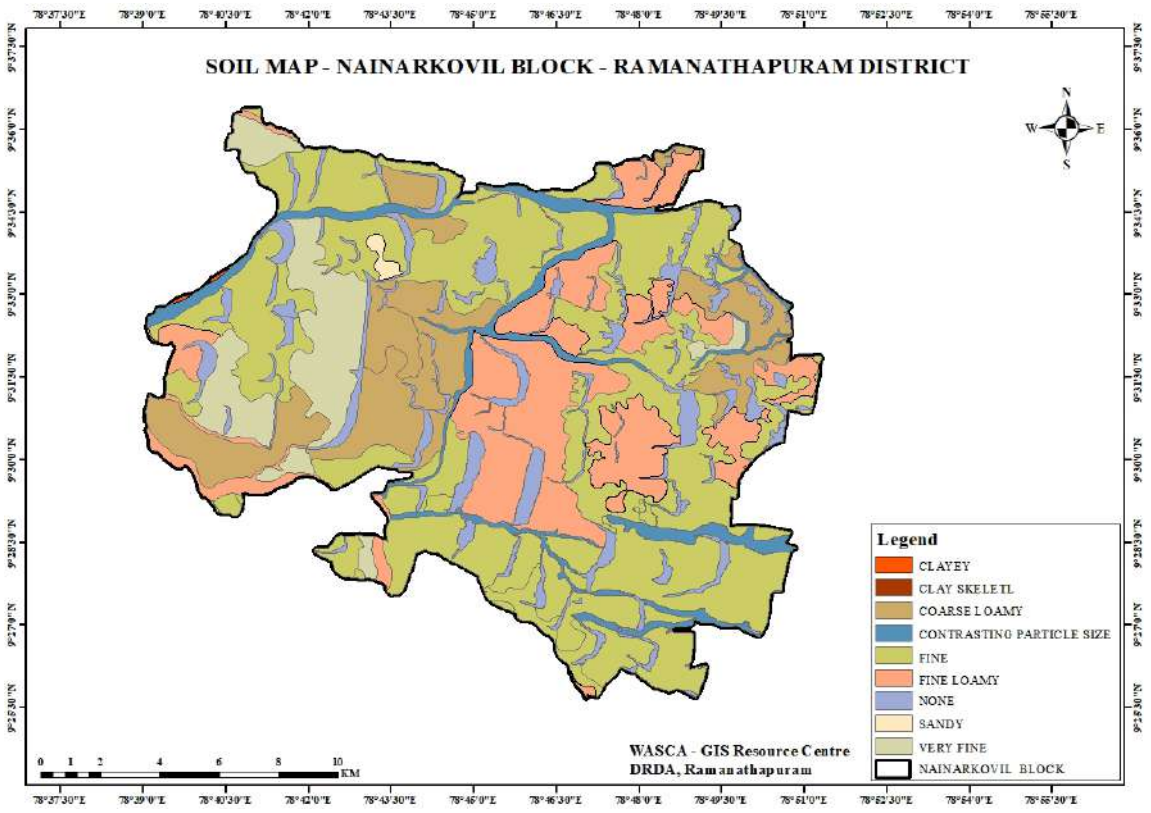


Figure 3.17. Soil texture

3.6.1.2 Soil erosion: Soil erosion is a natural process of displacement of the upper layer of soil caused by dynamic erosion agents i.e. water, air, plants and humans. Most of the GPs are witnessing the sheet erosion type of soil erosion type over the Block (Figure 3.18) and the illustration below gives area wise soil erosion details of the GPs. Data of Soil eroded sites will help in preparing plans, to suggest soil conservation and watershed management activities.

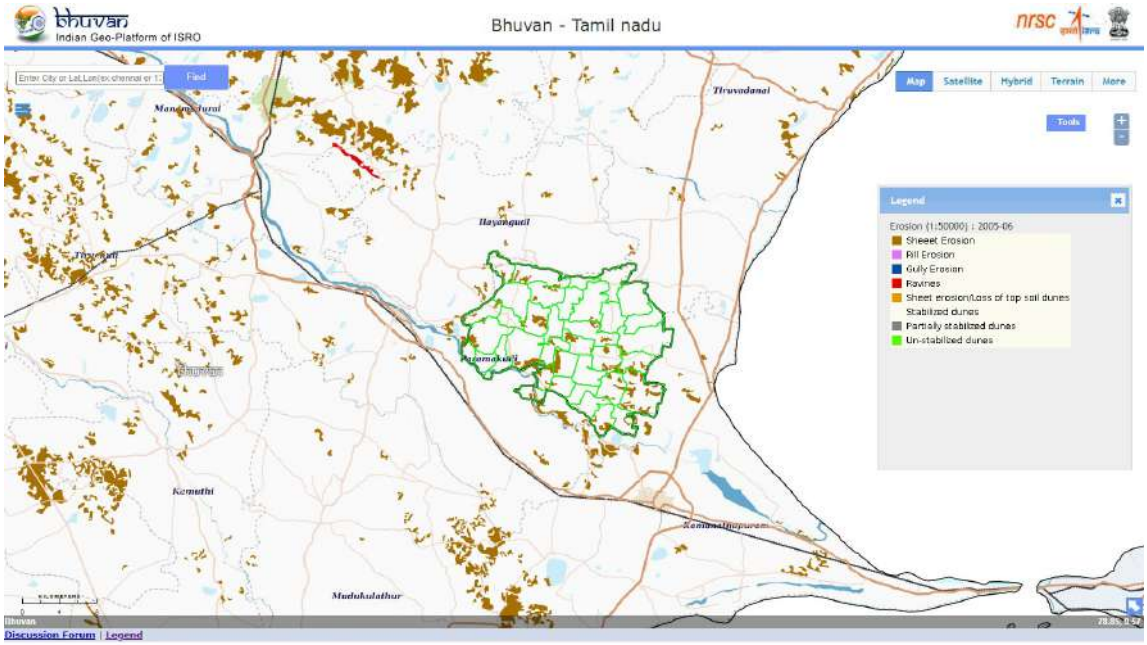


Figure 3.18. Soil erosion map

Erosion type	Area in %	Gram Panchayat
Sheet Erosion		
	21%	Siruvayal - 60%, A. Panaiyur - 45%, P Kodikulam, Perungalur - 35%, Arasanur, Sadurvedamangalam - 30%, Anjamadaikatchan, Radhappuli, Kulathur - 20%, Vaniyavallam, Pandiyur, Vallam - 15%, Karadaranthakudi, Pandappanendal, Koluvur, Kottakudi - 10%, Nainarkoil, Nagaram, Thalayad-ikottai - 5%

3.6.1.3 Land Use & Land Cover (LULC): LULC are two separate terminologies which are often used interchangeably. In general, land cover is defined as 'the observed biophysical cover on the Earth's surface'. It includes vegetation and man-made features as well as bare rock, bare soil, and inland water surfaces; while land use refers to 'the way in which land has been used by humans and their habitat, usually with the accent on the functional role of land for economic activities'. LULC has become an increasingly important factor playing a major role in making environment-development policies. Nainarkoil Block is majorly covered by agricultural crop land, fallow land followed by forest area and barren lands (Figure 3.19). The GP wise LULC is tabulated in the table below. LULC map helps the decision makers and planners to focus on the fallow land development activities.

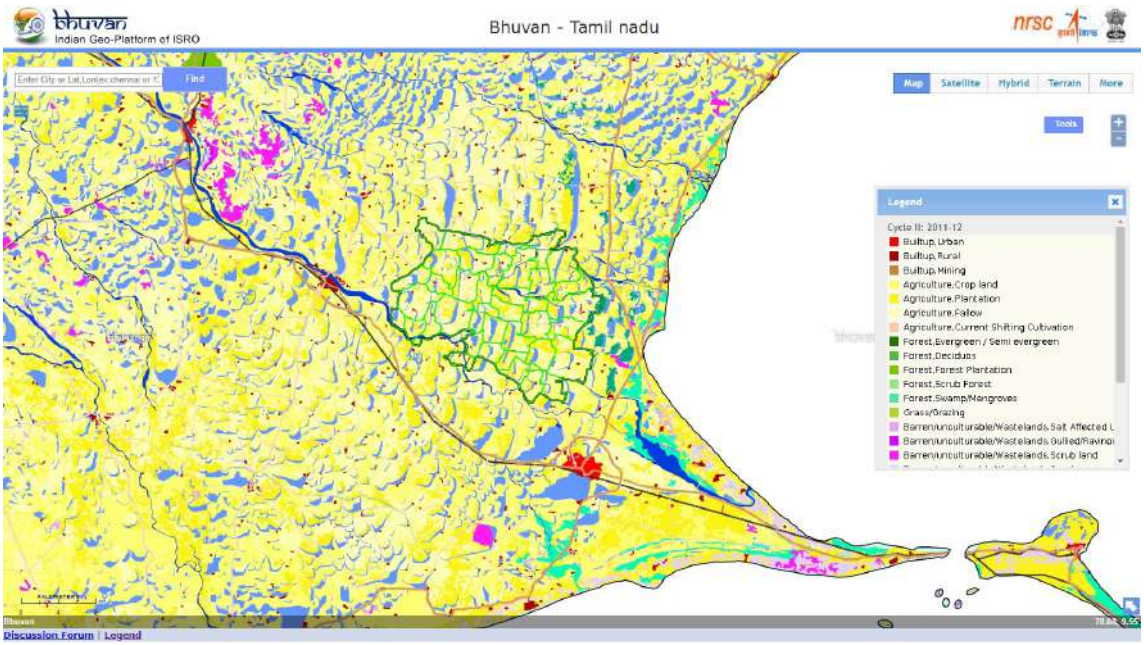


Figure 3.19. Land Use Land Cover map

Land Use	Area coverage in %	Gram Panchayat
Agriculture, Fallow lands	48%	Pagaivendri, Akkiramesi, Anjamadaikatchan, Siruvayal - 85%, Vallam, Vaniyavallam, Perungalur - 80%, Pottagavayal, Arasanur - 70%, Nagaramangalam, Thavalaikulam, P Kodikulam, A. Panaiyur - 65%, Keelakavanur, Karadaranthakudi - 60%, Kulathur - 50%, Koluvur, Pandiyur - 45%, Sirakikottai, Radhappuli, Vadavaneri, Ariyankottai, Manakudi, Kottakudi, Thiyagavanseri - 40%, Nainarkoil, Thalayadikottai, Nagaram, Mummudisathan - 30%, Sadurvedamangalam - 25%, Kalliyadiendal, Attangudi, Nainarkoil, Thethangal, Gangaikondan - 20%, Vagavayal - 15%, Pandappanendal - 10%
Agriculture, Crop lands	29%	Thethangal - 50%, Nagaram - 45%, Kulathur - 40%, Perungalur, Vallam, Karadaranthakudi - 30%, Akkiramesi - 25%, Mummudisathan - 20%, Vagavayal - 15%, Siruvayal - 10%
Agriculture, Plantation	38%	Vagavayal - 60%, Koluvur, Kiliyur - 45%, A. Panaiyur, Thalayadikottai, Radhappuli - 30%, Attangudi - 25%

3.6.1.4 Waste land: As per the data no wasteland is found in Nainarkoil Block (Figure 3.20).

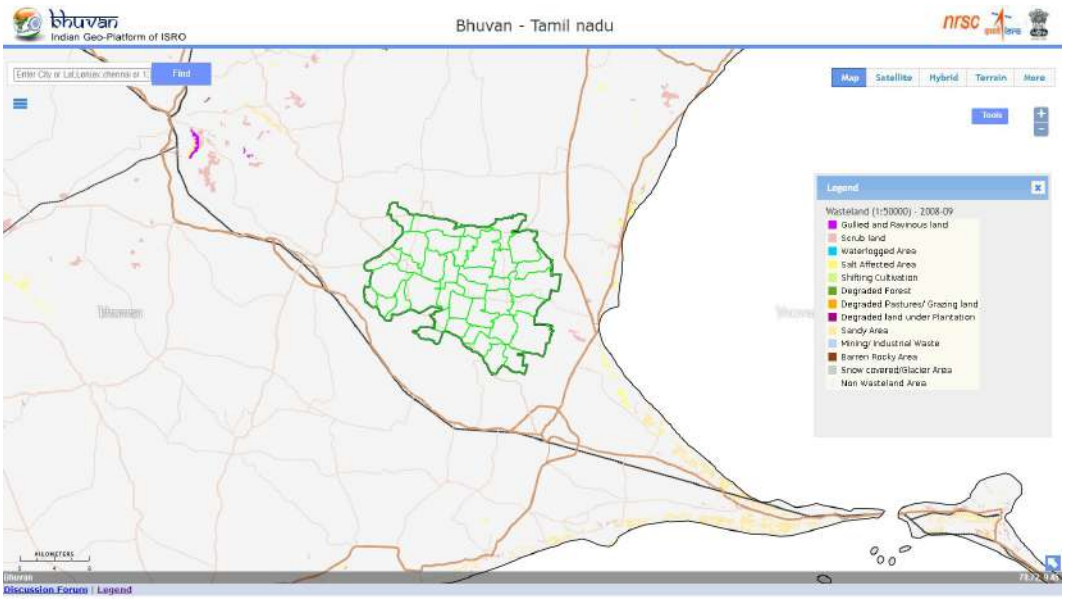


Figure 3.20. Wasteland map

3.6.1.5 Salt affected area: Due to the Block's proximity to coastal region, sodic content land parcels are noticed in the Eastern region of the Block (Figure 3.21). GP-wise details of salt affected area is shown in the illustration below. These parcels will act as a direct input in the planning process to propose soil conservation measures, mainly activities to reduce salinization and suggestions for alternative cropping.

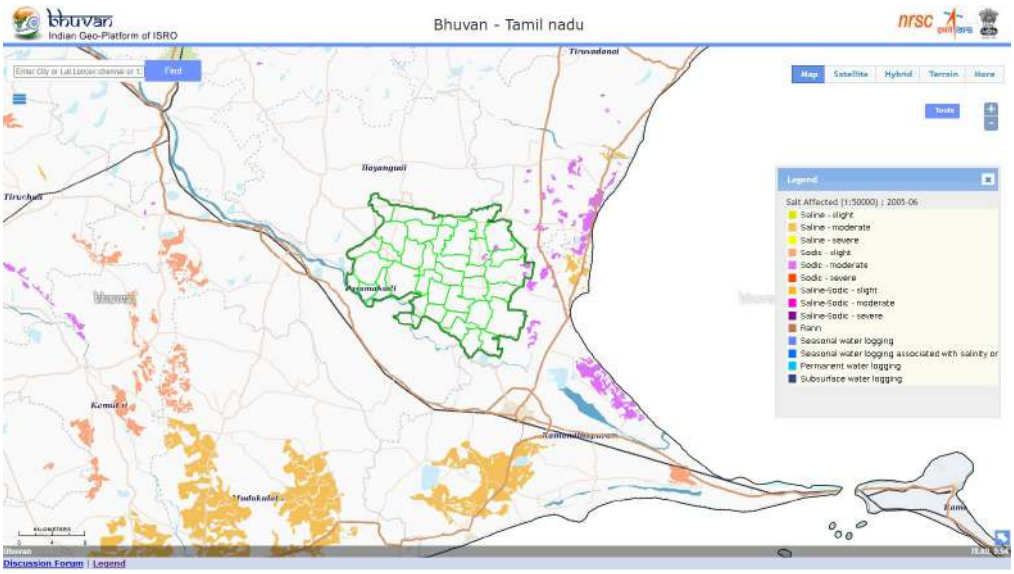


Figure 3.21. Salt affected area

Thematic unit	Area in %	Gram Panchayat
Sodic – Moderate		
	7%	Pottagavayal - 10%, Attangudi, Manakudi - 5%

3.6.2 NON SPATIAL DATA

Agriculture based non-spatial secondary data related to land resources, catchment, crop type, soil micro-macro nutrient, moisture, ET and livestock data were collected from govt. sources (Table 7). The key CWRM parameters of agriculture area for all GPs are tabulated in Annexure 3.10.

TABLE 7. CWRM PARAMETER BASED AGRICULTURE RESOURCES STATUS IN THE BLOCK

Key parameter	Extent
Area under Land Resources (ha.)	
Unirrigated Land	6,976.82
Non-Agricultural Uses	6,182.47
Area Irrigated by Source	4,808.13
Current Fallow land	3,733.90
Fallows Land other than Current Fallows	2,386.64
Land Under Miscellaneous Tree Crop etc.	2,150.81

Cultivable Waste Land	72.54
Area under Barren & Un-cultivable Land	27.00
Area under Permanent Pastures and Other Grazing Land	3.00
Land under Catchment Area (ha)	
Good Catchment	6,209.47
Average Catchment	2,226.35
Bad Catchment	17,905.49
Crop Details	
Irrigated Area (ha)	5,002.65
Rainfed area (ha)	8,396.87
Paddy Cultivation (ha)	10,089.10
Crop Water Requirement - Irrigated condition (ha.m)	6,594.08
Crop Water Requirement - Rainfed condition (ha.m)	7,394.76
Soil Resources: Status of Available Nitrogen (%)	
Very Low	72.78
Low	26.77
Status of Organic Carbon (%)	
Very Low	31.35
Low	54.96
Medium	2.30
High	1.03
Very High	10.36
Status of Soil Micro Nutrients (%)	
Sufficient	61.89
Deficient	38.11
Status of Physical condition of the soil (%)	
Highly Acidic	0.56
Moderately Acidic	4.74
Slightly Acidic	7.90
Neutral	0.70
Moderately Alkaline	82.25
Strongly Alkaline	3.80
Soil Texture (%)	
Fine Soil	66.52
Coarse loamy	15.24
Soil Water Permeability (Low, Moderate, high)	Moderate
Soil moisture and ET	
Volumetric Soil Moisture (%)	17
Estimated Soil Moisture (ha.m)	3,427
ET Losses (ha.m)	7,276
Means of Water Extraction (%)	
Gravity	44.19
Lifting	55.81
Irrigation Methods (%)	
Wild Flooding	68.43
Control Flooding	31.57

Livestock (No.)	
Cattle Population	3,002
Sheep Population	7,086
Goat Population	10,482
Poultry	12,513

3.6.2.1 Land utilization

The standard land use classification helps to understand the distribution and the extent of different land use categories. As the runoff and water harvesting actions are linked to the land use systems, its distribution across the geographical boundary of the Block is necessary to take decisions. Of the total land area of 26,341.31 ha, the highest of 26.49 % land is unirrigated land, followed by 23.47 % Non-agricultural uses, while less than five percent of land is cultivable wasteland, barren and uncultivable land and permanent pastures and other grazing land is being utilized (Figure 3.22).

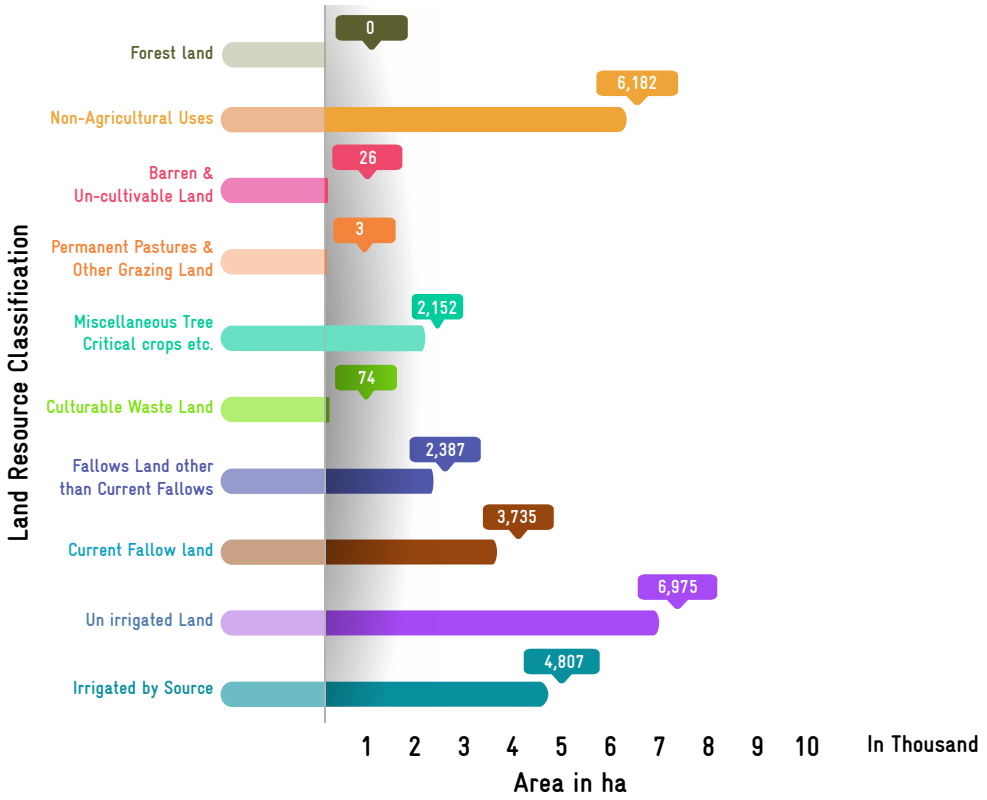


Figure 3.22. Land utilization

3.6.2.2 Catchment Area

The land use types in each of the GPs are categorized into three different types of runoffs; good, average and bad catchment area. Out of total catchment area of 26,341.31 ha, of the Block, the highest of 67.97 % is from bad catchment area followed by 23.57 % is from good catchment area and remaining is from average catchment area (Figure 3.23). This analysis helps to focus on prioritizing the works in the land use systems under the bad and good catchment areas.

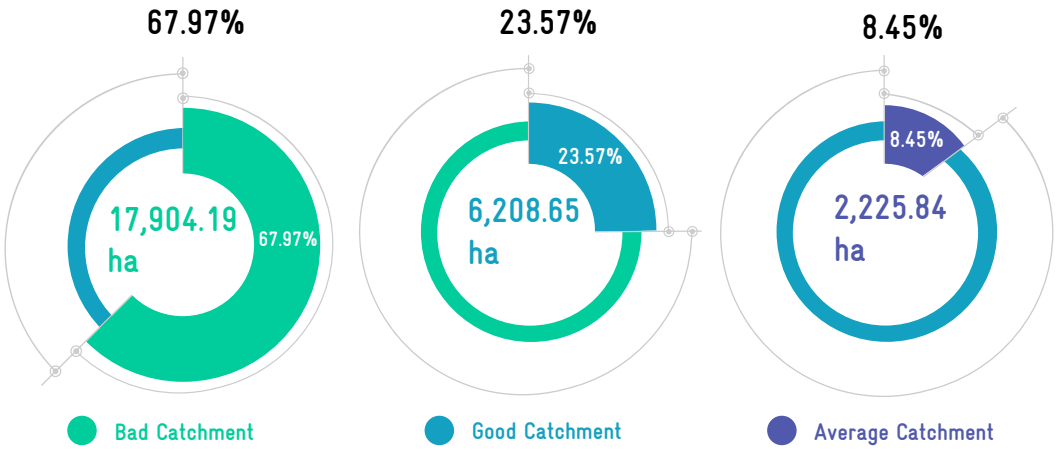


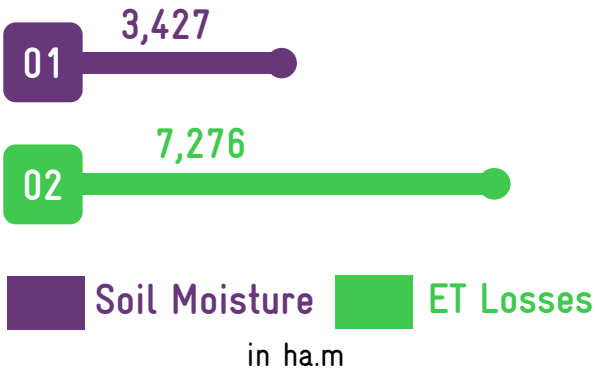
Figure 3.23. Catchment area

3.6.2.3 Soil moisture

Soil is an important medium to store the available water and the storage capacity varies with the type of soil especially its textural composition. In overall composite water budgeting, estimation of stored water in the soil assumes greater significance in this Block because of its significant proportion of area under rain-fed cultivation. The annual average volumetric soil moisture of this Block (17%), is taken for estimating the amount of water stored as soil moisture which accounts to 3,427 ha.m

3.6.2.4 ET losses

The transformation of liquid state of water state from earth surface to vapour state of water to atmosphere is the ET loss. The loss of water through ET is important in water budgeting. The Block area witnessed an annual total ET loss of 7,276 ha.m during 2018-19, with a monthly average of 506.1 ha.m.



3.6.2.5 Macro-nutrients
Nitrogen

The macro soil nutrients such as nitrogen and organic carbon falls under very low to low category in all the soil samples tested. The available nitrogen is very low in 72.78 % of the samples tested while it was 26.77 % under low category (Figure 3.24). According to soil resource map, this Block is identified as one of the nitrogen deficient Blocks (Ramanathapuram District profile 2020).

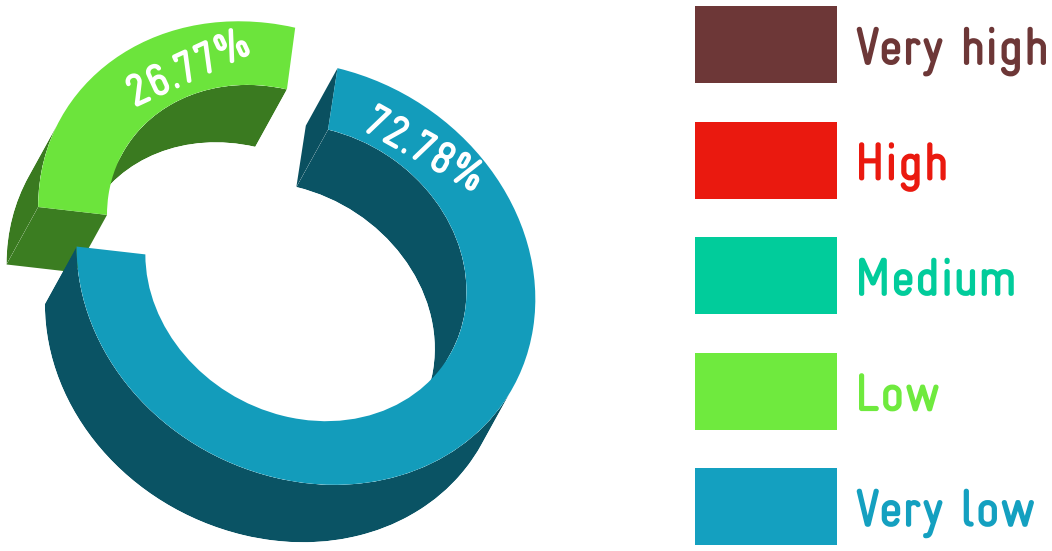


Figure 3.24. Status of available Nitrogen

Organic Carbon

Soil organic carbon ranges between very low and very high in the tested soil samples. Nearly 55 % of the soil samples tested fall under low category followed by 31.35 % which falls under very low category while 1.03 % falls under high organic carbon (Figure 3.25). This indicates that the soil fertility is poor.

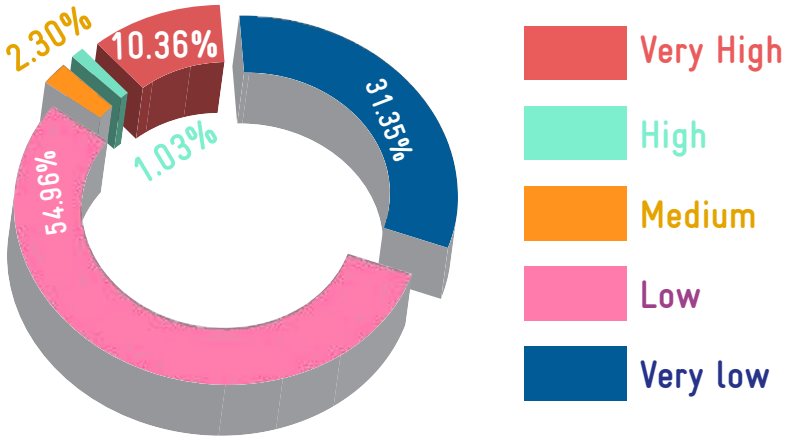


Figure 3.25. Status of soil Organic Carbon

3.6.2.6 Status of the soil micro-nutrients

This Block is one of the Nitrogen, Zinc and Ferrous deficient Blocks of Ramanathapuram District. The micro-nutrient status of the soil with specific reference to Manganese, Boron and Zinc, Ferrous, Copper, and Sulphate are deficient in 38.11 % and 61.89 % sufficient in the soils tested (Figure 3.26).

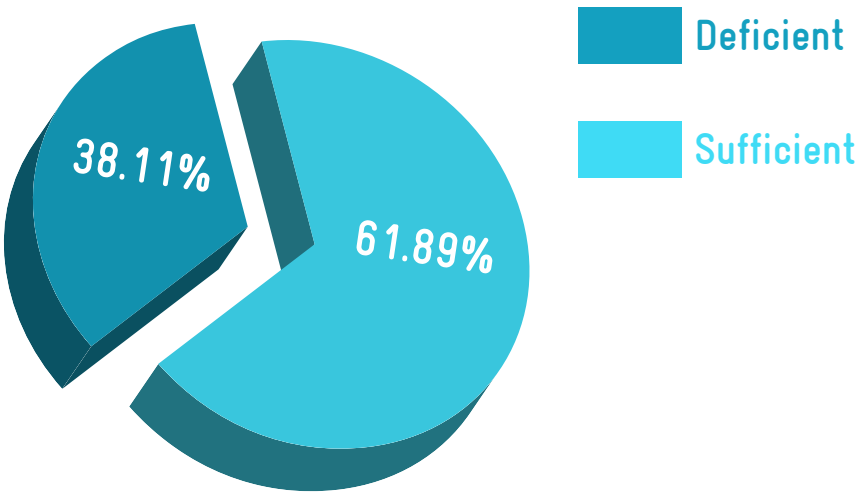


Figure 3.26. Status of soil micro-nutrients

3.6.2.7 Physical parameters – pH status

With reference to the physical parameters, 82.25 % of the soil is moderately alkaline and rest is acidic except 3.80 % is strong alkaline and 0.70 % is neutral (Figure 3.27).

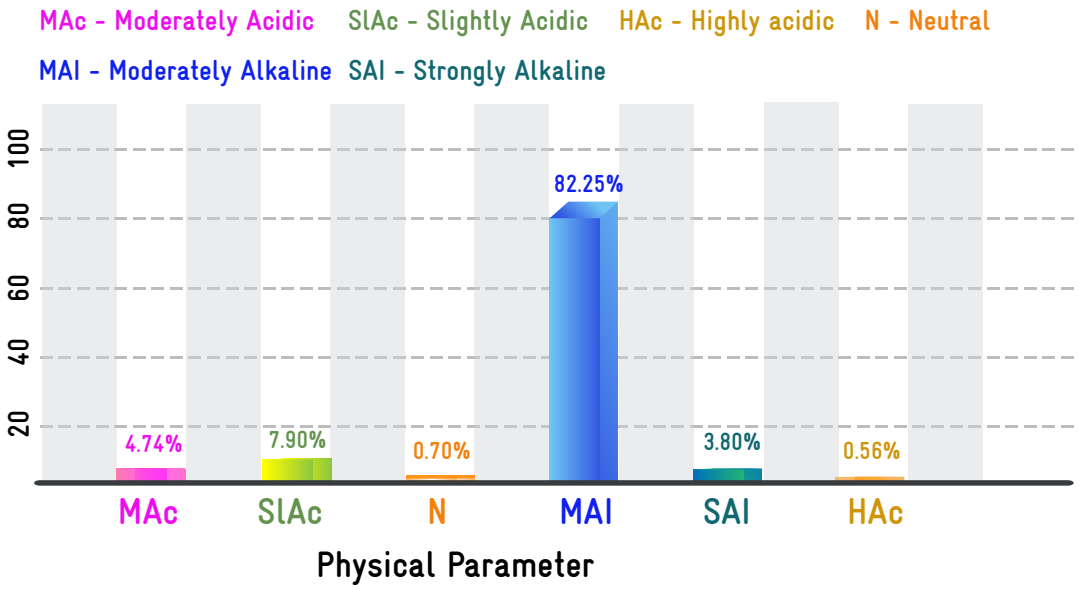


Figure 3.27. Status of pH of soil

3.6.2.8 Cropping pattern and the irrigation

A total of 28,857.4 ha area is used for crop cultivation in which 61.4 % area is rain fed cultivation and the rest is the irrigation based cultivation. Paddy is a major crop in with about 11,108.02 ha (38.77 %) followed by dry chilli with 17.64 while vegetables and spices are cultivated in less area. Sugar cane, red gram, ragi, dry chilli, brinjal, water melon, ladies finger, gourds, flower crops, banana, guava, medicinal plants, lemon, mango, tomato are cultivated in less than one percent of the area.

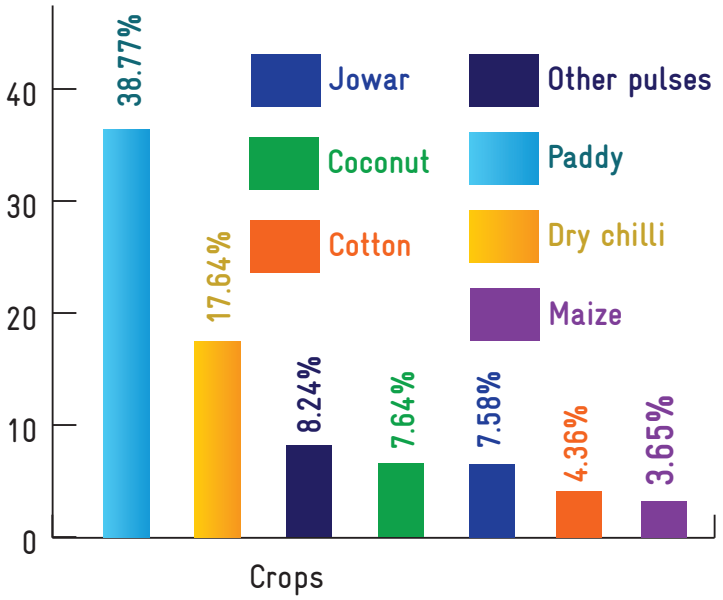


Figure 3.28. Crop pattern (including rain-fed and irrigation area)

3.6.2.9 Irrigation methods

In case of the surface water resources, wild flooding is the primary method of irrigation. But in case of ground water resources, the predominant type of irrigation is control flooding. In the Block, 68.43 % of the irrigation is done by wild flooding and rest of irrigation is done by control flooding (Figure 3.29).

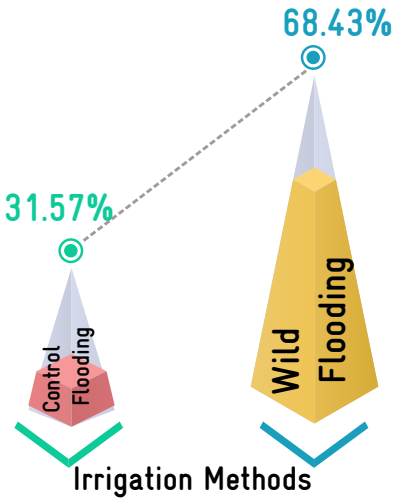


Figure 3.29. Irrigation methods

3.6.2.10 Means of water extraction

Water is extracted in two ways, one by gravity and another is by lifting. Water is drawn from surface water sources such as tanks, ponds etc., by using gravity method and that of ground water sources such as open well, hand pump, bore well by using lifting method. In the Block, 44.19 % of the water extraction is through gravity and rest comes under lifting means of water extraction (Figure 3.30).

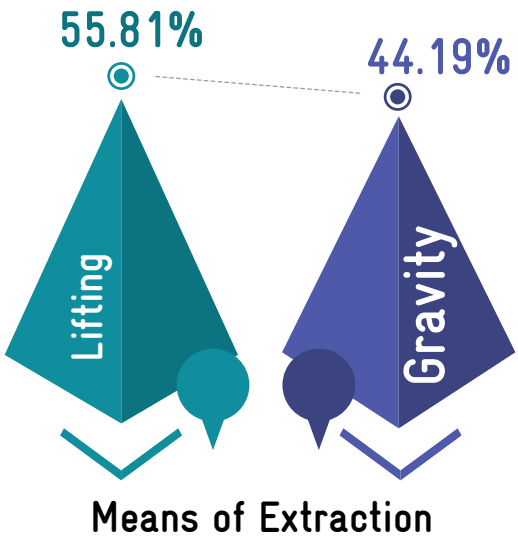


Figure 3.30. Means of water extraction

3.6.2.11 Livestock details

This Block has considerable proportion of livestock resources of about 33.083. Of which poultry population is high 38 % (12,513) followed by small ruminant's goats of 32 % (10,482), while cattle population is about 9 % (3,002) (Figure 3.31). The total water requirement for livestock is 17.43 ha.m. Of the total water demand 63 % is met through ground water and remaining is from surface water resources.

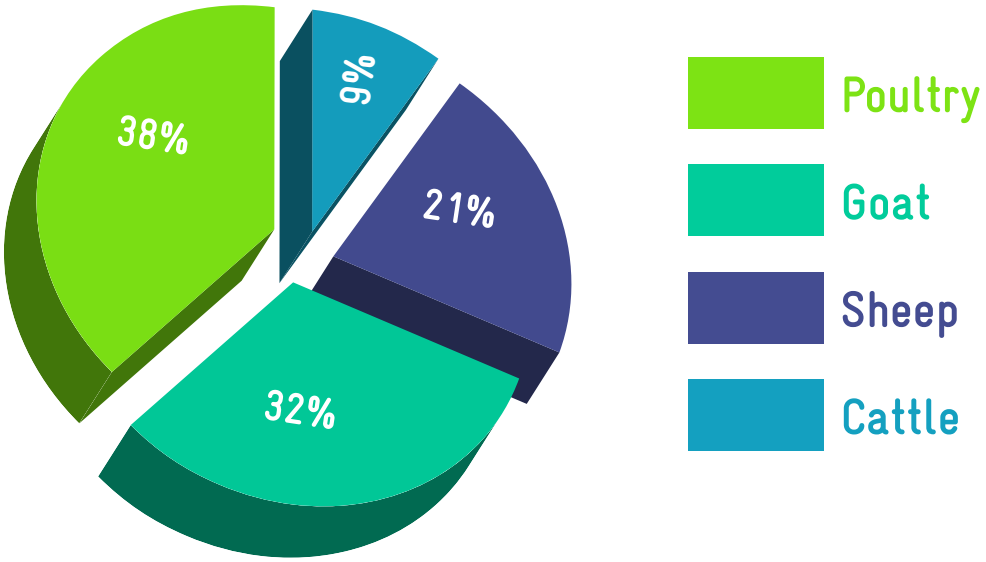


Figure 3.31. Livestock details

3.7 CWRM PLANNING ANALYSIS-SOCIO-ECONOMIC

The demographic details such as population, gender, vulnerable population/ households, drinking and grey water details are collected from authentic primary and secondary sources and analyzed. Data of MGNREGA job holders is also taken for the analysis. Table 8 lists the demographic and socio-economic status of Nainarkoil Block. GP wise demographic and socio-economic status is attached in Annexure 3.11.

TABLE 8. CWRM PARAMETER BASED SOCIO-ECONOMIC STATUS IN THE BLOCK

Parameter	Total
Geographical Area (ha)	26,187
Male Population (No.)	29,337
Female Population (No.)	29,461
Total Population (No.)	58,798
SC Population (No.)	12,185
Vulnerable Population (No.)	12,187
Households (HH's) (No.)	15,994
Only one room HH's (SECC) (No.)	1,947
Female Headed HH's (SECC) (No.)	1,576
Vulnerable Households (SECC) (No.)	1,835
% of Vulnerable Households (%)	11
Registered MGNREGA Job cards (Persons)	16,495
Active person working in MGNREGA job Cards (Persons)	12,829
Drinking Water Sources (No.)	1,009
HH's have tap water connection for drinking water (No.)	3,782
HH's dependent on other sources for drinking water (No.)	18,833
Annual Greywater Generation (ha.m)	107

3.7.1 Population:

The total population of this Block is 58,798* in which the female proportion is slightly higher than male population. In the CWRM planning process due attention is given for the intersecting variables such as gender, class, caste and marital status and availability of safe drinking water resources. In the Block, about 21 % of the total population are under vulnerable population of SC (Figure 3.32).

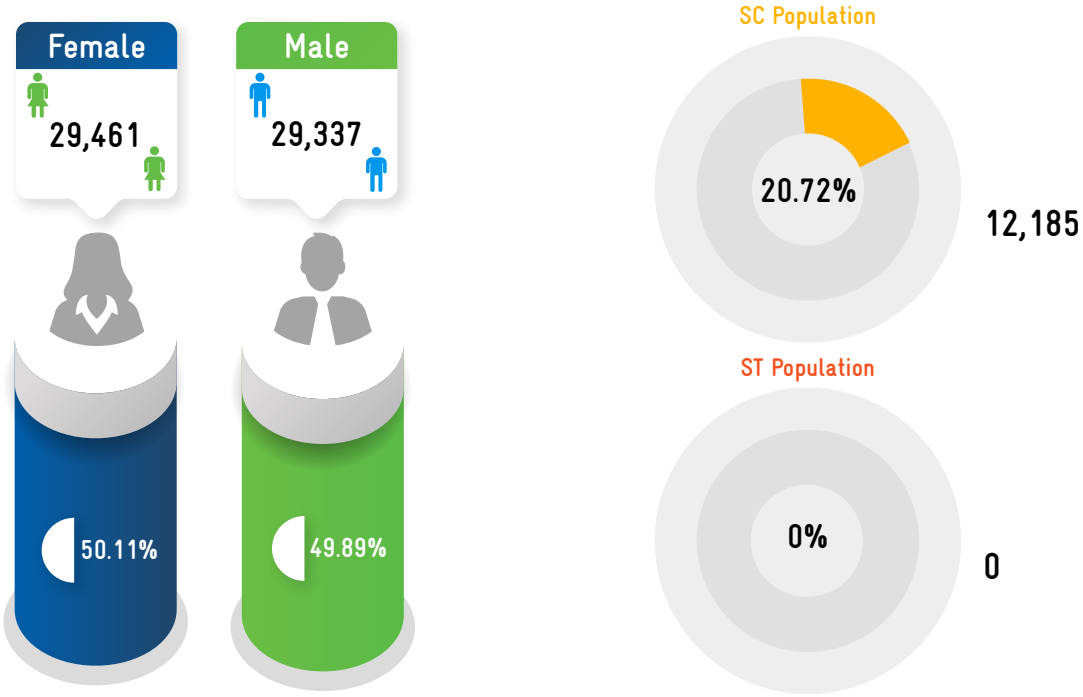


Figure 3.32. Population details

**population figures may differ from Census 2011 due to categorization of GPs based on revenue panchayat boundaries*

3.7.2 Details of households

There are a total of 15,994 households in which 12 % households have only one room, 10 % households are headed by women and 11 % are vulnerable households (Figure 3.33).

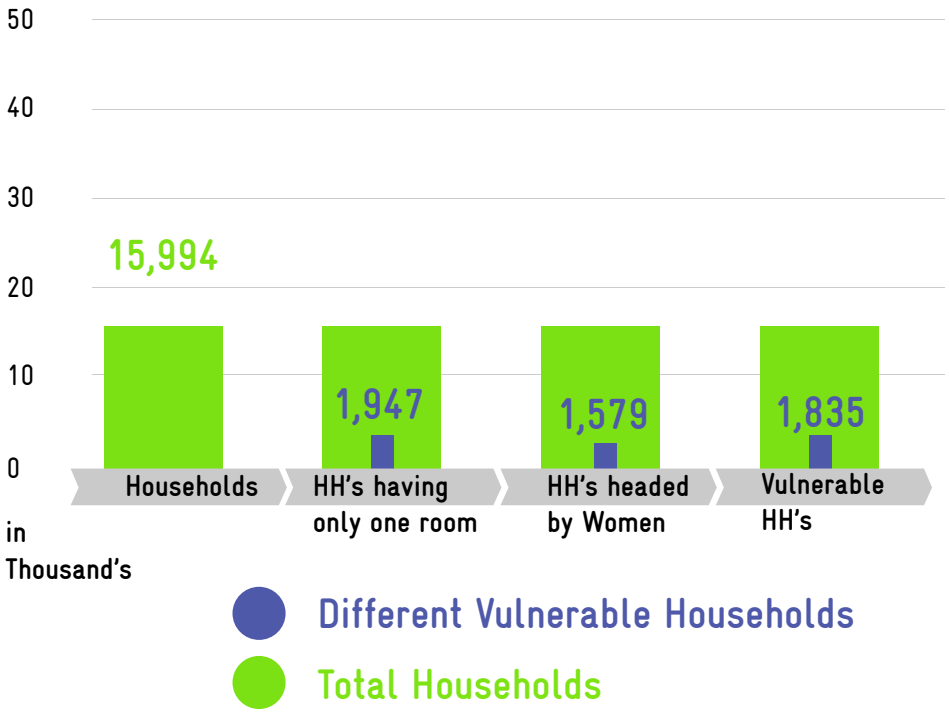


Figure 3.33. Details of households

3.7.3 Status of Mahatma Gandhi NREGA - job card status

In the Block, of the total population of 57,798. 16,495 are registered for job cards in Mahatma Gandhi NREGA scheme in which 78 % of the job cards are in active category (Figure 3.34)

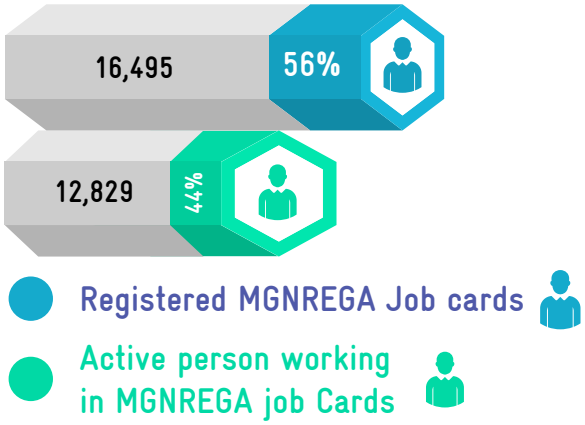


Figure 3.34. Status of MGNREGA job cards

3.7.4 Drinking Water Sources

Nearly 3,782 households have tap water connection and 18,833 households depend on other water sources for domestic use, where other sources include RTRWHS / Tanka (roof rain water harvesting systems, hand pump, open wells, bore wells, tank/ pond/ oorani, springs and river/ streams.

Tap water connection

3,782
Households

Other sources include RTRWHS / Tanka (Roof Rain Water Harvesting Systems), Hand pump, Open well, Bore well, Tank/ Pond/ Oorani, Springs and River/ Streams

18,833
Households

3.7.5 Annual Greywater Generation

The grey water generation estimated across this Block is 107 ha.m which is available for reuse or recycle.

SPATIAL DATA DERIVED AREA SCOPE FOR TREATMENT MEASURES IN GP'S

Morphology

A Panaiyur, Gangaikondan, Siruvayal

Physicochemical parameters

P Kodikulam, Radhappuli, Ariyankottai

Soil erosion

Siruvayal, A Panaiyur, P Kodikulam, Perungalur

Upland/Slope

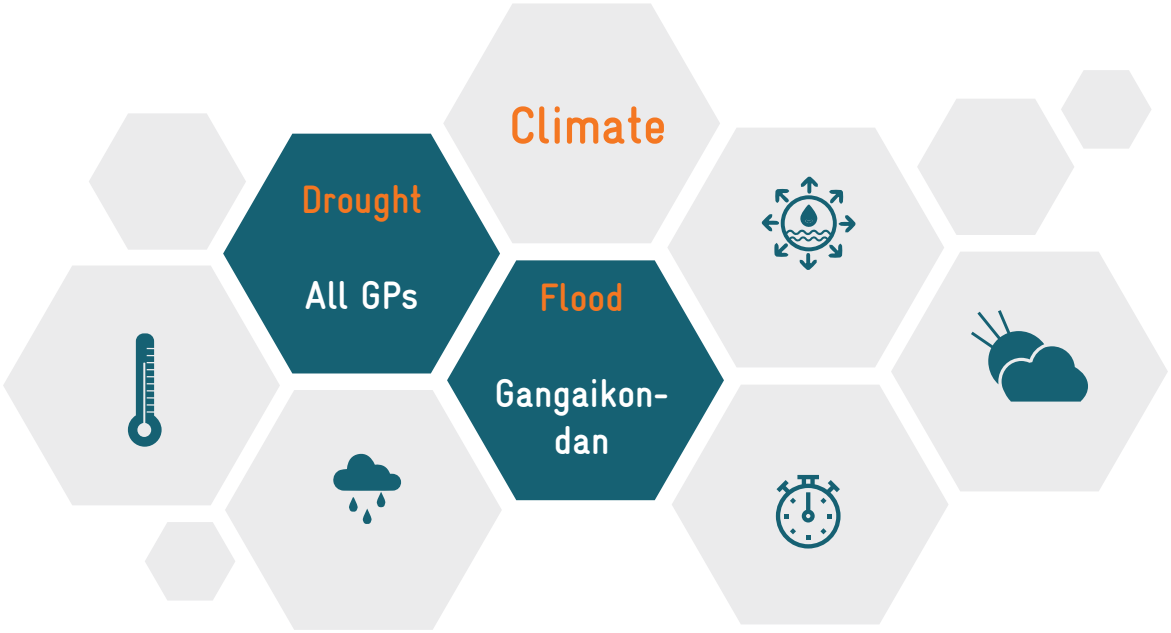
Arasanur, Pottagavayal

Ground water prosperity

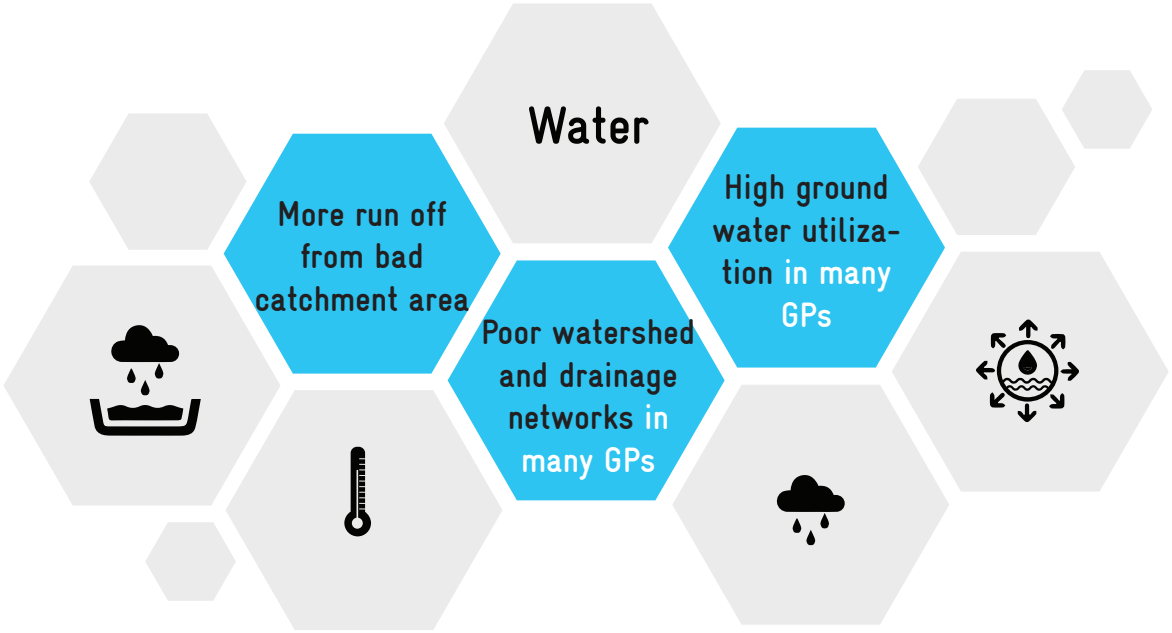
Pottagavayal, Kulathur, Attangudi, Kottakudi

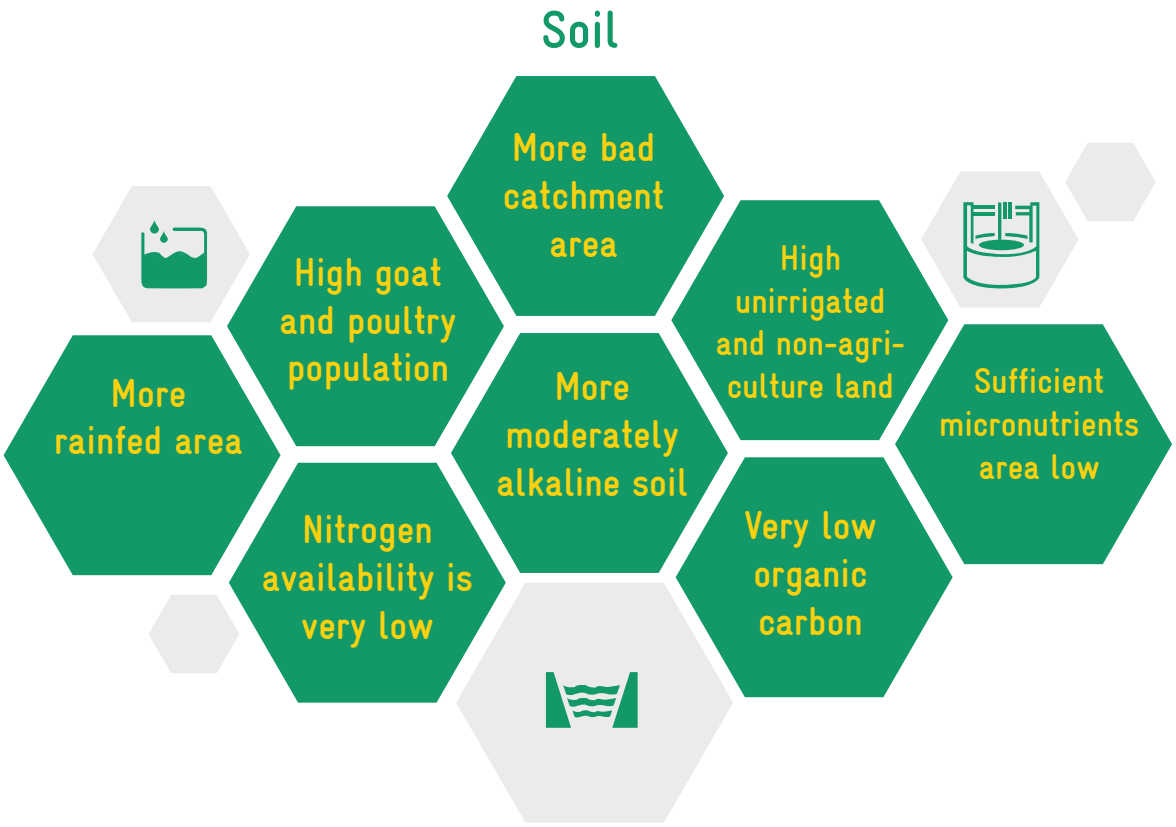
Salt affected area

Pottagavayal, Attangudi, Manakudi


Climate
Drought
All GPs
Flood
Gangaikon-
dan


Socio economic
Population density high in Pagaivendri, Nain-arkoil, Kalliyadi-yendai
Vulnerable population high in Kullathur, Vani-yavallam, Nain-arkoil
% of vulnerable households high in Karadaranthakudi, Nagaram, Attangudi
Grey water generation more in Vaniyavallam, Nainarkoil
No. of households and female headed households high in Vallam
Total population, Female population high in Vaniyavallam, Nainarkoil
Most of GP HH's have tap water connection for drinking water high in Akkiramesai, Vaniyavallam, Nainarkoil
Registered MGNREGA job cards and active persons working are low in A. Panaiyur, Kalliyadiyendai


Water
More run off from bad catchment area
High ground water utiliza-tion in many GPs
Poor watershed and drainage networks in many GPs


Soil
More bad catchment area
High goat and poultry population
High unirrigated and non-agri-culture land
More rainfed area
More moderately alkaline soil
Sufficient micronutrients area low
Nitrogen availability is very low
Very low organic carbon

கெடுப்பதூஉம் கெட்டார்க்குச் சார்வாய்மற் றாங்கே
எடுப்பதூஉம் எல்லாம் மழை

குறள் - 15

Destruction it may sometimes pour
But only rain can life restore

Thirukkural - 15

CHAPTER 4

4 VULNERABILITY RANKING OF GP

The vulnerability assessment has been carried out using IPCC methodology. Intergovernmental Panel on Climate Change (IPCC) defined Vulnerability as 'the propensity or predisposition to be adversely affected' (IPCC 2014). Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and the lack of capacity to cope and adapt. It is determined by sensitivity and adaptive capacity of the system (Figure 4.1).

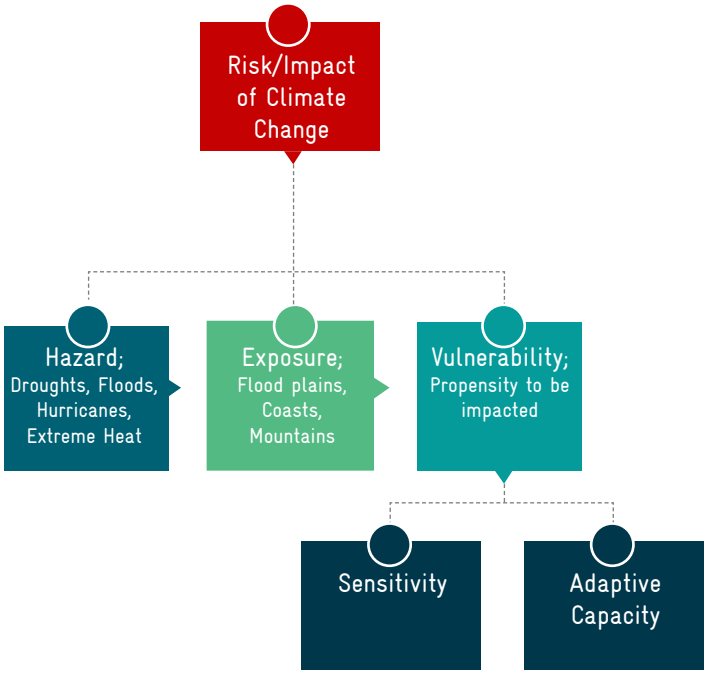


Figure 4.1. Vulnerability of the system as defined by IPCC

Generally, vulnerability assessments are made to identify.

- current and potential hotspots
- entry points for intervention
- drivers of vulnerability
- priorities adaptation interventions

The CWRM parameters which been explored through rigorous study were considered here to address the key water challenges at GP level. About 73 spatial and non-spatial parameters/ indicators under 4 dimensions via Climate (3), Water (28), Agriculture (31) and Socio-demographic (11) are categorized into adaptive capacity, sensitivity and exposure indicators for vulnerability analysis as per IPCC norms. Table 9 lists CWRM parameters/indicators, its rationale to vulnerability, source of data and its linkage with WASCA TN's primary 18 indicators.

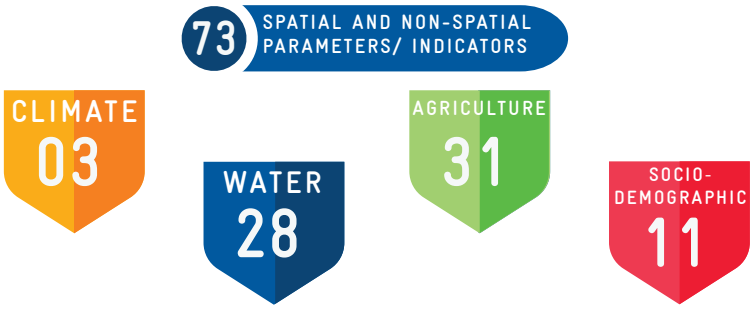


TABLE 9. CWRM PARAMETERS/INDICATORS SELECTED FOR BLOCK LEVEL VULNERABILITY

	Key CWRM Parameter	Vulnerability relationship
Climate	Drought	Climate risk/Sensitivity
	Flood locations	
	Heat Wave	
Water	**Canal Network (in m)**	
	Length of main canal	Adaptive capacity
	Length of minor canal	
	Length of distributaries	
	Water courses (Field channels)	
	Traditional water bodies (in No.)	
	No. of Tanks	Adaptive capacity
	No. of Ooranis	
	Other surface waterbodies	
	Irrigation Facilities (in ha)	
	Area under Tank irrigation	Sensitivity
	Area under canal irrigation	
	Area under open & tube well irrigation	
	Catchment Area wise Available Runoff (ha.m)	
	Good Catchment Area	Sensitivity
	Average Catchment Area	
	Bad Catchment Area	
	Watershed and Drainage Networks	
	Length of Natural Drainage Lines (m)	Adaptive capacity
	Number of Natural Drainage Lines	
	Number of Micro-watersheds	
	Water demand (ha.m)	
	For Humans	Sensitivity
	For Livestock	
	For Agriculture	
	% GW utilization for Drinking	
	% GW utilization for Livestock	
	% GW utilization for Agriculture	
	% SW utilization for Drinking	
	% SW utilization for Livestock	
	% SW utilization for Agriculture	
	Watershed and Drainage Networks	
	Water Quality Index	
	Sea Mixing Index	
	Salinity Index	
Agriculture	**Area under land resources (in ha)**	
	Forest land	Adaptive capacity
	Non-Agricultural Uses	
	Barren & Un-cultivable Land	
	Permanent pastures and Other grazing land	
	Land under miscellaneous tree crops etc.	
	Cultivable wasteland	

Agriculture	Fallows land other than current fallows	Sensitivity
	Current fallow land	
	Unirrigated land	
	Area irrigated by source	
	Land under catchment area (ha)	
	Good Catchment	Adaptive capacity
	Average Catchment	
	Bad Catchment	Sensitivity
	Crop Area details (in ha)	
	Irrigated Area	Sensitivity
	Rainfed area	
	Soil Resources: Status of available Nitrogen (in %)	
	Very low to low	Sensitivity
	Status of Organic Carbon (in %)	
	Very low to low	Sensitivity
	Status of Soil Micro Nutrients (in %)	
	Deficient	Sensitivity
	Status of Physical condition of the soil (in %)	
	Highly acidic/alkaline	Sensitivity
	Slightly acidic	Adaptive capacity
	Neutral	
	Moderately alkaline	
	Soil Texture (in %)	
	Clay	Sensitivity
	Fine	Adaptive capacity
	Coarse loamy	
	Soil Water Permeability (Low, Moderate, high)	
	Soil moisture and ET (in ha.m)	
	Estimated soil moisture	Adaptive capacity
	ET losses	Sensitivity
	Means of Water Extraction (in %)	
	Lifting	Sensitivity
	Irrigation Methods (in %)	
	Wild flooding	Sensitivity
	Livestock (in No.)	
	Livestock density (cattle, sheep, Goat, poultry)	Sensitivity
Socio economic	Population density (persons per ha)	Sensitivity
	Demographic (in %)	
	Female Proportion	Sensitivity
	Vulnerable population Proportion	
	Economic (In %)	
	Only one room HH's	Sensitivity
	Female headed HH's	
	Vulnerable households	
	MGNREGA (in %)	
	Registered MGNREGA Job cards	Adaptive capacity
	Active person working in MGNREGA job Cards	

Socio economic	**Water accessibility (in %)**	
	HH's have tap water connection for drinking water	Adaptive capacity
	HH's dependent on other sources for drinking water	Sensitivity
	Annual Greywater Generation (in ha.m)	

The identified indicators are from different sources and measured in different units. As the vulnerability assessment is about ranking, the indicators have to be in common units. This is done through normalization. The normalized indicators are aggregated and categorized to different vulnerability levels very high, high, medium, low and very low category. The vulnerability assessment methodology is given in Annexure 4. The GPs categorized based on vulnerability scores are shown in Figure 4.2. Kullathur, Radhappuli, Kiliyur, Keelakavanoor and Kalliyadiyendai GPs have very high rural water security vulnerability to climate risks followed by Pagaivendri, Siruvayal, Karadaranthakudi, Vaniyavallam, Sadurvedamangalam, Nainarkoil, Vallam, Thalayadikottai, Siraikottai and P.Kodikulam GPs with high vulnerability. Thenthangal, Vadavaneri, Thiyagavanseri, Thavalaikulam GPs have very low vulnerability.

Upto	Category	Color range
0.541	Very High	
0.516	High	
0.490	Medium	
0.465	Low	
0.439	Very low	

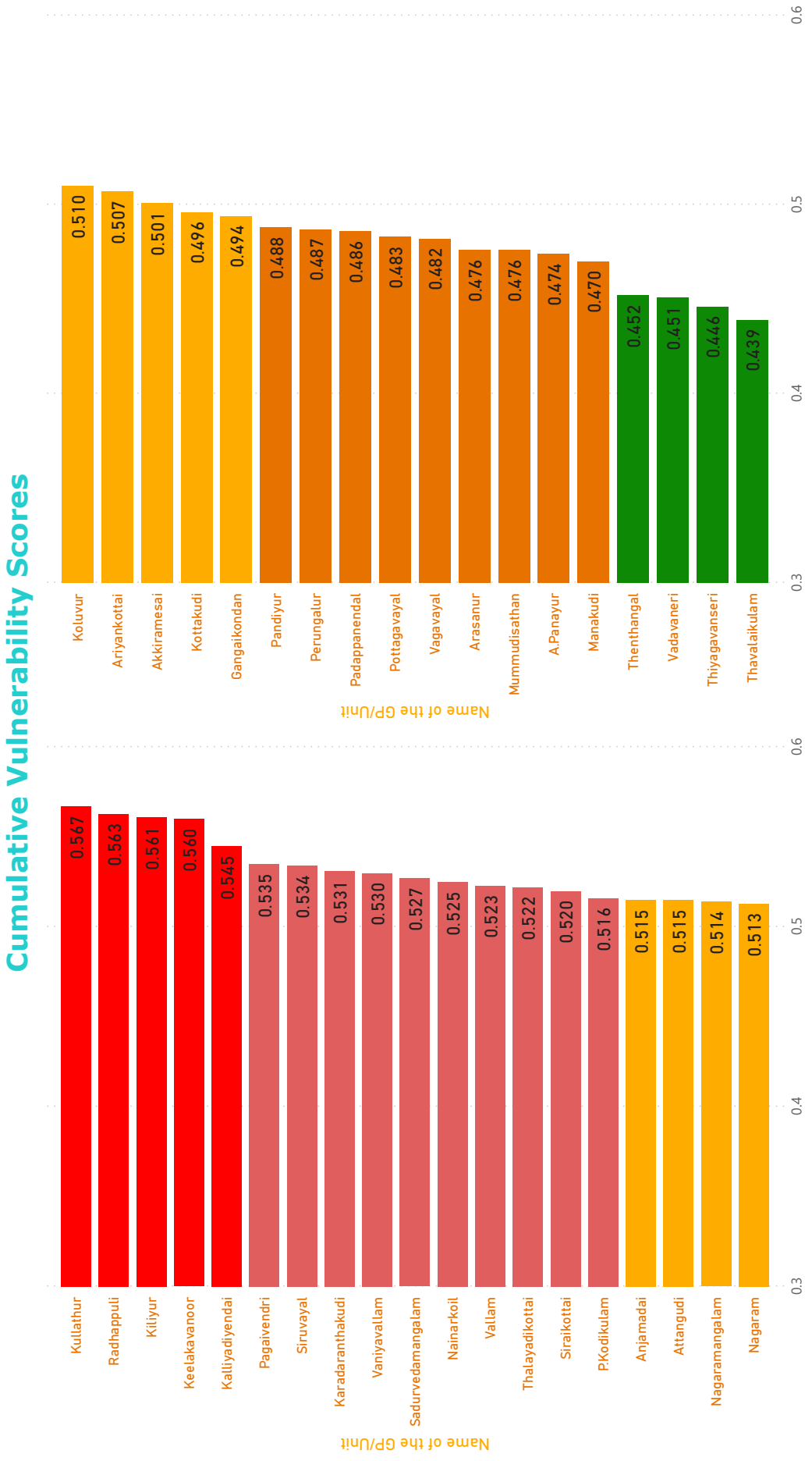


Figure 4.2. Final cumulative vulnerability scores

Sectoral vulnerability

The vulnerability indices were calculated within climate risks, water resource, agriculture and socio-economic dimensions and are shown in Figure 4.3 to identify area wise vulnerable GPs.

Climate risks vulnerability

The climate risk vulnerability index shows that all GPs in this Block are affected with droughts in last decades. Gangaikondan GP has moderate flood vulnerability

GANGAIKONDAN

Water resource vulnerability

The water resources vulnerability index shows that Radhappuli, Sadurvedamangalam, Karadaranthakudi, Keelakavanoor, P.Kodikulam, Vaniyavallam GPs have high vulnerability

RADHAPPULI, SADURVEDAMANGALAM, KARADARANTHAKUDI, KEELAKAVANOOR, P.KODIKULAM, VANIYAVALLAM

Agriculture resources vulnerability

In agriculture and allied sectors, Kullathur, Kiliyur, Kottakudi, Keelakavanoor GPs have high vulnerability

KULLATHUR, KILIYUR, KOTTAKUDI, KEELAKAVANOOR

Socio-economic vulnerability

Pagaivendri, Pottagavayal, Nagaram, Vaniyavallam, Vallam Kalliyadiyendai, Attangudi, Kiliyur GPs have high socio-economic vulnerability

PAGAIVENDRI, POTTAGAVAYAL, NAGARAM, VANIYAVALLAM, VALLAM KALLIYADIYENDAI, ATTANGUDI, KILIYUR

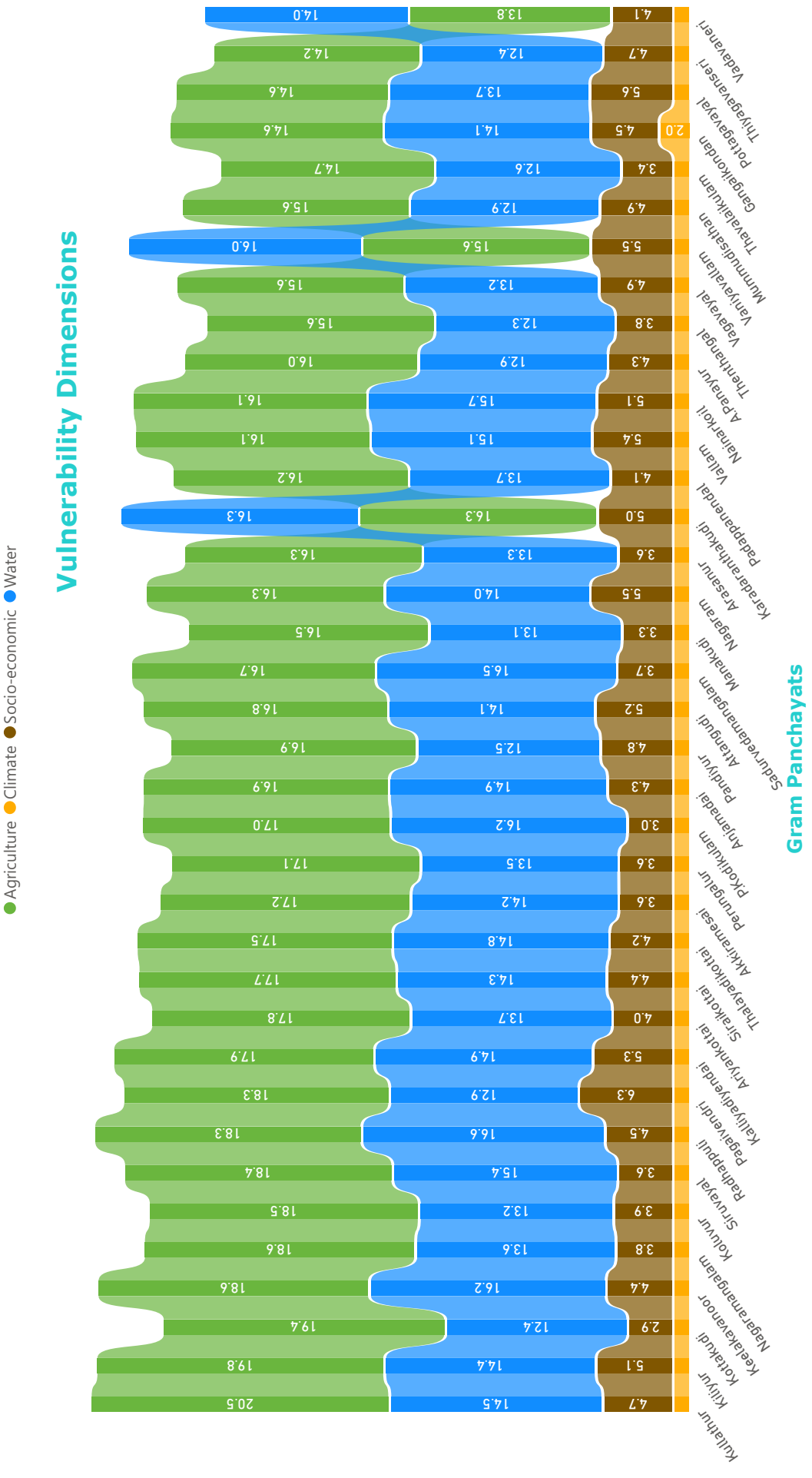
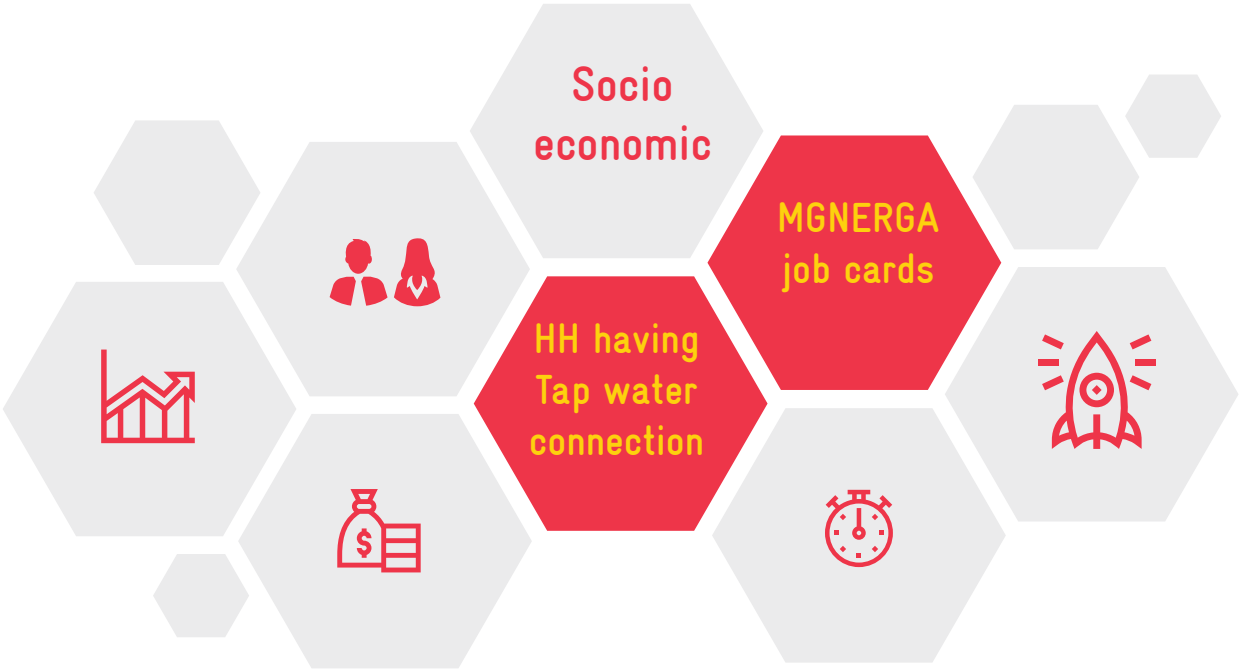
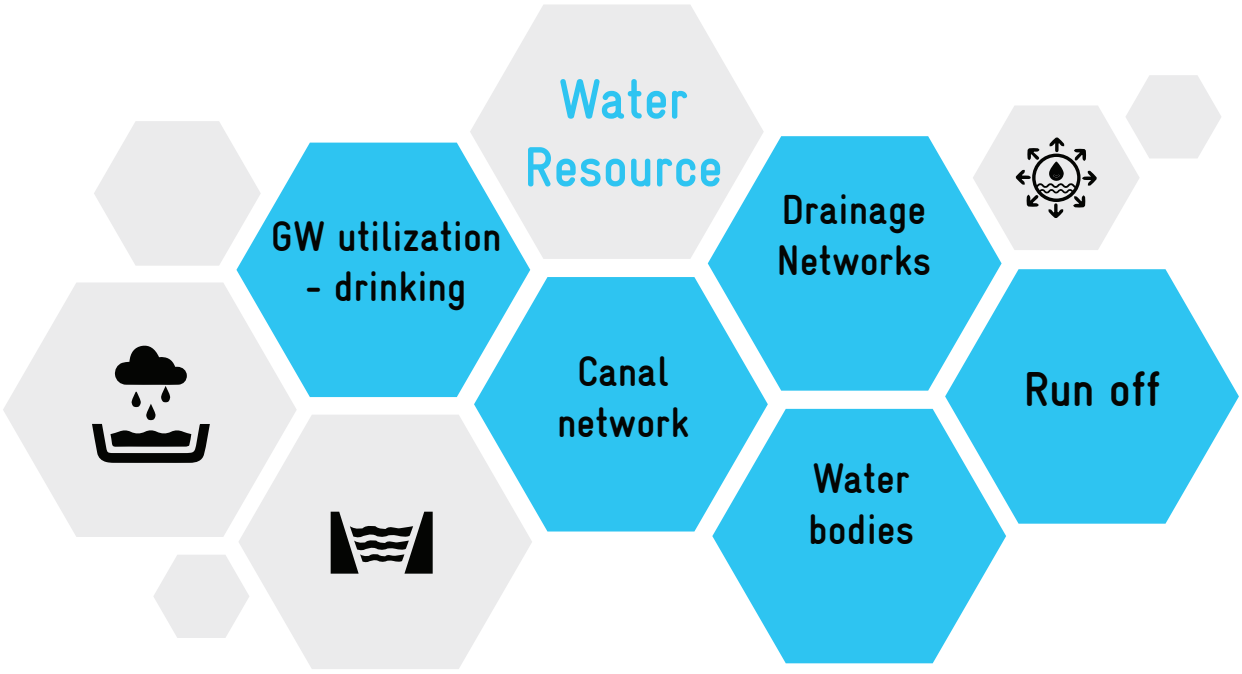
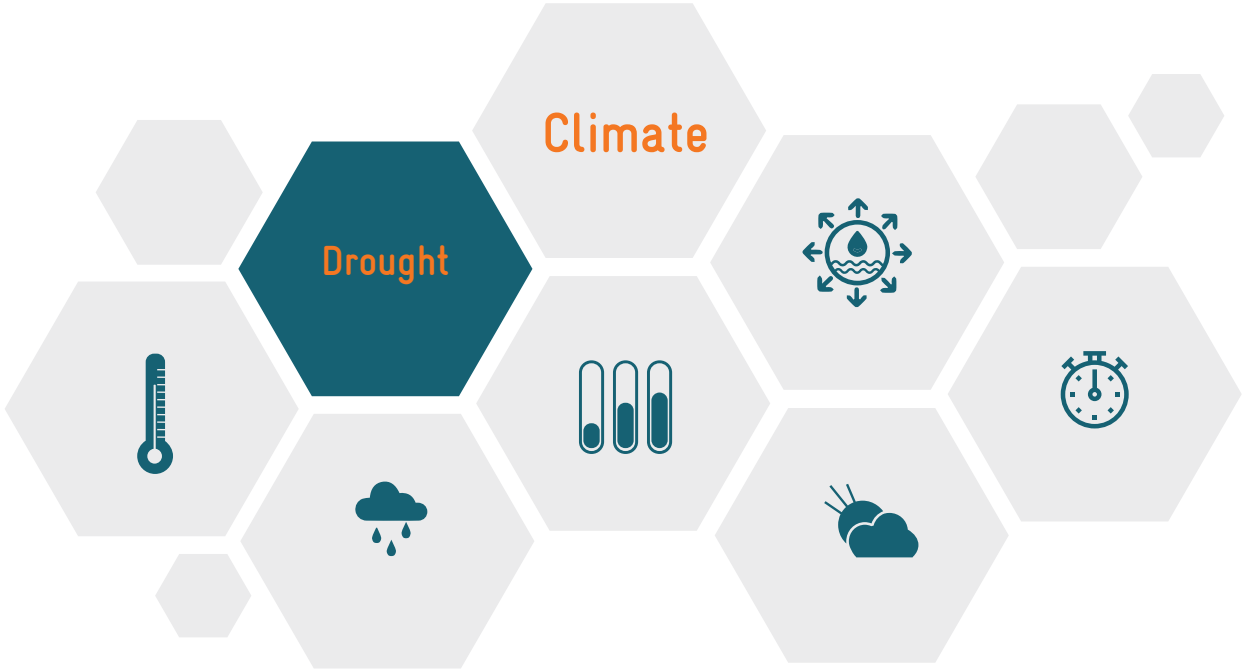


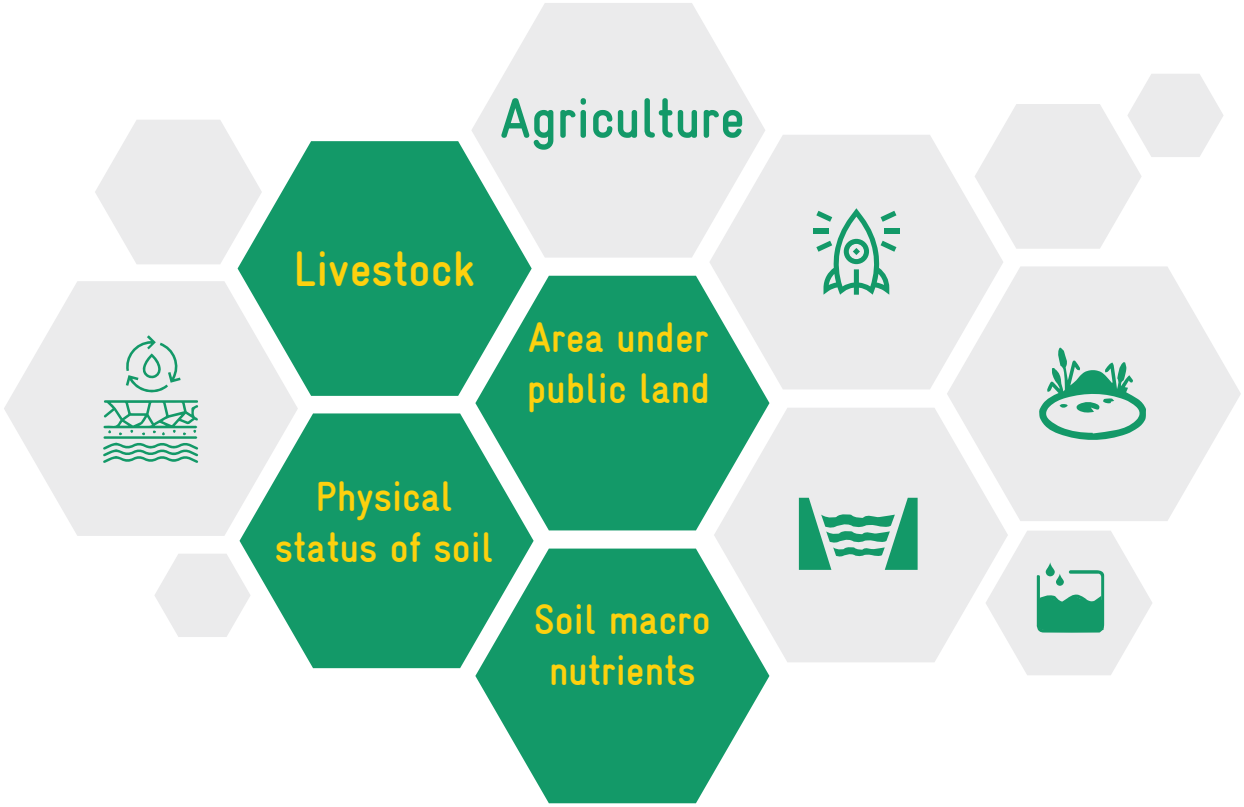
Figure 4.3. GP wise vulnerability dimensions

Contributing indicators to the total vulnerability









Based on the vulnerability assessment, high attention has been provided to identify more shelf of works/actions in the resource management in order to reduce the vulnerability and increase its adaptive capacity towards climate change.

விசும்பின் துளிவீழின் அல்லால்மற் றாங்கே
பசும்புல் தலைகாண்பு அரிது

குறள் - 16

No grassy blade its head will rear
If from the cloud no drop appear

Thirukkural - 16

CHAPTER 5

PROPOSED KEY WATER ACTIONS UNDER MAHATMA GANDHI NREGS CONVERGENCE

5 PROPOSED TREATMENT ACTIONS UNDER WASCA, CWRM AND CRM IN THE BLOCK

After identifying the key water issues at GP level through vulnerability analysis, the area for key water action treatments were proposed. The comprehensive and holistic understanding of the key water challenges adopting the eco-system approach enable to identify water action works in public and common land (afforestation, soil and water conservation, improving the traditional water storage and catchment assets etc.,), agriculture and allied sector (farm ponds, artificial recharge structures, on-farm plantation, irrigation methods, livestock - fodder development etc.,) and rural infrastructure (on safe drinking water and efficient handling of grey water).

5.1 THE PROPOSED AREA UNDER WASCA TREATMENT

Out of 26,341.31 ha available land in Nainarkoil Block, 4,784.89 ha (18.16%) area is considered for treatment under WASCA TN– CWRM planning. A major portion of key water actions is proposed in land under miscellaneous tree crops (38.21 % of total area proposed area), followed by unirrigated land (17.68 %) while least of 0.05 % area of permanent pastures and other grazing land was considered for treatment. The detailed land wise proposal for WASCA treatments is given in the Table 10 and Figure 5.1. GP wise proposed area for treatment is also attached in Annexure 5.1.

TABLE 10. THE PROPOSED AREA FOR WASCA TREATMENT

Land use	Total available land (ha)	WASCA proposed treatment area (ha)
Land Under Miscellaneous Tree Crops etc.	2,150.81	1,828.17
Unirrigated Land	6,976.82	846.00
Area Irrigated by Source	4,808.13	785.21
Current Fallow land	3,733.90	436.98
Fallows Land other than Current Fallows	2,386.64	402.78
Non-Agricultural Uses	6,182.47	398.61
Cultivable Waste Land	72.54	61.64
Barren & Un-cultivable Land	27.00	22.95
Permanent Pastures and Other Grazing Land	3.00	2.55

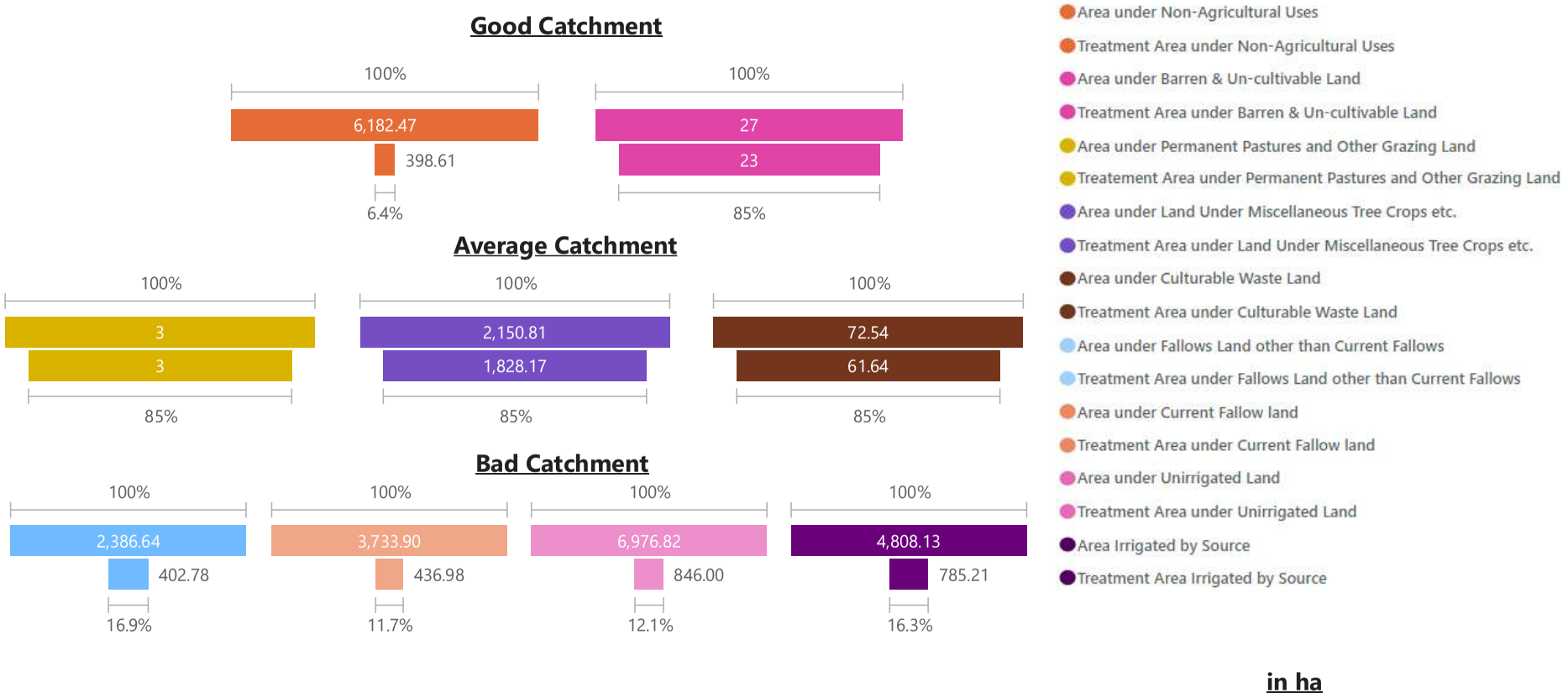


Figure 5.1. WASCA treatment area in percentage

Expected Runoff Conservation after WASCA treatment

The productive developmental activities that were taken up in the WASCA proposed areas are termed as Key Water Actions. With the above proposed treatment area, the expected runoff harvested due to WASCA intervention would be around 1,320 ha.m which is 34.82 % of the total runoff. Of the expected runoff conservation, the highest of 48.71 % good catchment area was considered for treatment followed by 30.53 % of bad and rest from average catchment area (Figure 5.2).

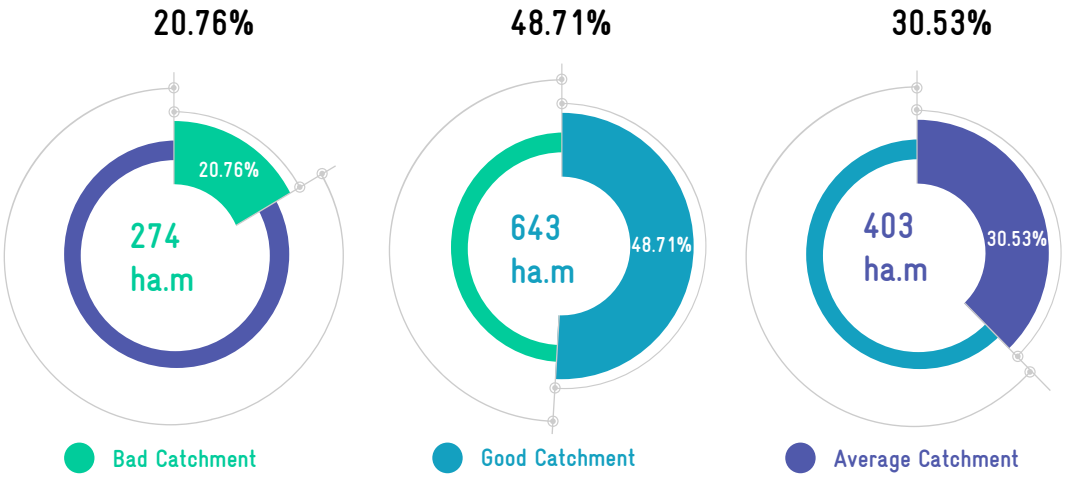


Figure 5.2. Expected conservation after WASCA treatment

The GP wise expected runoff conservation after completion of WASCA treatment is shown in Figure 5.3 (Annexure 5.2).

All the works are proposed based on watershed and livelihood approach. The summary statistics of all proposed works are given below. The detailed list of works for all GP are attached in Annexure 5.3.

Work (unit)	Abbreviation (unit)	No.	Extent (area in ha or length in m)
Azolla units - Individual (Number of units)	Az	75	710
Cattle Shelters (Number of units)	CS	75	710
Cattle Trough(Number of units)	CT	75	710
Fodder development - Community & Individual	FD	75	710
Goat Sheep Shelters (Number of units)	GSS	529	5,183
Poultry Shed (Number of units)	PS	157	1,554
Silvi-pasture Development (ha)	SPD	2,040	3
Soak Pits (Community) (Number of units)	SPC	160	15,816
Soak Pits (Individual) (Number of units)	SPI	1,585	15,816

Artificial Recharge Structure(Number of units)	ARS	688	1,720
Construction of Farm Ponds - Individual (Number of units)	FP	672	2,471
Restoration of water bodies:PWD and Union Tanks(Number)	RPWDT	71	
Restoration of water bodies:Ooranis(Number)	Roo	282	
Restoration of water bodies:Ponds(Number)	RP	-	
Roof Rain Water Harvesting (Number of units)	RRWH	74	
Water Course - Irrigation Channels - Desilting (Mtrs)	WCICD	41,406	
Afforestation in Public/common lands(ha)	Aff	3,37,248	422
Avenue plantation(Km)	AVP	31,489	1,25,948
Block Plantation (Community)(ha)	BP	13,14,704	1,892
Canal Bund Plantation(ha)	CBP	23,041	92,155
Contour Continuous Bunds (CCB) for Afforestation area(Mtrs)	CCBF	84,312	422
Drainage Line Treatment (Mtrs)	DLT	12,859	51,418
Dry land Horticulture/Agro-forestry - Individual (ha)	DLHAI	493	1,236
Irrigation Channel Plantation (Mtrs)	ICP	10,354	41,406
Linear Plantation(Km)	LP	11,619	46,475
Micro Irrigation(ha)	MI	311	785
Nursery Development (Number of units)	ND	79,080	15,816
Composting(Number of units)	Co	753	2,471
Farm Bunding with Boundary Trenches - Individual (ha)	FBBTI	988	2,471
Land development - Individual (ha)	LDI	343	843
NADEP Vermi compost (Number of units)	NADEP	75	710


Proposed works are included the drought proofing, livelihood, land development and WCWH, measures
Land development works over 6,494 ha area
More than 18.7 Lakhs plants planting
1,787 sites for WCWH
4,771 livelihood works

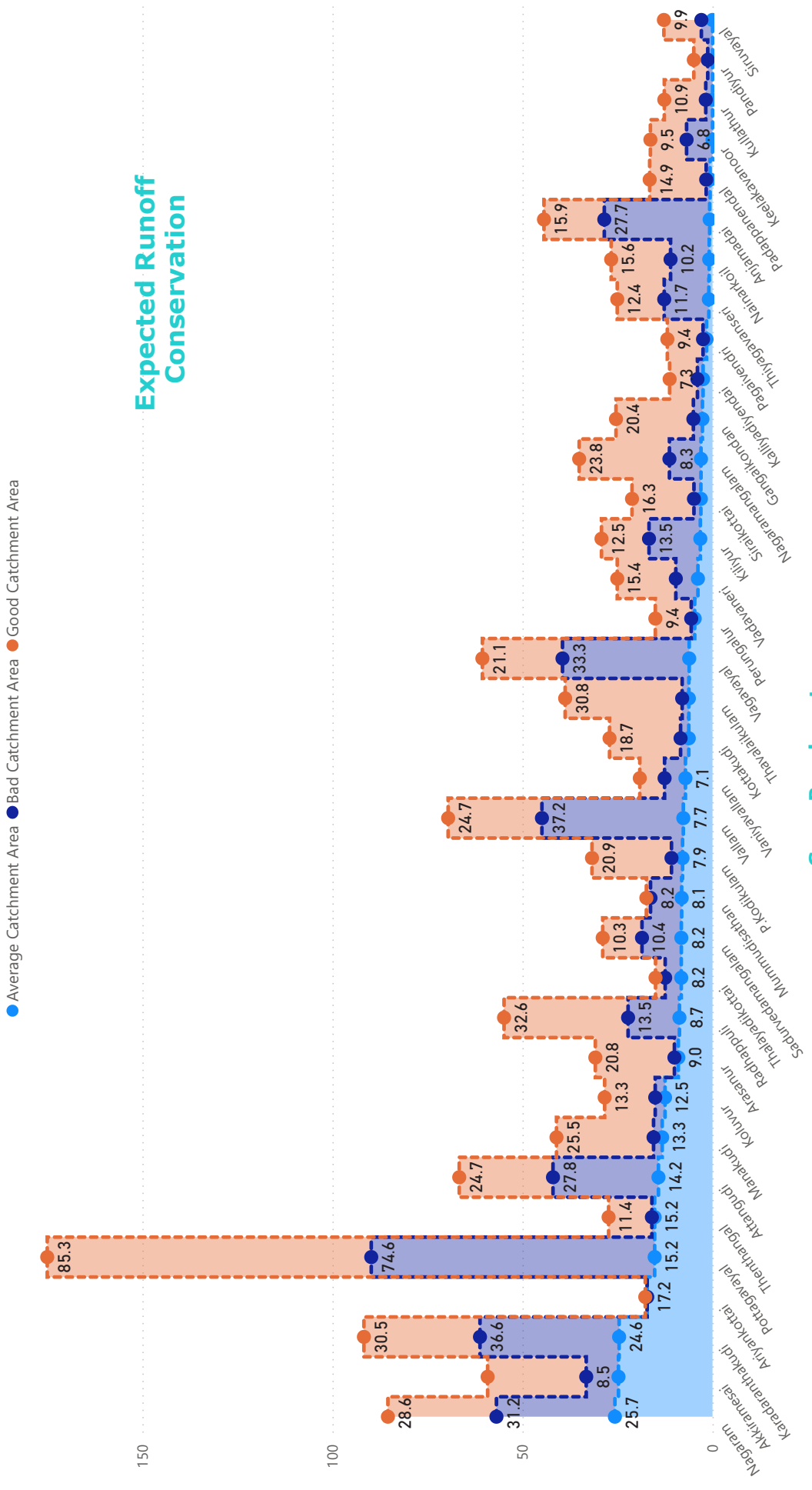


Figure 5.3. Expected GP wise runoff conservation after WASCA treatment

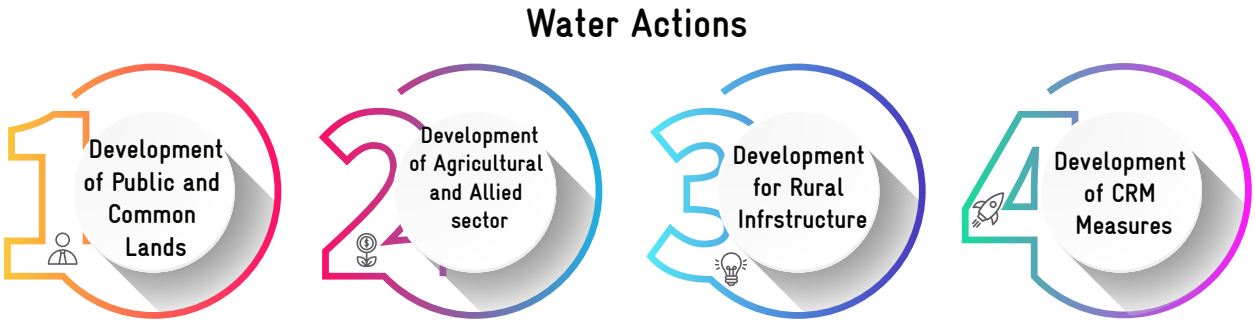
MAHATMA GANDHI NREGS Annual circular 2020-21 (Clause 6.3)

Planning and design of works under Mahatma Gandhi NREGS should take into account, impacts of climate change in order to ensure resilience of vulnerable rural communities and make the benefits sustainable in the long run. Specifically, the following things should be ensured:

I. Historical and projected climate change data, especially incidence of droughts and floods, along with vulnerability assessment at the District, Block or gram panchayat level should be used in the planning and design of Mahatma Gandhi NREGS works.

II. Different kinds of complementary Natural Resource Management (NRM) works such as land development with plantation on the bunds, farm ponds, and compost pits should be combined, in order to ensure durability of assets and resilience of communities that depend on such assets.

The Key Water Actions proposed under 4 categories through Mahatma Gandhi NREGS convergence of considering its models under Right to Plan and Prepare a Shelf of Projects (Clause 6) are



5.2 DEVELOPMENT OF PUBLIC & COMMON LANDS

The effective water augmentation measures are proposed in public and common lands via massive tree plantation, restoration of waterbodies etc., as listed in Table 11 and Figure 5.4.

DEVELOPMENT OF PUBLIC AND COMMON LANDS

TABLE 11. DETAILS OF WORK PROPOSED TO DEVELOP PUBLIC AND COMMON LANDS

	NO. OF WORKS	PERSON DAYS PER UNIT	UNIT COST IN INR (LAKHS)	ESTIMATED COST IN INR (LAKHS)	ESTIMATED PERSON DAYS
CONTOUR CONTINOUS BUNDS (CCB) FOR AFFORESTATION AREA(m)	1,686	10	0.025	42.16	16,862
COMPOSTING (NUMBER OF UNITS)	753	15	0.17	128.01	11,295
AFFORESTATION IN PUBLIC/ COMMON LANDS (ha)	422	3,344	8.6	3,625.42	14,09,697
BLOCK PLANTATION (COMMUNITY) (ha)	1,892	4,320	11.1	21,005.75	81,75,211
SILVI-PASTURE DEVELOPMENT (ha)	3	6,664	17.1	43.61	16,993
LINEAR PLANTATION (km)	46	703	1.8	83.66	32,672
CANAL BUND PLANTATION (ha)	161	2,930	7.5	1,209.68	4,72,580
IRRIGATION CHANNEL PLANTATION (m)	4,125	6	0.015	61.88	24,752
AVENUE PLANTATION(km)	126	703	1.8	226.71	88,541
NURSERY DEVELOPMENT (NUMBER OF UNITS)	395	2,344	15	5,931	9,26,818
RESTOTARATION OF WATER BODIES: PWD AND UNION TANKS (NUMBER)	73	800	5	365	58,400
RESTORATION OF WATER BODIES: OORANIS (NUMBER)	255	200	2	510	51,000
RESTORATION OF WATER BODIES: PONDS (NUMBER)	10	200	1	10	2,000
ARTIFICIAL RECHARGE STRUCTURE (NUMBER OF UNITS)	486	391	2.5	1,215	1,90,026
WATER COURSE - IRRIGATION CHANNELS - DESILTING (M)	4,125	3	0.0075	30.94	12,376
DRAINAGE LINE TREATMENT (m)	1,286	5	0.03	38.58	6,430

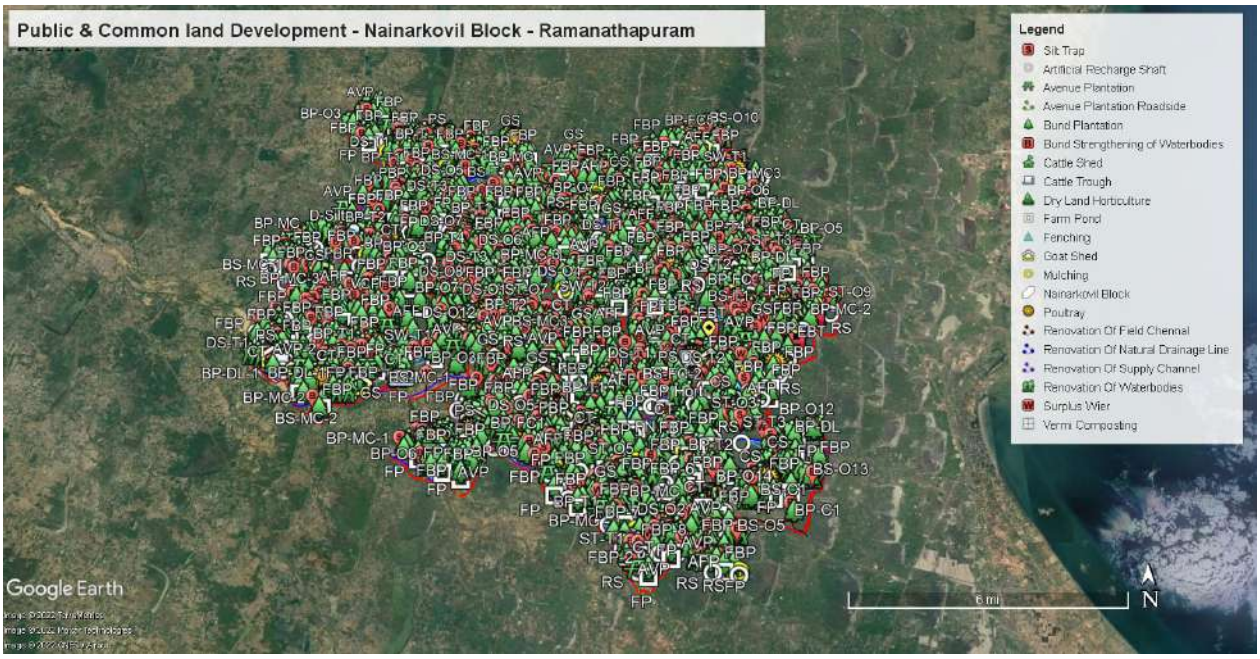


Figure 5.4. Proposed development activities in Public and Common land

5.3 DEVELOPMENT OF AGRICULTURE AND ALLIED SECTOR

Based on the assessment, the works which enhance the agriculture and allied sectors particularly for irrigation, soil and live stocks are proposed in the lands under individual ownership (Table 12 & Figure 5.5).

DEVELOPMENT OF AGRICULTURE AND ALLIED ACTIVITIES

TABLE 12. DETAILS OF WORKS PROPOSED TO DEVELOP AGRICULTURE AND ALLIED SECTORS

	NO. OF WORKS	PERSON DAYS PER UNIT	UNIT COST IN INR (LAKHS)	ESTIMATED COST IN INR (LAKHS)	ESTIMATED PERSON DAYS
FARM BUNDING WITH BOUNDARY TRENCHES - INDIVIDUAL (ha)	2,471	586	1.5	3,706.50	14,48,006
MICRO IRRIGATION (ha)	785	-	1	311	-
CONSTRUCTION OF FARM PONDS - INDIVIDUAL (NUMBER OF UNITS)	2,471	781	2	1,344	5,24,832
LAND DEVELOPMENT - INDIVIDUAL (ha)	843	3,906	10	8,430	32,92,758
DRY LAND HORTICULTURE/AGRO-FORESTRY - INDIVIDUAL (ha)	1,236	3,321	8.5	10,506	41,04,756
AZOLLA UNITS - INDIVIDUAL (NUMBER OF UNITS)	710	23	0.15	11.25	1,725
NADEP VERMI-COMPOST (NUMBER OF UNITS)	710	27	0.18	13.50	2,025
FODDER DEVELOPMENT - COMMUNITY & INDIVIDUAL	710	2,344	1.48	111	1,75,800
CATTLE SHELTERS (NUMBER OF UNITS)	710	331	2.12	159	24,825
GOAT SHEEP SHELTERS (NUMBER OF UNITS)	5,183	355	2.27	1,200.83	1,87,795
CATTLE TROUGH (NUMBER OF UNITS)	710	6	0.05	3.75	450
POULTRY SHED (NUMBER OF UNITS)	1,554	10	0.09	14.13	1,570

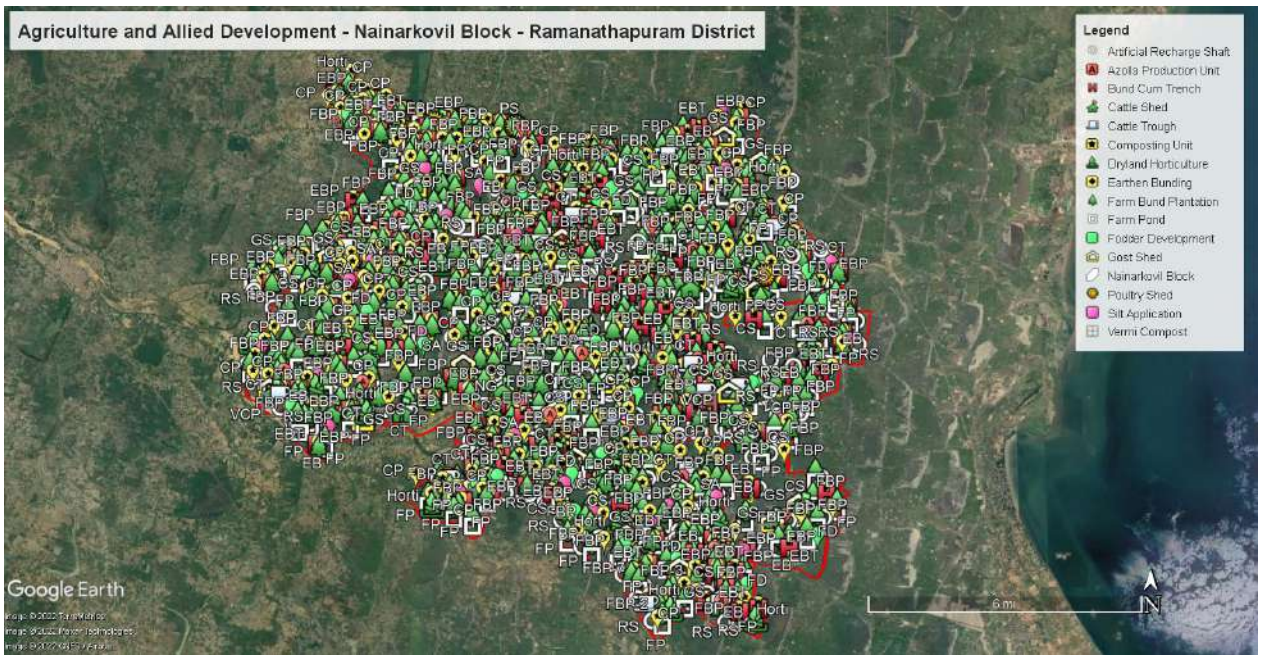


Figure 5.5. Proposed development activities in Agriculture and allied Sectors

5.4 DEVELOPMENT OF RURAL INFRASTRUCTURE

The prominent works on constructing structures for water harvesting and grey water management are proposed as in Table 13 and Figure 5.6.

DEVELOPMENT OF RURAL INFRASTRUCTURE

TABLE 13. DETAILS OF WORK PROPOSED TO DEVELOP RURAL INFRASTRUCTURE

	NO. OF WORKS	PERSON DAYS PER UNIT	UNIT COST IN INR	ESTIMATED COST IN INR (LAKHS)	ESTIMATED PERSON DAYS
SOAK PITS (COMMUNITY) (NUMBER OF UNITS)	160	20	0.13	20.80	3,200
SOAK PITS (INDIVIDUAL) (NUMBER OF UNITS)	1,585	16	0.1	158.50	25,360
ROOF RAIN WATER HARVESTING (NUMBER OF UNITS)	74	625	4	296	46,250
TANKA - COMMUNITY LEVEL (NUMBER OF UNITS)	-	300	30	-	-

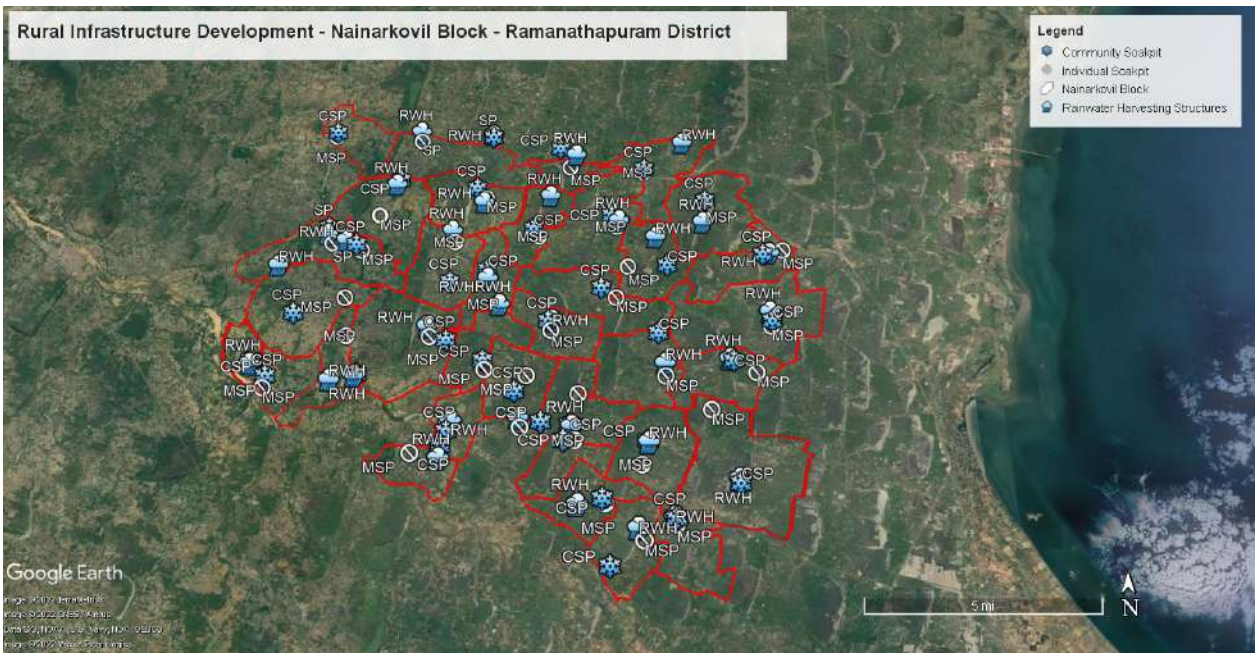


Figure 5.6. Proposed Rural Infrastructure activities

5.5 PROPOSED CLIMATE RESILIENCE MEASURES

Climate resilient measures are proposed to enable the system to cope up with future climate risks such as droughts, heatwaves and floods (Figure 5.7). Proposed CRM includes public, agriculture and rural infrastructure activities, whereas focus is given on public and common land development measures followed by agriculture and allied development (Table 14). Measures such as farm ponds (Table 15), fallow land development (Table 16), horticulture park (Table 17), mega forest plantation (Table 18), GP level nurseries (Table 19), mini forestry (Table 20), Cascade of tanks (Table 21) tankas (Table 22) were proposed in this Block in saturation mode.

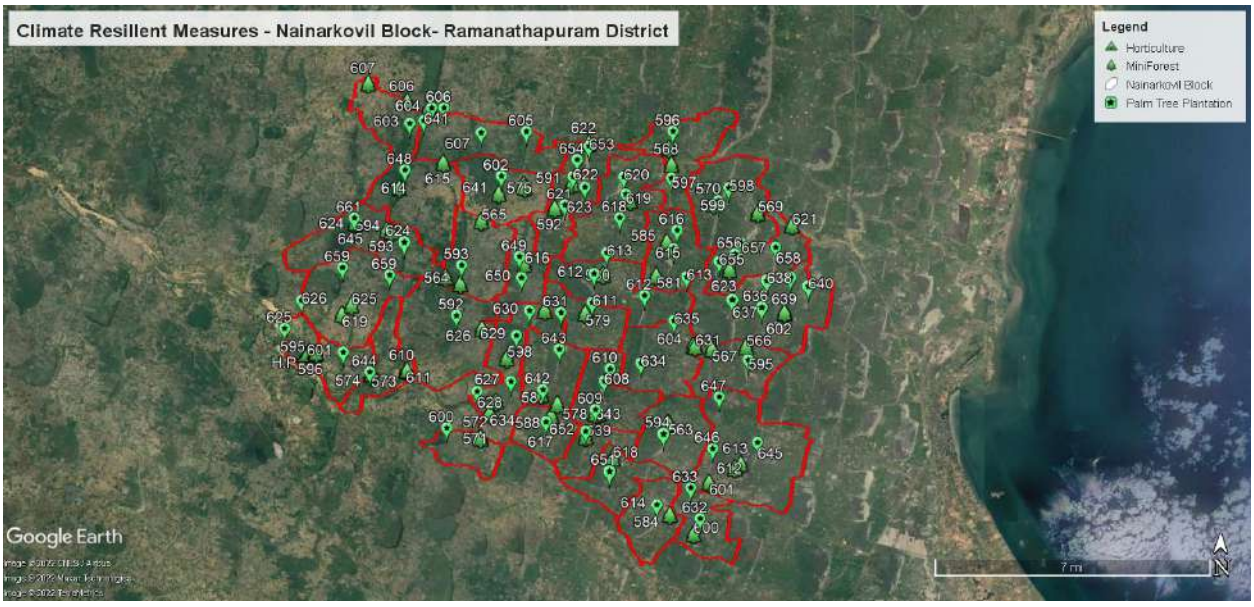


Figure 5.7. Proposed Climate Resilient measures

TABLE 14. GP WISE PROPOSED CRM

GP	Agriculture and allied activities	Public and common land	Rural infrastructure
A. Panaiyur	Mini Forest	GP Level Nursery	Tanka
A.Katchan	Mini Forest		
Akkiramesi	Mini Forest	GP Level Nursery	Tanka
Anjamadaikatchan		GP Level Nursery	Tanka
Arasanur	Mini Forest	GP Level Nursery	Tanka
Ariyankottai	Cascade of Tanks	GP Level Nursery	
Attangudi	Cascade of Tanks	GP Level Nursery	Tanka
	Mini Forest		
Gangaikondan	Mini Forest	GP Level Nursery	Tanka
Kadaranthakudi	Mini Forest		Tanka
Kalliyadiendal			Tanka
Kalliyadiyenthal	Mega Forest	GP Level Nursery	
Karadarnthakudi		GP Level Nursery	
Keelakavanur	Mini Forest	GP Level Nursery	Tanka
Kiliyur	Mega Forest	GP Level Nursery	Tanka
	Fallow Land Development/Dry Land Horticulture		
	Mini Forest		
Koluvur	Mini Forest	GP Level Nursery	Tanka
Kottakudi	Mini Forest	GP Level Nursery	Tanka
Kulathur	Mini Forest	GP Level Nursery	Tanka
Manakudi	Mini Forest	GP Level Nursery	Tanka
Mummudi Chathan		GP Level Nursery	
Mummudisathan	Mini Forest		Tanka
Nagaram	Cascade of Tanks	GP Level Nursery	Tanka
	Mini Forest		
	Mega Forest		
Nagaramangalam	Mini Forest	GP Level Nursery	Tanka
Nainarkoil	Mini Forest		
Nainarkoil		GP Level Nursery	Tanka
P Kodikulam	Mini Forest	GP Level Nursery	Tanka
Pagaivendri	Horticulture Parks	GP Level Nursery	Tanka
	Mini Forest		
Pandappanendal			Tanka
Pandiyur	Mini Forest	GP Level Nursery	Tanka
Panthapanenthal	Mini Forest	GP Level Nursery	
Perungalur	Mini Forest	GP Level Nursery	Tanka
Potagavayal	Mini Forest	GP Level Nursery	Tanka
Radhappuli	Mini Forest	GP Level Nursery	Tanka
S.V.Mangalam	Mini Forest		
Sadurvedamangalam		GP Level Nursery	Tanka
Sirakikottai	Mini Forest	GP Level Nursery	Tanka

Siruvayal	Mini Forest	GP Level Nursery	Tanka
	Fallow Land Development/Dry Land Horticulture		
Thalaiyadikottai	Mini Forest		Tanka
Thalayadikottai	Mega Forest	GP Level Nursery	
Thavalaikulam	Mini Forest	GP Level Nursery	Tanka
Thethangal	Mini Forest	GP Level Nursery	Tanka
Thiyagavancei	Mini Forest	GP Level Nursery	Tanka
Vadavaneri	Cascade of Tanks	GP Level Nursery	Tanka
	Mini Forest		
Vagavayal	Mega Forest	GP Level Nursery	
Vallam	Mini Forest	GP Level Nursery	Tanka
Vaniyavallam	Mega Forest	GP Level Nursery	Tanka
	Mini Forest		

TABLE 15. DETAILS OF PROPOSED FARM PONDS ACTIVITY UNDER CRM

Block Target	Community Farm Ponds	Community Farm Ponds Completed	Individual Farm Ponds	Individual Farm Ponds Completed	Individual Farm Ponds Ongoing
100	90	90	10	6	4

TABLE 16. DETAILS OF PROPOSED FALLOW LAND DEVELOPMENT/DRY LAND HORTICULTURE ACTIVITIES UNDER CRM

GP	Classification of land
Siruvayal, Kiliyur	Individual Land

TABLE 17. DETAILS OF PROPOSED HORTICULTURE PARK ACTIVITIES UNDER CRM

GP	Area in ha	No. of Plants (1 ha – 10,000 saplings)	Land type
Pagaivendri	0.70	51	**Govt. Purampokku land**

TABLE 18. DETAILS OF PROPOSED MEGA FOREST ACTIVITY UNDER CRM

GP	Area in ha	No. of Plants	Land type
Kalliyadiyenthal	0.5	5,000	**Govt. Purampokku land**
Kiliyur	1	10,000	
Nagaram	0.5	5,000	
Thaliyadikottai	1.5	15,000	
Vagavayal	1	10,000	
Vaniyavallam	0.5	5,000	
Total	**5**	**50,000**	

TABLE19. DETAILS OF PROPOSED GP LEVEL NURSERY ACTIVITY UNDER CRM

GP	Total No.of Plants
A. Panaiyur	1,000 saplings in each GP
Akkiramesi	
Anjamadaikatchan	
Arasanur	
Ariyankottai	
Attangudi	
Gangaikondan	
Kalliyadiyenthal	
Karadarnthakudi	
Keelakavnur	
Kiliyur	
Koluvur	
Kottakudi	
Kulathur	
Manakudi	
Mummudi Chathan	
Nagaram	
Nagaramangalam	
Nainarkoil	
P. Kodikulam	
Pagaiventri	
Pandiyur	
Panthappanenthal	
Perungalur	
Potagavayal	
Radhappuli	
Sadurvedamangalam	
Sirakikottai	
Siruvayal	
Thaliyadikottai	
Thavalaikulam	
Thethangal	
Thiyagavanseri	
Vadhavanery	
Vagavayal	
Vallam	
Vaniyavallam	
Total	**37,000**

TABLE 20. DETAILS OF PROPOSED MINI FOREST ACTIVITY UNDER CRM

GP	Area for Plantation (In ha)	Total No. of Plants (1 ha - 10000 saplings)	Classification of land
A.Katchan	0.1	1,000	Govt Purampokku land
A.Panaiyur	0.15	1,500	
Akkiramesi	0.1	1,000	
Arasanur	0.1	1,000	
Ariyankottai	0.1	1,000	
Attangudi	0.1	1,000	
Gangaikondan	0.1	1,000	
Kadaranthakudi	0.2	2,000	
Kalliyadiyenthal	0.1	1,000	
Keelakavanur	0.1	1,000	
Kiliyur	0.15	1,500	
Koluvur	0.05	500	
Kottakudi	0.15	1,500	
Kulathur	0.1	1,000	
Manakudi	0.1	1,000	
Mummutisathan	0.15	1,500	
Nagaram	0.15	1,500	
Nagaramangalam	0.1	1,000	
Nainarkoil	0.1	1,000	
P.Kodikulam	0.1	1,000	
Pagaivendri	0.1	1,000	
Pandiyur	0.1	1,000	
Panthapanenthal	0.1	1,000	
Perungalur	0.1	1,000	
Pottagavayal	0.1	1,000	
Radhapuli	0.05	500	
S.V.Mangalam	0.1	1,000	
Sirakikottai	0.2	2,000	
Siruvayal	0.1	1,000	
Thalaiyadikottai	0.25	2,500	
Thavalaikulam	0.05	500	
Thethangal	0.1	1,000	
Thiyagavancei	0.1	1,000	
Vadhavanery	0.1	1,000	
Vagavayal	0.15	1,500	
Vallam	0.1	1,000	
Vaniyavallam	0.1	1,000	
Total	**4.2**	**42,000**	

TABLE 21. DETAILS OF PROPOSED CASCADE OF TANKS ACTIVITY UNDER CRM

Sl. No.	GP
1	Ariyankottai
2	Attangudi
3	Nagaram
4	Vadavaneri

TABLE 22. DETAILS OF PROPOSED TANKAS ACTIVITY UNDER CRM

Sl. No.	GP
1	A_Panaiyur
2	Akkiramesi
3	Anjamadaikatchan
4	Arasanur
5	Attangudi
6	Gangaikondan
7	Kalliyadiendal
8	Karadaranthakudi
9	Keelakavanur
10	Kiliyur
11	Koluvur
12	Kottakudi
13	Kulathur
14	Manakudi
15	Mummudisathan
16	Nagaram
17	Nagaramangalam
18	Nainarkoil
19	P_Kodikulam
20	Pagaivendri
21	Pandappanendal
22	Pandiyur
23	Perungalur
24	Pottagavayal
25	Radhappuli
26	Sadurvedamangalam
27	Sirakikottai
28	Siruvayal
29	Thalayadikottai
30	Thavalaikulam
31	Thethangal
32	Thiyagavanseri
33	Vadavaneri
34	Vallam
35	Vaniyavallam

நெடுங்கடலும் தன்நீர்மை குன்றும் தடிந்தெழிலி
தான்நல்கா தாகி விடின்

குறள் - 17

The ocean's wealth will waste away
Except the cloud its stores repay

Thirukkural - 17

CHAPTER 6

PROJECTED OUTCOMES OF PLANNING

6 PROJECTED OUTCOMES OF PLANNING

In view of Mahatma Gandhi NREGS guidelines, Key Water Actions are proposed based on climate vulnerability assessment and challenges at GP level for three years period from 2021- 2022 to 2023-2024. At the end of the implementation period during 2024, the following productive outcomes are envisaged on successful accomplishment of all proposed Key Water Actions. The anticipated outcomes will reduce the water security vulnerability and increase the resilience of the GPs under current and projected climatic change scenarios.

6.1 OUTCOMES OF DEVELOPMENT OF PUBLIC AND COMMON LANDS

OUTCOMES OF DEVELOPMENT OF PUBLIC AND COMMON LANDS

	INDICATOR	OUTCOMES/ IMPACT
1	Proportion of Land development under WASCA treatment	4,784.89 ha (18.16 %) of the total area treated under WASCA
2	Percentage reduction of run off	1,320 ha.m i.e 35 % of the total runoff harvested due to WASCA interventions
3	No. of waterbodies restored	338 waterbodies (tanks/pond and ooranis) restored
4	Area under afforestation	421.56 ha area under afforestation
5	Length of drainage line treated	51.418 Km length of drainage line treated
6	Canal Bund Plantation	More than 32 thousands plants through 161 works
7	Nursery development	395 units

4,784.89 ha
AREA TREATED

1,320 ha.m
TOTAL RUNOFF HARVESTED

338
WATER BODIES RESTORED

421.56 ha
AREA AFFORESTATION

51.418 km
DRAINAGE LINE TREATED

32,000
PLANTS

395 UNITS
NURSERY DEVELOPMENT

6.2 OUTCOMES OF DEVELOPMENT OF AGRICULTURE AND ALLIED SECTOR

OUTCOMES OF DEVELOPMENT OF AGRICULTURE AND ALLIED ACTIVITIES

	INDICATOR	OUTCOMES/ IMPACT
1	Assessment of sources of water for live-stock and agriculture demand No of structures established for on-farm (in-situ) water harvesting in dry lands	672 farm ponds established which target the harvest of 11,82,720 cu.m of water which has the potential to irrigate 235.2 ha area
2	Improvement in soil health	75 NADEP vermicomposting units for soil health improvement
3	Dry land development with agro-forestry	1,236 ha under dry land horticulture
4	Households established fodder plots	710 vulnerable households established fodder plots
5	Sheds for livestock's (cattle, goat, poultry)	761

672 FARM PONDS

75 COMPOST UNITS

710 FODDER PLOTS

1,236 ha DRY LAND HORTICULTURE

761 SHEDS FOR LIVESTOCK'S

6.3 OUTCOMES OF RURAL INFRASTRUCTURE DEVELOPMENT

OUTCOMES OF RURAL INFRASTRUCTURE DEVELOPMENT

	INDICATOR		OUTCOMES/ IMPACT
1	No. of villages having liquid waste management systems	1	11,173 individual and 1,118 community level soak pits established for recycle of grey water benefiting 52,635 HHs
2	Roof rain water harvesting measures	2	56 common roof rainwater harvesting and storage structures with a target to harvest and store 0.1 ha.m of rainwater for use
3	Nutri-garden	3	15,994 HHs established nutri-gardens in homesteads and planted 79,970 saplings

1,118 COMMON &
11,173 INDIVIDUAL
SOAK PITS

56
COMMON ROOF
RAINWATER HARVESTING

15,994
NUTRI-GARDENS

79,970
SAPLINGS

6.4 OUTCOMES OF CLIMATE RESILIENCE MEASURES

OUTCOMES OF CLIMATE RESILIENCE MEASURES

	INDICATOR	OUTCOMES/ IMPACT
1	Climate resilient measures are identified for climate risks	8 models are identified via., Farm ponds, horticulture park, GP level nursery, fallow land development, mini forest, mega forest, Cascade of tanks, and tankas 90 community and 10 individual farm ponds are completed in the GP GP level nursery in 37 GPs with total 37,000 plants (1,000 per GP) Horticulture park in 2 ha. Mega forest in 5 ha area with 50,000 plants Mini forest in 4.2 ha area with 42,000 plants Fallow land Development in two GP Cascade of tanks in 4 GPs Tankas in 35 GPs

90 COMMUNITY & **10** INDIVIDUAL FARM PONDS

4 CASCADE OF TANKS

37 GP LEVEL NURSERY

5 ha MEGA FOREST

2 ha HORTICULTURE PARK

4.2 ha MINI FOREST

35 TANKAS

Estimated person days

The total estimated person days required for the above proposed activities are 2,13,35,005 as specified below Figure 6.1.

Estimated Cost

The total estimated cost budgeted for the above proposed activities is Rs 60,813.63 Lakhs as specified below in Figure 6.2.

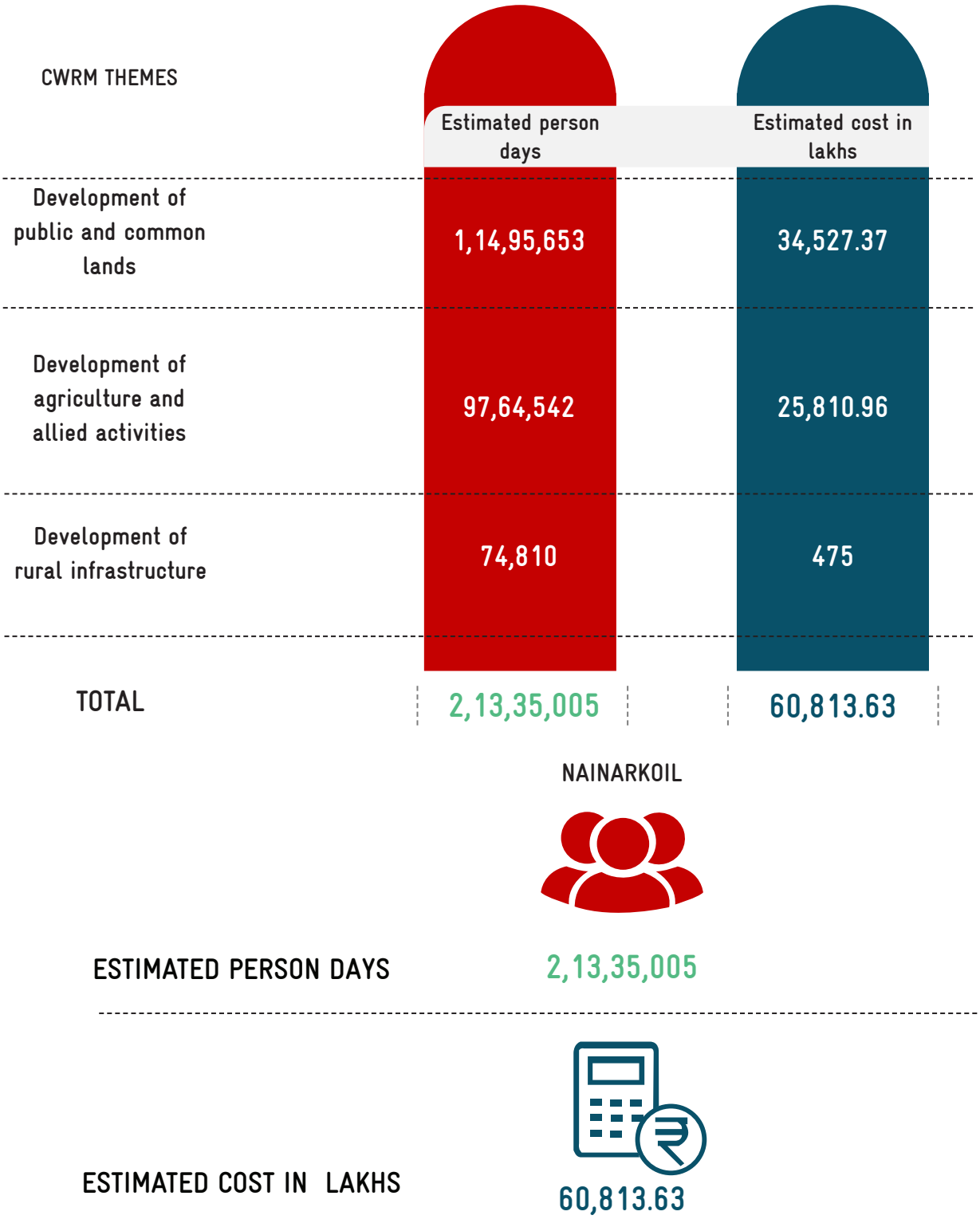


Figure 6.1 & 6.2. Estimated person days & cost for all water actions

6.5 LINKAGES TO SDGS, NDCS

The 2030 Agenda and the Paris Agreement put forth an innovative and complementary framework for accelerating action and achieving ambitious sustainable development objectives. Under the 2030 Agenda, a series of 17 global Sustainable Development Goals (SDGs) have been agreed that are to be universally achieved. Under the Paris Agreement, countries are committed to reduce greenhouse gas emissions through Nationally Determined Contributions (NDC) in order to strengthen resilience to climate change. Both the SDGs and Paris Agreements demands urgent climate action and linking WASCA activities with these two agendas is indispensable.

6.5.1 NATIONALLY DETERMINED CONTRIBUTION GOALS AND WASCA TN PROGRESS THROUGH NDC

2015 was a historic year in which 196 Parties came together under the Paris Agreement to transform their development trajectories so that they set the world on a course towards sustainable development, aiming at limiting warming to 1.5 to 2 ◦ C above pre-industrial levels. Through the Paris Agreement, Parties also agreed to a long-term goal for adaptation – to increase the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production. Additionally, they agreed to work towards making finance flows consistent with a pathway towards low greenhouse gas emissions and climate- resilient development. Nationally Determined Contributions (NDCs) are at the heart of the Paris Agreement and the achievement of these long-term goals. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement (Article 4, Paragraph 2) requires each Party to prepare, communicate and maintain successive NDCs that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

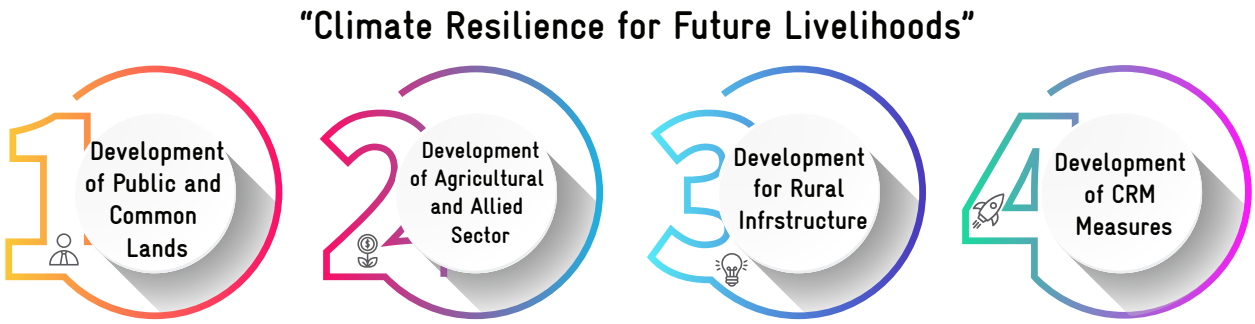
Internationally, the recent process on NDC Enhancement (2020) significantly acknowledge the climate change vulnerability on national sectors including agriculture, energy, and urban areas, especially through impacts on water resources. The role that water and water-related activities play in national economies has been increasingly recognized in most Nationally Determined Contributions (NDCs). Many parties included measures related to flooding and drought and chose to include qualitative information on the likely effect of climate change on key sectors.

WASCA TN marching on the road to support India's NDC vision by,

1. Supporting creation of an additional carbon sink of 2.5–3 billion tonnes through additional forest and tree cover
2. Enhancing investments in development programs for climate change adaptation in vulnerable sectors
3. Implementing programs to achieve the sustainable natural resource management and efficient utilization of natural resources, leading to a reduction in the "ecosystem footprint"
4. Providing qualitative information on the likely effect of climate risks on key sectors via, water, agriculture and allied sector and socio economic

6.5.2 WASCA TN SUPPORTS SDG

WASCA – TN's four major actions for making "Climate Resilience for Future Livelihoods" are envisaged through SDGs.



TN WASCA will achieve the above actions working closely with Mahatma Gandhi NREGA programme of Ministry of Rural Development and National Water Mission programme of (MoJS). These two ministries are the key stakeholders for WASCA. Apart from these two ministries, the works under WASCA TN are closely linked with Ministry of Agriculture and MoEFCC. The commitments of the above mentioned four ministries towards SDG goals achievements are mapped in connection with the interventions under WASCA Tamil Nadu. The intervention under WASCA TN has direct and indirect contribution to the SDGs and its national targets set as per NITI Aayog.

6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.A, 6.B

SDG GOAL 6

SDG 6 by 2030 : Ensure availability and sustainable management of water and sanitation for all

6.1	Achieve universal and equitable access to safe and affordable drinking water for all
6.2	Achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3	Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
6.4	Increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
6.5	Implement integrated water resources management at all levels (6.5.1)
6.6	Protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
6.A	Expand international cooperation and capacity-building support to developing countries in water-and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
6.B	Support and strengthen the participation of local communities in improving water and sanitation management

Indicators considered for District and Block level vulnerability assessment of WASCA TN which is also used in SDG India 2020-21 report (Table 23).

TABLE 23. COMMON VULNERABILITY INDICATORS USED IN WASCA TN & SDG INDIA 2020-21

Head count ratio as per the multidimensional poverty index (%)	
	Persons provided employment as a percentage of persons who demanded employment under MGNREGA

Percentage of rural population getting safe and adequate drinking water within premises through piped water supply

Percentage of rural population having improved source of drinking water

Percentage of ground water withdrawal against availability

Percentage of Blocks/Mandals/Talukas over-exploited

Percentage of area covered under afforestation schemes to the total geographical area

Percentage of degraded land over total land area

Percentage increase in area of desertification

The indicators used for District level vulnerability assessment along with its linked SDGs are already tabulated in (Table 2). The detailed proposed water actions in CWRM which was assessed based on the vulnerability dimensions are linked with climate vulnerability index and SGDs are tabulated in Table 24 to 26.

TABLE 24. WATER ACTIONS ON DEVELOPMENT OF PUBLIC & COMMON LANDS & ITS LINKED SDG

Name of the work	No. of CWRM works	Climate Vulnerability Index Impacting (WASCA TN)	Linked SDG Goal
Contour Continuous Bunds for Afforestation area (m)	1,686	W3	SDG 1,2, 6,13&15
Composting (No. of units)	753	W1	SDG1& 6
Afforestation in Public/common lands (ha)	422	C1,C2,C3, W3,	SDG 1, 2,6,13&15
Block Plantation (Community) (ha)	1,892	C1,C2,C3,W3,S2	SDG 1,2, 6 &13, 15
Silvi-pasture Development (ha)	3	C1,C2,C3,W3	SGG 12 &15
Linear Plantation (Km)	46	C1,C2,C3,W3,S2	SDG 1,2,6,12&13, 15
Canal Bund Plantation (ha)	161	C1,C2,C3,W3,S2	SDG 1, 6&13, 15
Irrigation Channel Plantation (m)	4,125	W4,W5,S2	SDG 1,2& 6, 15
Avenue plantation (Km)	126	C1,C2,C3,W3,S2	SDG 1, 6&13

Nursery Development (No. of units)	395	C1,S2,S4	SDG 1,2 &6
Restoration of waterbodies :PWD and Union Tanks (No.)	73	S2, S1	SDG 6, 1, 13
Restoration of water bodies : Ooranis (No.)	255	S2, S1	SDG 6, 1, 13
Restoration of waterbodies :Ponds (No.)	10	S2, S1	SDG 6,1, 13
Artificial Recharge Structure (No. of units)	486	W3	SDG 1, 2, & 6
Water Course - Irrigation Channels - Desilting (m)	4,125	C1,C2,C3,W3,S2	SDG 1, 6&13
Drainage Line Treatment (m)	1,286	W1,W3,W4	SDG1 & 6

TABLE 25. WATER ACTIONS ON DEVELOPMENT OF AGRICULTURAL AND ALLIED SECTOR & IT'S LINKED SDG

Name of the Work	No. of CWRM works	CVI	SDG
Farm Bunding with Boundary Trenches - Individual (ha)	2,471	A1,A3,W1,W3	SDG 1,2&6
Micro Irrigation(ha)	311	A1,A3,A5,W5	SDG 1, 2&6
Construction of Farm Ponds - Individual (No. of units)	672	A1,A3,W5,W1, W3	SDG 2& 6
Land development - Individual (ha)	843	W1,W5,A1,A3,S2,S4	SDG 2, 6&
Dry land Horticulture/Agro-forestry - Individual (ha)	1,236	A1,A3,A4,W1,S4,S2,C1	SDG 1& 2,15
Azolla units - Individual (No. of units)	75	A3,A4,S4	SDG 1& 2
NADEP Vermi compost (No. of units)	75	A3, W1, S4	SDG 1& 2,6
Fodder development - Community & Individual	75	A3, S4	SDG 1& 2, 15
Cattle shelters (No. of units)	75	S4	SDG 1& 2
Goat/sheep shelters (No. of units)	529	S4	SDG 1& 2
Cattle trough (No. of units)	75	W5,S4	SDG 1& 2
Poultry Shed (No. of units)	157	S2,S4	SDG 1& 2

TABLE 26. WATER ACTIONS ON RURAL WATER MANAGEMENT & IT'S LINKED SDG

Name of the work	No. of CWRM works	CVI	Linking SDG
Soak Pits (Community) (No. of units)	160	W3,S2	SDG 1& 6
Soak Pits (Individual) (No. of units)	1,585	W3,S2	SDG 1& 6
Roof Rain Water harvesting (No. of units)	74	W3,S1,S3	SDG 1& 6

சிறப்பொடு பூசனை செல்லாது வானம்
வறக்குமேல் வானோர்க்கும் ஈண்டு

குறள் - 18

The earth beneath a barren sky
Would offerings for the gods deny

Thirukkural - 18

CHAPTER 7

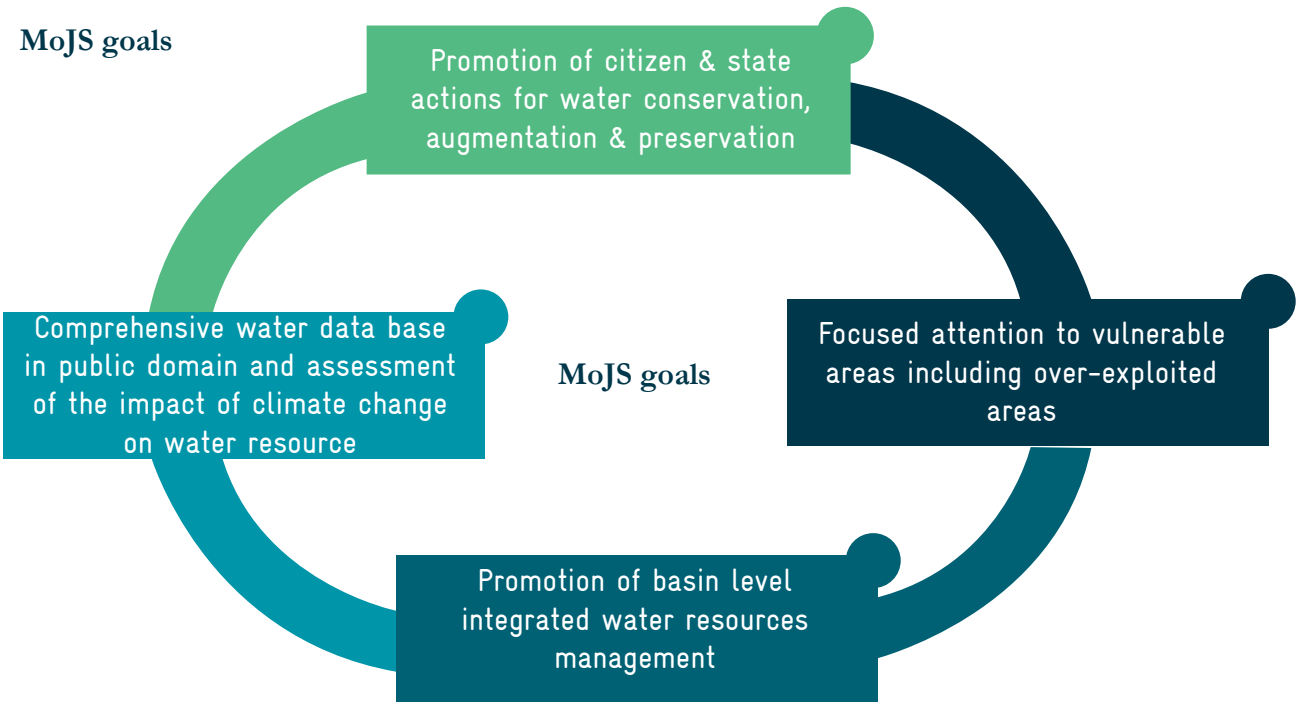
7 IMPLEMENTATION OF GP PLANS

Execution of GP plans includes integrating all verified, approved works in MORD's web enabled application NREGA Soft (https://nrega.nic.in) for mainstreaming WASCA. The target GPs are identified first, the status of GIS based plans and total works along with its expenditure and category wise estimation cost of works as per GIS Plan, GIS based planning cumulative report are uploaded as given below

7.1 INTEGRATION INTO NREGA SOFT

WASCA is progressing towards digitizing and integrating GP level GIS based plans, both NRM and Non-NRM into Mahatma Gandhi NREGS portal. The performance and implementation of GP plans of Nainarkoil Block is listed in Table 27 and work progress, expenditure during the past 3 financial years are shown in Figure 7.1 and 7.2. The Total No. of works, ongoing and completed GIS works are shown in Figure 7.3. The GP wise recommendations and works uploaded are given in Annexure 7.1.

TABLE 27. GIS-BASED PLAN IMPLEMENTATION- KEY PARAMETERS PERFORMANCE IN NAINARKOIL BLOCK



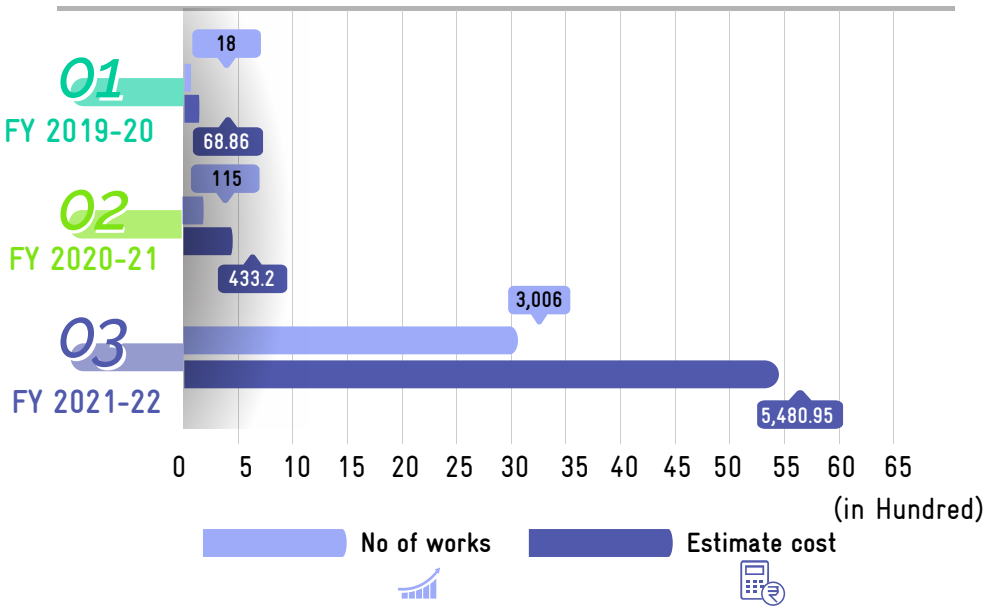


Figure 7.1. Work progress in last three years

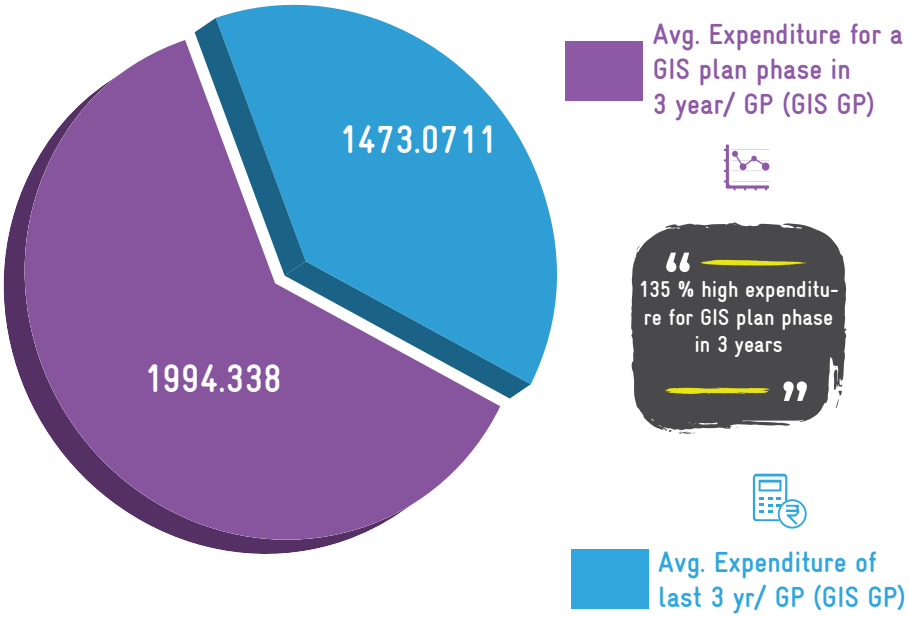
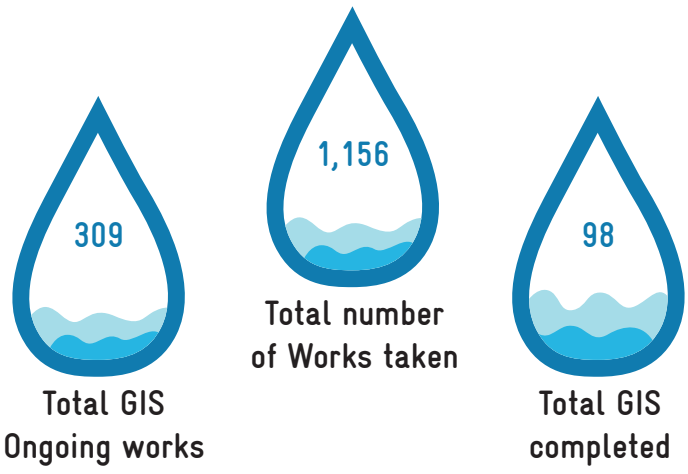


Figure 7.2. Average Expenditure for GIS plan in last 3 years



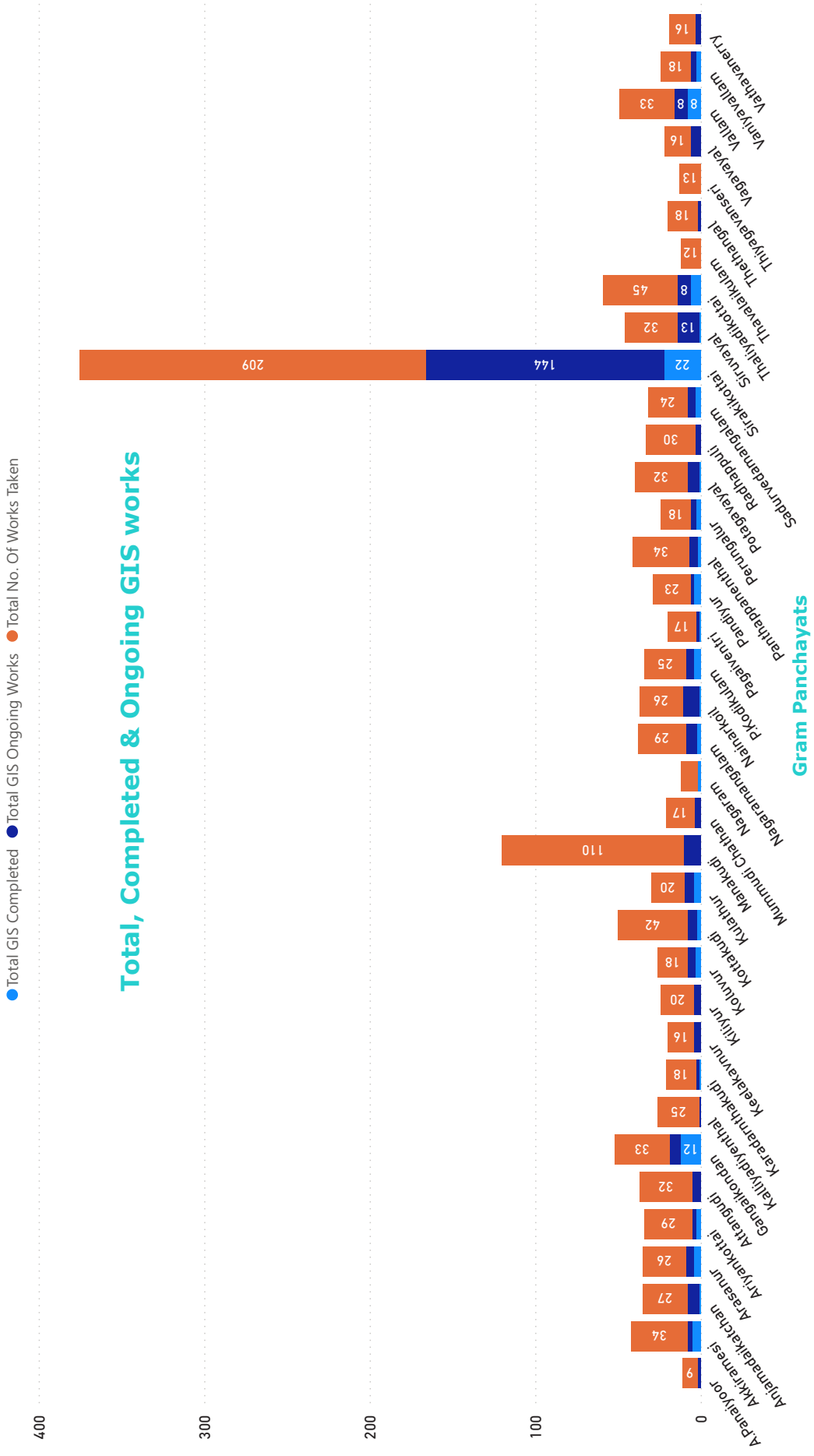
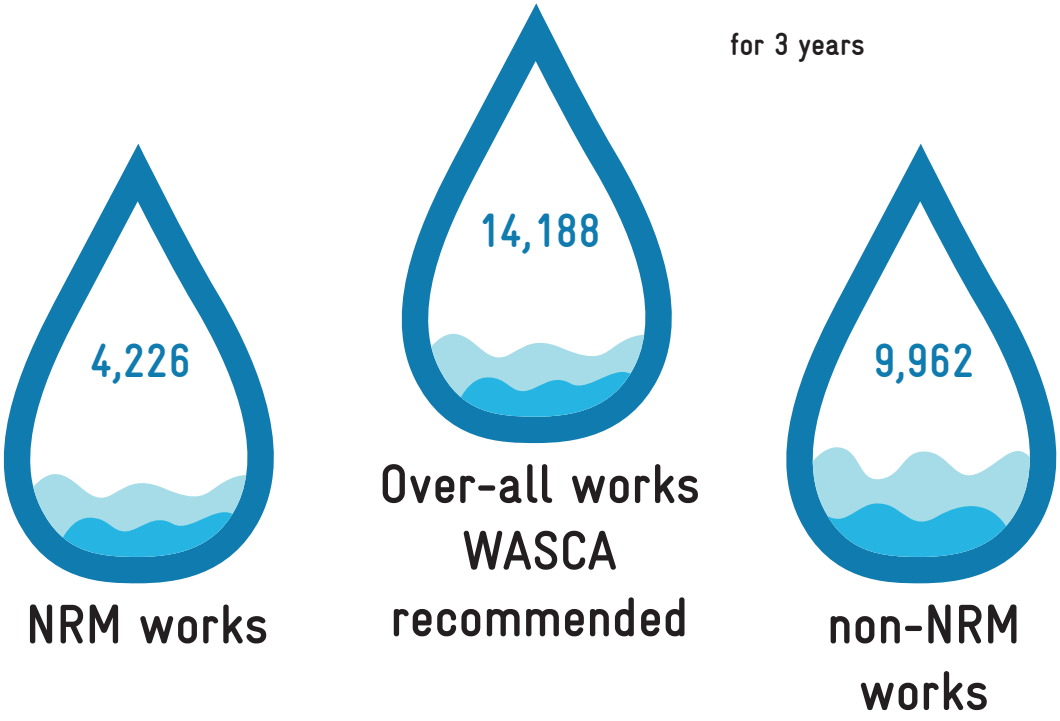


Figure 7.3. GP wise total, completed and ongoing GIS works (2021-22)

7.2 WASCA RECOMMENDED NRM AND NON-NRM WORKS

WASCA recommended 14,188 works for a period of 3 years, out of which 4,226 are NRM works and 9,962 are non NRM works (Figure 7.4). A total of 2,572 works has been uploaded so far for the financial year 2021-22 as on 14/032/2022.



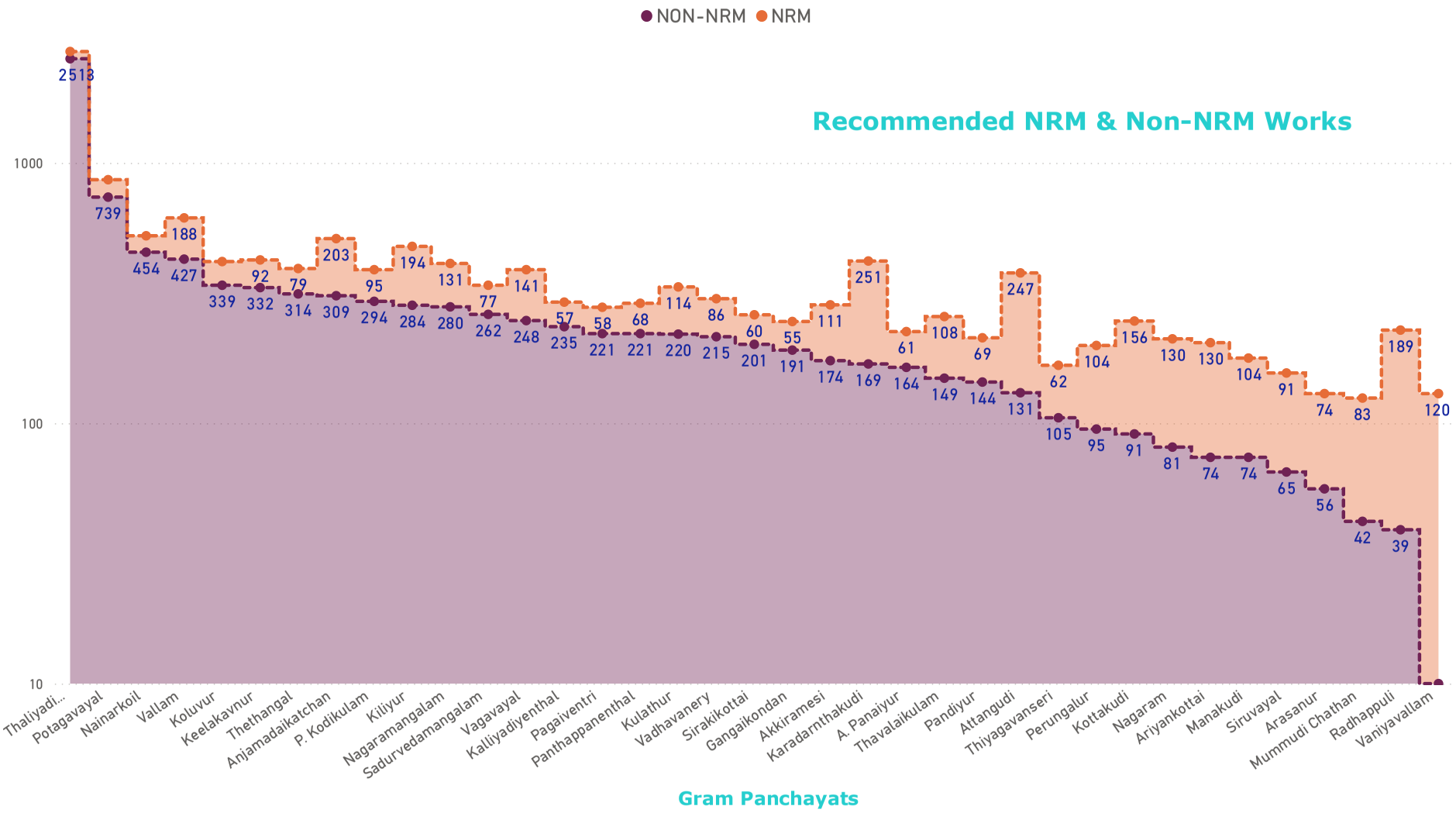


Figure 7.4. GP wise recommended NRM and Non-NRM works

7.3 ONGOING WORKS

The ongoing works in Nainarkoil Block includes Water Conservation and Water Harvesting, Works on Individual Lands (Category IV), Rural Connectivity, and Drought Proofing. A total of 74 works are ongoing in the Block, in which WCWH shares the higher in number followed by individual beneficiary works while other category works are less than a percent (Figure 7.5), GP and work category wise ongoing works are tabulated in Annexure 7.2.

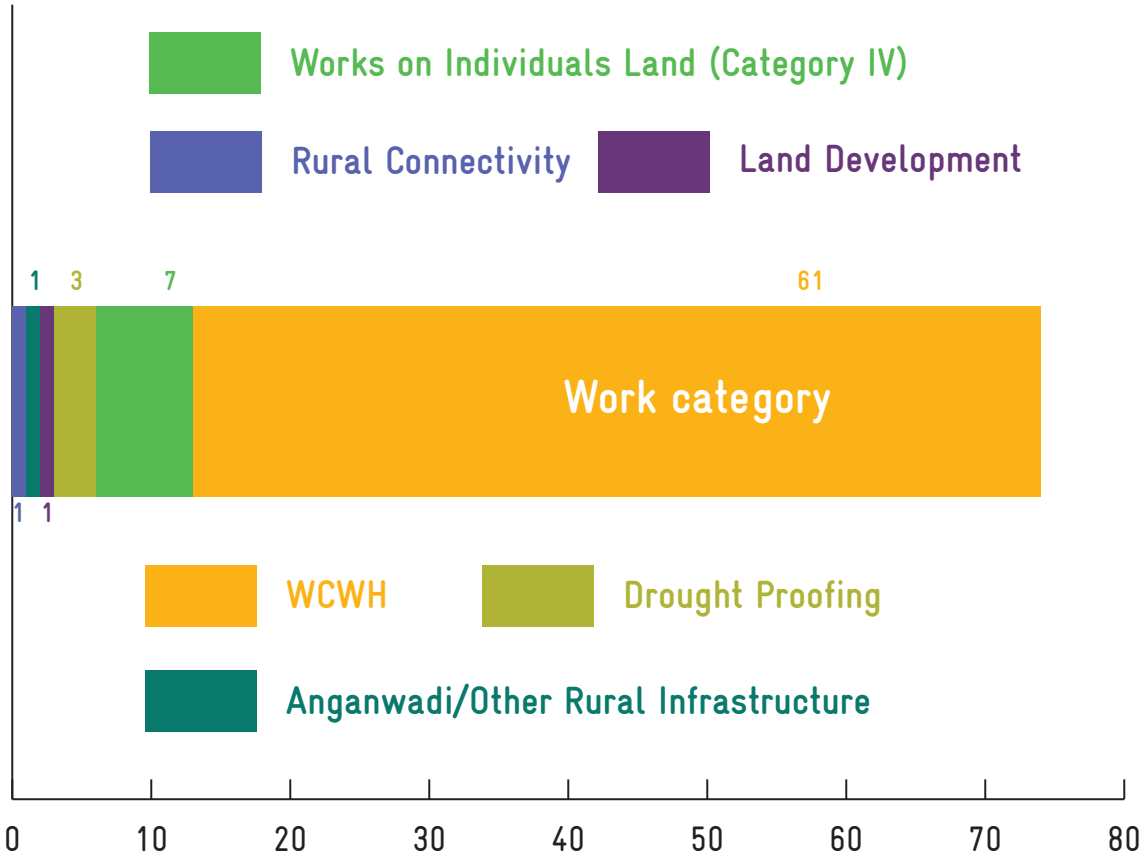


Figure 7.5. Category-wise ongoing works in Nainarkoil Block

7.4 CATCH THE RAIN

The NWM's campaign "Catch the Rain" with the tagline "Catch the rain, where it falls, when it falls" is to nudge the states and stakeholders to create appropriate Rain Water Harvesting Structures (RWHS) suitable to the climatic conditions and subsoil strata before monsoon season. Under this campaign, drives to make check dams, water harvesting pits, rooftop RWHS, removal of encroachments and de-silting of tanks to increase their storage capacity, removal of obstructions in the channels which bring water to them from the catchment areas, repairs to step-wells and using defunct bore wells and unused wells to put water back to aquifers etc., are to be taken up with the active participation of people. The total expenditure towards progressive works on Catch the Rain campaign of Nainarkoil Block is Rs. 1,544.75 Lakhs and nearly 61.5% of the expenditure utilized for water conservation and Rain water harvesting (Figure 7.6).

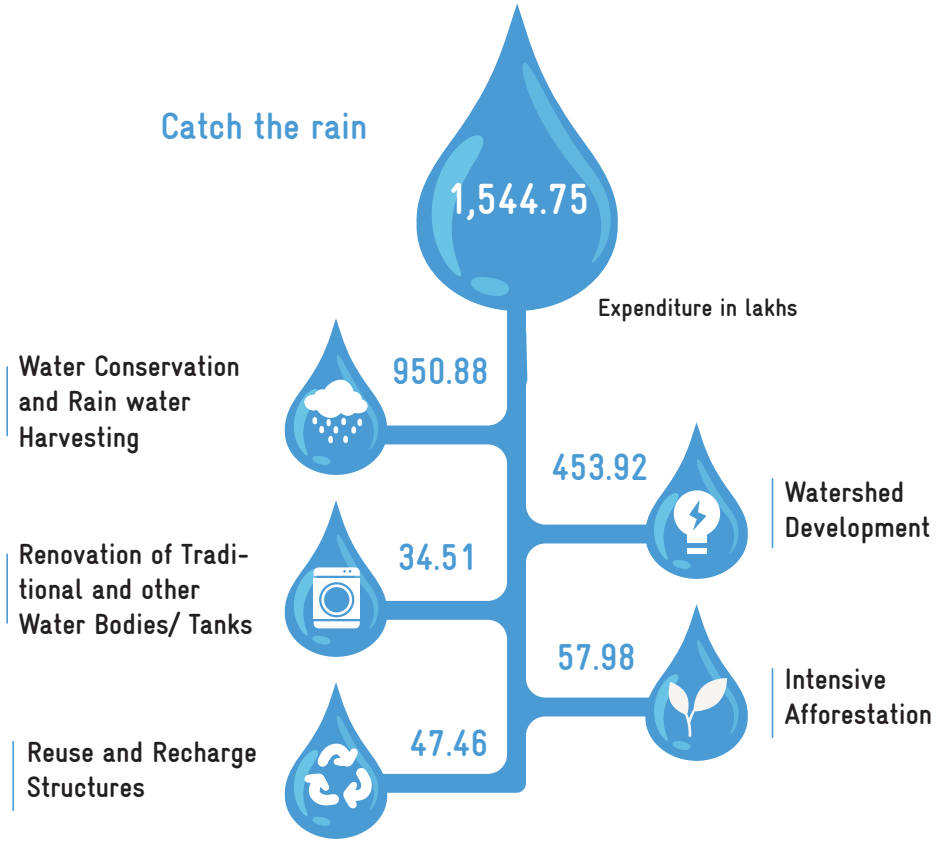
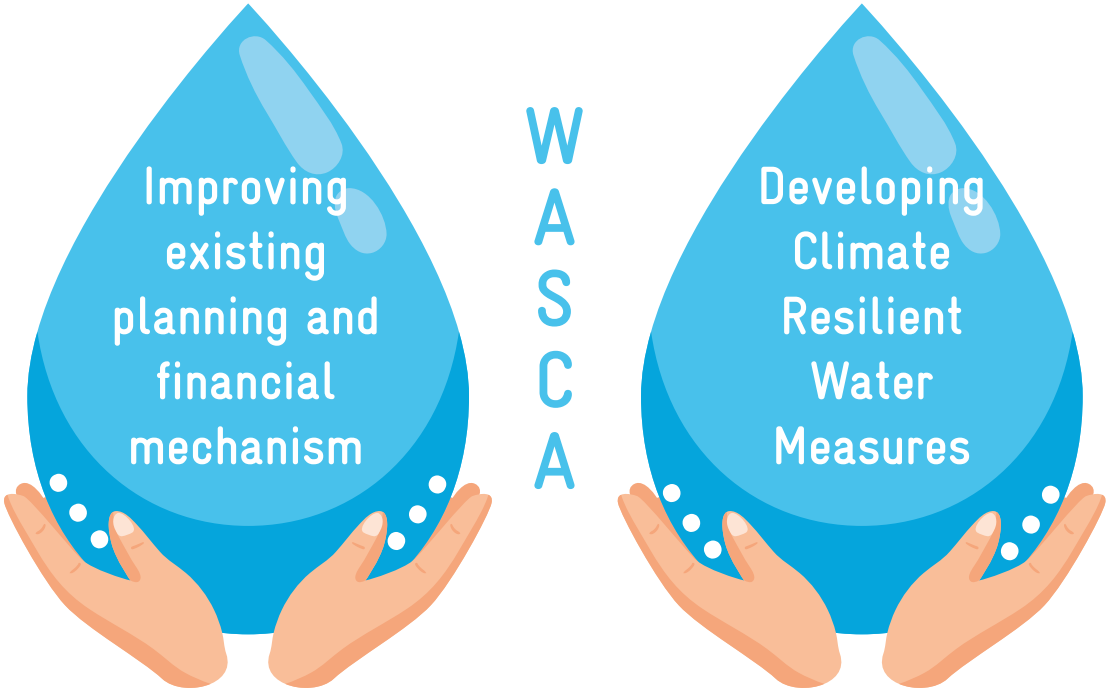


Figure 7.6. Expenditure for Catch the Rain campaign in Nainarkoil Block



தானம் தவம்இரண்டும் தங்கா வியன்உலகம்
வானம் வழங்கா தெனின்

குறள் - 19

Were heaven above to fail below
Nor alms nor penance earth would show

Thirukkural - 19

CHAPTER 8

8 CASE STUDY

This chapter illustrates how CWRM planning processes unfolds the analysis, results and impacts from Macro-watershed to the lowest planning unit, the GP through case studies. Case studies explain the need for an integrated multi-tier approach to address the issues of water conservation seen through the lens of climate change. Case studies on micro-watersheds and GP are expounded holistically through macro-watersheds to warrant long-term benefits. This integrated approach will help in watershed assessment, management and monitoring of implementation of projects efficiently.

8.1 MACRO-WATERSHEDS OF NAINARKOIL BLOCK

Nainarkoil Block comes under Lower Vaigai and Kottakkaraiyar sub-basin of Vaigai and Pambar Kottakkaraiyar basin. Vaigai River flows through the Block. Lower Vaigai (4) and Kottakkaraiyar macro-watersheds cover 64 micro-watersheds. Lower Vaigai (4) watershed (4A2A1) has 60 micro-watersheds covering an area of 25746.13 ha. Kottakkaraiyar watershed (4A2B1) has 4 micro-watersheds covering an area of 882.31 ha. (Figure 8.1) and (Table 28). In Nainarkoil Block, out of 37 GPs 35 GPs fall under Lower Vaigai (4) watershed and 2 GPs fall under Kottakkaraiyar watershed.(Table 29). The micro-watershed related works are identified using Basin, Sub-basin, and micro-watershed with GP administrative boundaries through CWRM approach.

TABLE 28. GENERAL DESCRIPTION OF MACRO-WATERSHEDS COVERING NAINARKOIL BLOCK

Macro-watershed	Area in ha	No. of micro-watersheds
Lower Vaigai (4)	25746.13	60
Kottakkaraiyar	882.31	4

TABLE 29. NO. OF GPs COVERED UNDER WATERSHEDS IN NAINARKOIL BLOCK

Name of watershed	No. of GPs
Lower Vaigai (4)	35
Kottakkaraiyar	2

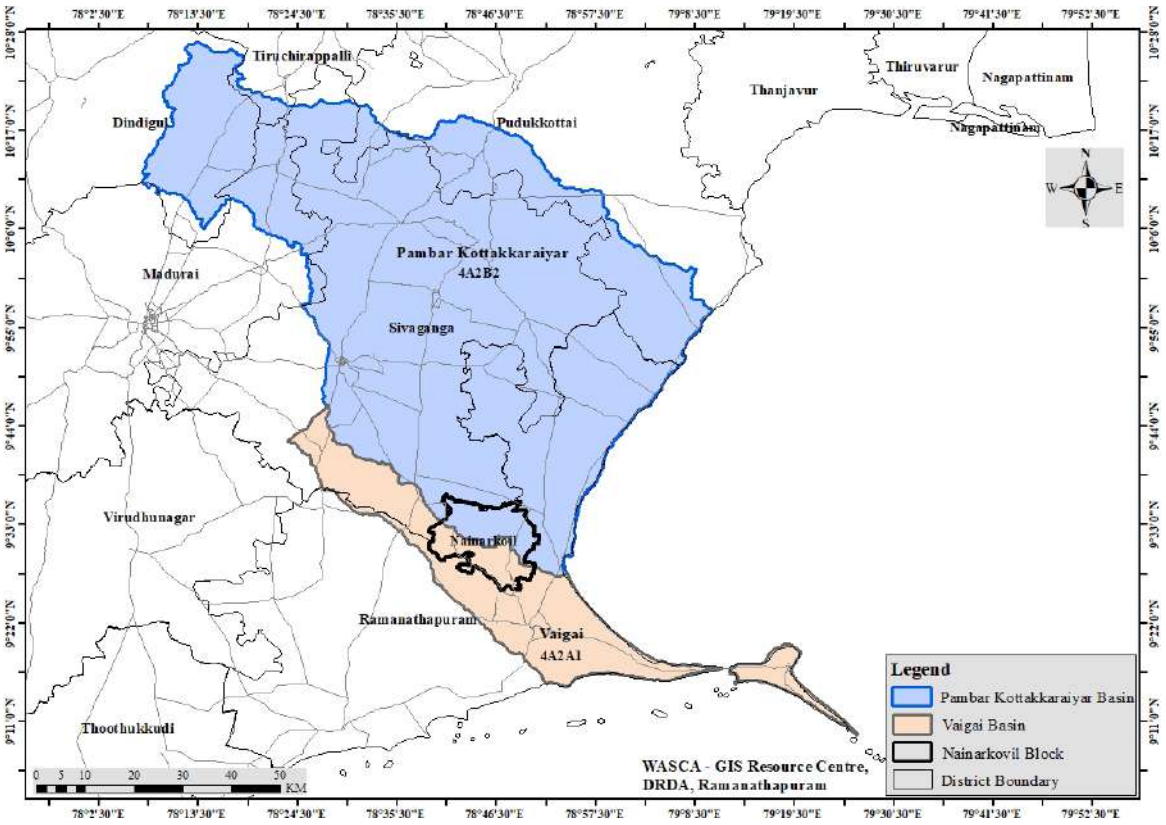


Figure 8.1. Macro-watershed map - Nainarkoil Block

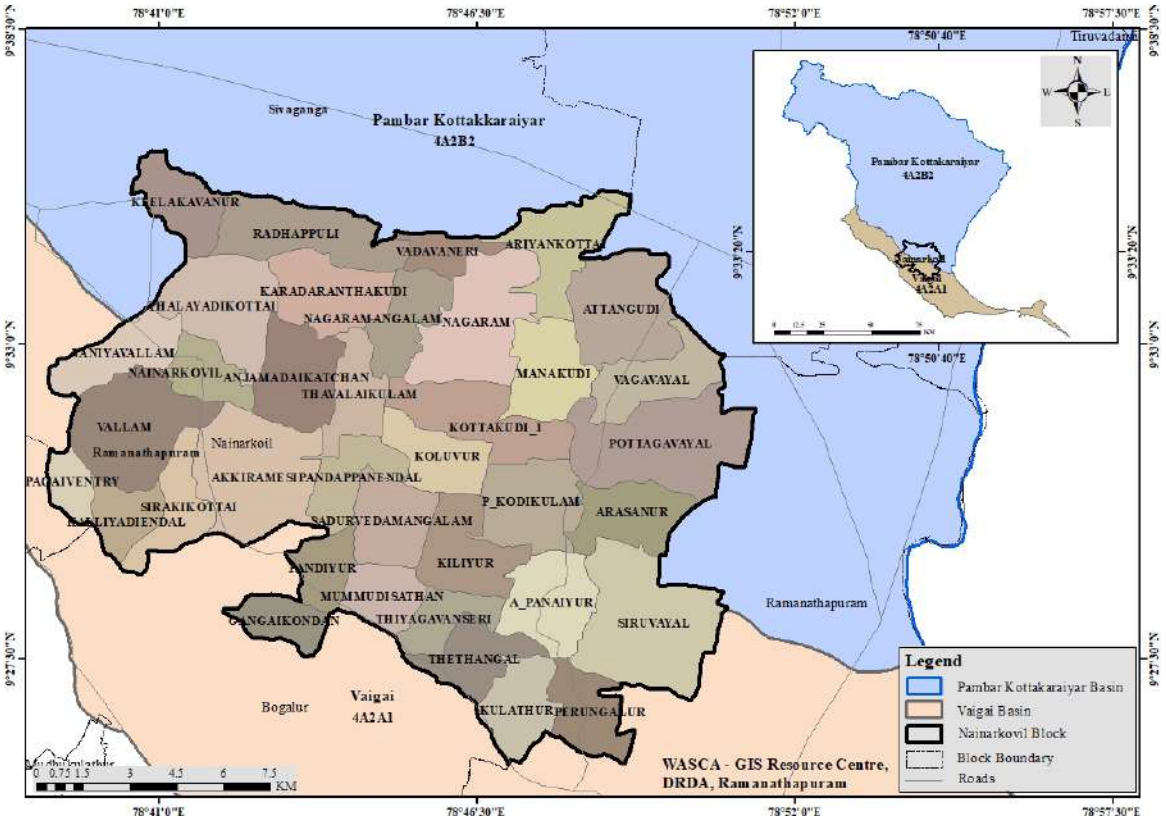


Figure 8.2. Macro-watershed with GPs

All the proposed works are identified using basin, sub-basin, and micro-watershed with GP administrative boundaries through Composite Water Resources Management plan approach. The ridge details, proposed works in all macro-watersheds of GPs in Nainarkoil Block are listed in Tables 30 to 35.

TABLE 30. MICRO-WATERSHED FALLING UNDER LOWER VAIGAI (4) MACRO-WATERSHED IN NAINARKOIL BLOCK

Sl.No	Micro-watershed Code	Micro-watershed Area in ha	Ridge Type
1	4A2A1e11c	507.40041	Lower
2	4A2A1e11d	394.9760772	
3	4A2A1a11d	57.04527223	
4	4A2A1e11b	354.1906074	
5	4A2A1e10b	552.6807747	
6	4A2A1a11c	39.51642268	
7	4A2A1e05c	78.64823427	
8	4A2A1e08a	1193.422616	
9	4A2A1e10a	570.5039876	
10	4A2A1e10d	301.4873729	
11	4A2A1e10c	570.4958567	
12	4A2A1e11a	779.1690206	
13	4A2A1e05b	533.0214413	
14	4A2A1a10d	502.1084824	
15	4A2A1e08b	426.6969858	
16	4A2A1a11b	0.870365018	
17	4A2A1a10c	688.8870575	
18	4A2A1e08c	270.5351996	
19	4A2A1e03a	499.7174919	
20	4A2A1a08b	837.1194342	
21	4A2A1a08c	713.3577083	
22	4A2A1a07b	1030.923756	
23	4A2A1e03b	1.056538652	
24	4A2A1e09c	367.0540976	
25	4A2A1e05a	489.3822566	
26	4A2A1a10b	100.1284461	
27	4A2A1a09b	716.2903314	
28	4A2A1a10a	428.6253265	
29	4A2A1e03c	547.4302661	
30	4A2A1e09a	1044.748207	
31	4A2A1e09b	425.5879265	
32	4A2A1a06a	948.7878105	
33	4A2A1e07b	838.2566212	
34	4A2A1e07c	245.405233	
35	4A2A1e07a	624.8222822	
36	4A2A1d05a	1.129073951	
37	4A2A1e06b	353.0172394	
38	4A2A1a09a	543.2439608	

39	4A2A1a06b	657.0700303	Lower
40	4A2A1e04d	41.59408041	
41	4A2A1e06a	149.1763085	
42	4A2A1a08a	143.3788059	
43	4A2A1e06c	562.2017548	
44	4A2A1a07a	249.6034252	
45	4A2A1d04b	9.953489543	
46	4A2A1a13e	552.9784984	
47	4A2A1d03b	115.5928531	
48	4A2A1d04a	110.512353	
49	4A2A1a13d	510.5922655	
50	4A2A1d03a	171.4188246	
51	4A2A1a05d	586.3822446	
52	4A2A1a05c	219.8693758	
53	4A2A1a13c	762.9469447	
54	4A2A1a05b	308.2250672	
55	4A2A1a13b	279.3780312	
56	4A2A1a05a	215.9764416	
57	4A2A1a13a	376.1559992	
58	4A2A1a04c	577.0974616	
59	4A2A1a04b	567.1727785	
60	4A2A1d02a	1.119859442	

TABLE 31. LIST OF GPs WITH TYPE OF RIDGE FALLING UNDER LOWER VAIGAI (4) MACRO-WATERSHED IN NAINARKOIL BLOCK

Sl.No	Name of the GP	Ridge Type
1	Akkiramesi	Lower
2	Anjamadaikatchan	
3	A. Panaiyur	
4	Arasanur	
5	Attangudi	
6	Gangaikondan	
7	Kalliyadiyenthal	
8	Karadarnthakudi	
9	Kiliyur	
10	Koluvur	
11	Kottakudi	
12	Kulathur	
13	Manakudi	
14	Mummudi Chathan	
15	Nagaram	
16	Nagaramangalam	
17	Nainarkoil	
18	Pagaivendry	
19	Pandiyur	
20	Panthappanenthal	

21	Perungalur	Lower
22	P. Kodikulam	
23	Potagavayal	
24	Radhappuli	
25	Sadurvedamangalam	
26	Sirakikottai	
27	Siruvayal	
28	Thaliyadikottai	
29	Thavalaikulam	
30	Thethangal	
31	Thiyagavanseri	
32	Vadhavanery	
33	Vagavayal	
34	Vallam	
35	Vaniyavallam	

TABLE 32. LIST OF WORKS PROPOSED UNDER CWRM – WASCA WITH TYPE OF RIDGE FALLING UNDER LOWER VAIGAI (4) MACRO-WATERSHED IN NAINARKOIL BLOCK

Sl.No	Proposed Work	Ridge Type	Extent
1	Contour Continuous Bunds (CCB) for Afforestation area (m)	Lower	4,175
2	Afforestation in Public/common lands (ha)		417.5
3	Drainage Line Treatment (m)		4,817
4	Block Plantation (Community) (ha)		1776.75
5	Avenue plantation (Km)		118.05
6	Composting (No.)		35
7	Canal Bund Plantation (Km)		89.6
8	Restoration of water bodies: Tanks and Ooranis (No.)		334
9	Artificial Recharge Structure (No.)		674
10	Farm Bunding with Boundary Trenches - Individual (ha)		2371.8
11	Construction of Farm Ponds - Individual (No.)		637
12	Land development - Individual (ha)		798.57
13	Azolla units - Individual (No.)		72
14	NADEP Vermi compost (No.)		72
15	Fodder development - Community & Individual (No.)		72
16	Cattle Shelters (No.)		72
17	Goat Sheep Shelters (No.)		477
18	Cattle Trough (No.)		72
19	Soak Pits (Community) (No.)		149
20	Soak Pits (Individual) (No.)		1479
21	Roof Rain Water Harvesting (No.)		70
22	Nutri Garden (No.)		35
23	Silt application (No.)		80
24	Mini Forest (ha)		80

TABLE 33. MICRO-WATERSHED FALLING UNDER KOTTAKKARAIYAR MACRO-WATERSHED IN NAINARKOIL BLOCK

Sl.No	Micro-watershed Code	Micro-watershed Area in ha	Ridge Type
1	4A2B1c10a	235.5251046	Lower
2	4A2B1c02a	133.5291076	
3	4A2B1c03a	297.2059402	
4	4A2B1c02b	216.0538153	

TABLE 34. LIST OF GPs WITH TYPE OF RIDGE FALLING UNDER KOTTAKKARAIYAR MACRO-WATERSHED IN NAINARKOIL BLOCK

Sl.No	Name of the GP	Ridge Type
1	Ariyankottai	Lower
2	Keelakavnur	

TABLE 35. LIST OF WORKS PROPOSED UNDER CWRM – WASCA WITH TYPE OF RIDGE FALLING UNDER KOTTAKKARAIYAR MACRO-WATERSHED IN NAINARKOIL BLOCK

Sl.No	Proposed Work	Ridge Type	Extent
1	Contour Continuous Bunds (CCB) for Afforestation area (m)	Lower	406
2	Afforestation in Public/common lands (ha)		4.06
3	Drainage Line Treatment (m)		3,244
4	Block Plantation (Community) (ha)		115.66
5	Avenue plantation (Km)		7.9
6	Composting (No.)		35
7	Canal Bund Plantation (Km)		25.73
8	Restoration of water bodies: Tanks and Ooranis (No.)		19
9	Artificial Recharge Structure (No.)		14
10	Farm Bunding with Boundary Trenches - Individual (ha)		99.07
11	Construction of Farm Ponds - Individual (No.)		35
12	Land development - Individual (ha)		44.28
13	Azolla units - Individual (No.)		3
14	NADEP Vermi compost (No.)		3
15	Fodder development - Community & Individual (No.)		3
16	Cattle Shelters (No.)		3
17	Goat Sheep Shelters (No.)		52
18	Cattle Trough (No.)		3
19	Soak Pits (Community) (No.)		11
20	Soak Pits (Individual) (No.)		106
21	Roof Rain Water Harvesting (No.)		4
23	Nutri Garden (No.)		2
24	Silt application (No.)		18
25	Mini Forest (ha)		4

8.2 MODEL MICRO-WATERSHED- A. PANAIYUR

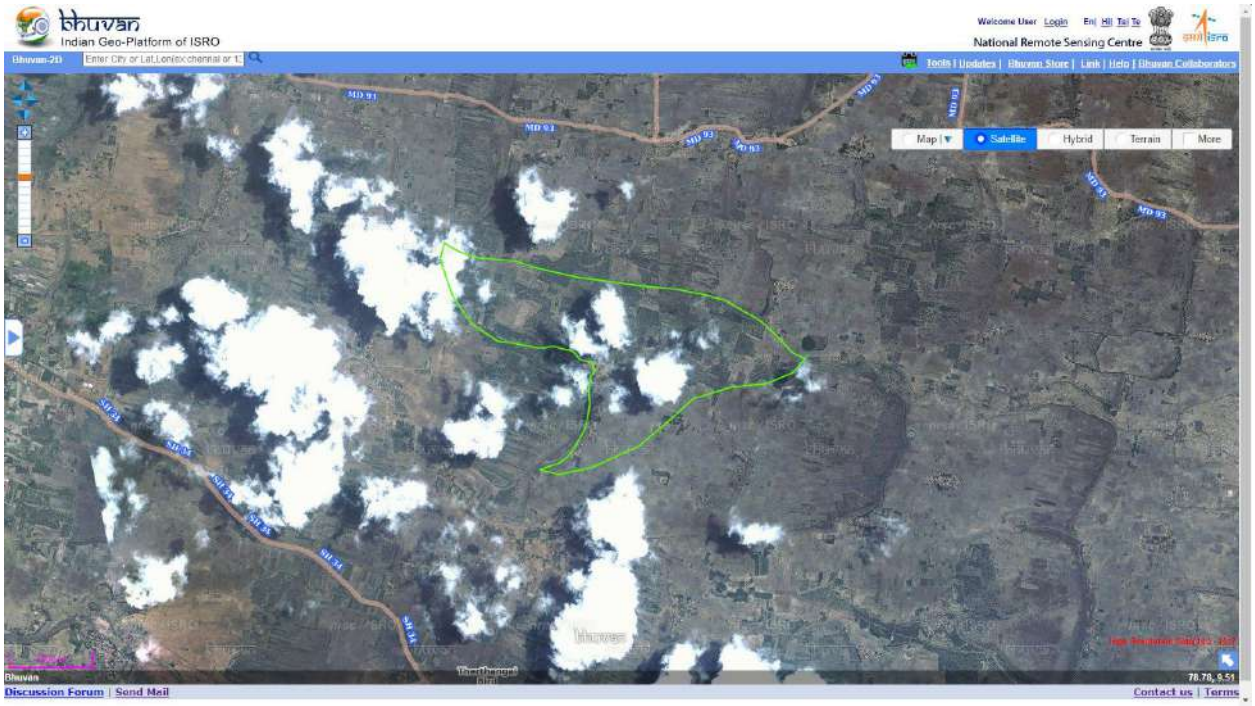


Figure 8.3. Satellite image of A. Panaiyur micro-watershed

The micro-watershed case study addresses the issues of water conservation and climate change through an integrated approach. The decentralized micro-watershed planning has been conceived for holistic development and management to ensure sustainable long-term benefits. The micro-watershed plan has been sequenced from ridge to valley for proper implementation of different development programs. This includes coordination of various natural components like groundwater, surface water, geology, hydrogeology, catchment, land use, soil, population, salt affected water along with various water resource supply and demand components. The ultimate goal is to achieve and maintain a balance between resources development to increase the welfare of the population.

A. PANAIYUR MICRO-WATERSHED

A. Panaiyur micro-watershed falls under Kiliyur, A. Panaiyur and Siruvayal GPs, of Nainarkoil Block in Ramanathapuram District. The satellite image of the micro-watershed is shown in Figure 8.3. This micro-watershed is a part of Lower Vaigai(4) macro-watershed in Lower Vaigai sub-basin. The general information, geology, hydrogeology, natural drainage line, catchment area, ground water status, water budget of A. Panaiyur micro-watershed is given below in separate sections followed by proposed works, ridge wise proposed treatment area, estimated cost and required person days and key outcomes. (Table 36 to 49 & Figure 8.4). The key CWRM parameters for the GPs falling in this micro-watershed is in Annexure 8.

TABLE 36. GENERAL INFORMATION OF THE MICRO-WATERSHED

Description	Name/ Number/ Quantity/ Status
Name of the Micro-watershed	A. Panaiyur Micro-watershed
Micro-watershed Number	4A2A1a13d
Name of the Basin	Vaigai Basin
Name of the sub basin	Lower Vaigai Sub Basin
Name of the Macro-watershed	Lower Vaigai (4)
Number of GPs covered under the Micro-watershed	3
Name of the GP	1. Kiliyur
	2. A. Panaiyur
	3. Siruvayal
Latitude of Micro-watershed (From To)	9°26'52.126"N to 9°29'47.195"N
Longitude of Micro-watershed (From To)	78°46'24.738"E to 78°49'24.09"E
Total area of the Micro-watershed in ha	510.59
% of Micro-watershed area in Kiliyur GP	17
Area of Micro-watershed falling in Kiliyur GP (ha)	89.39
% of Micro-watershed area in A. Panaiyur GP	72
Area of Micro-watershed falling in A. Panaiyur GP (ha)	367
% of Micro-watershed area in Siruvayal GP	11
Area of Micro-watershed falling in Siruvayal GP (ha)	54.2 ha
Total Population of Kiliyur GP	1,430
Total Population of A. Panaiyur GP	926
Total Population of Siruvayal GP	2,081
Annual Average Rainfall (mm)	821
Annual maximum Temperature (°C)	32.6
Annual Minimum Temperature (°C)	23.8
Evapo-Transpiration Losses of Kiliyur GP (ha.m)	14.62
Evapo-Transpiration Losses of A. Panaiyur GP (ha.m)	17.22
Evapo-Transpiration Losses of Siruvayal GP (ha.m)	28.92
Volumetric soil moisture availability (%)	17
Climate Risk	Drought
CVI Index Value for Kiliyur (Based on WASCA Climate study)	(High Water Vulnerability)
CVI Index Value for A. Panaiyur (Based on WASCA Climate study)	(High Water Vulnerability)
CVI Index Value for Siruvayal (Based on WASCA Climate study)	(High Water Vulnerability)
Agro-Climatic Zone	Southern Zone (TN 05)
Agro Ecological Sub-Region (ICAR)	Hot dry semiarid eco sub region (18.1)
Status of Ground water in Kiliyur GP	Safe
Status of Ground water in A. Panaiyur GP	Safe
Status of Ground water in Siruvayal GP	Safe

TABLE 37. HYDROGEOLOGY & OTHER CHARACTERISTICS IN MICRO-WATERSHED

Type of Geomorphology	Coastal Origin - Older Deltaic Plain
Geomorphology occurrence in %	95
Principle Aquifer	Alluvium
Salt Affected Area passing through the micro-watershed	32.2 ha (Lower Ridge)
Type of lineaments passing through the micro-watershed	None
Barren & waste lands	8.66 ha (Lower Ridge)

TABLE 38. EXISTING WATER HARVESTING STRUCTURES IN KILIYUR, A. PANAIYUR, AND SIRUVAYAL GPs

Sl. No.	Name of Structure	Kiliyur GP		A. Panaiyur GP		Siruvayal GP	
		Existing Structures		Existing Structures		Existing Structures	
		No.	Area in ha	No.	Area in ha	No.	Area in ha
1	Oorani	4	4.27	4	5.17	18	19.24
2	Tank	1	3.86	1	7.65	3	17.59
3	Farm Pond	12	6.83	10	5.26	32	16.58
	Total	**17**	**14.96**	**15**	**18.08**	**50**	**53.41**

TABLE 39. CATCHMENT AREA OF MICRO-WATERSHED (STRANGE METHODOLOGY - CGWB)

Catchment Area in ha	Kiliyur GP	A. Panaiyur GP	Siruvayal GP
Good catchment area	125.56	340.07	309.64
Average catchment area	28.87	58.61	0
Bad catchment area	579.01	354.61	1261.88

TABLE 40. GROUND WATER STATUS OF MICRO-WATERSHED

Name of the Firka (Assessment Unit) falling under micro-watershed	Kiliyur
Recharge from other sources during monsoon season (ha.m)	1,203.60
Recharge from other sources during non-monsoon season (ha.m)	278.91

TABLE 41. SALINITY AND SEA WATER INTRUSION IN THE MICRO-WATERSHED

Pre monsoon Water Quality Index	Poor Quality
Post monsoon Water Quality Index	Medium Quality
Pre monsoon Sea Water Mixing Index	<=1
Post monsoon Sea Water Mixing Index	<=1

TABLE 42. WATER BUDGET OF GP'S FALLING IN MICRO-WATERSHED- KILIYUR, A. PANAIYUR, AND SIRUVAYAL GPs

Water Budget in ha.m	Kiliyur GP	A. Panaiyur GP	Siruvayal GP
Water for human	3.91	2.53	5.7
Water for agriculture	311.3	311.8	835.5
Water for livestock's	0.5	0.32	0.22
Village wise water required	315.7	314.6	841.5
Available run-off from rain water (derived from Strange method)	98.6	125.7	212.0
Harvested Runoff from Water Harvesting Activities	87.3	49.8	10.2
Potential Harvesting from proposed Interventions	31.5	33	12.8
Total Water harvested	118.8	82.8	23.0
Water demand and Supply Difference	-196.9	-231.8	-818.5
Water demand supply gap status	Deficient	Deficient	Deficient
Per capita Water Availability in cum	830.77	869.23	110.52
International Standard per capita water Availability (cum)	1,700	1,700	1,700
Water Availability Gap (cum)	- 869.23	- 894.17	- 1,589.48
Water security status	Water Stress	Water Stress	Water Stress

TABLE 43. GP WISE PROPOSED MICRO-WATERSHED WORKS – KILIYUR, A. PANAIYUR, AND SIRUVAYAL GPs

Proposed Work	Kiliyur GP	A. Panaiyur GP	Siruvayal GP
Proposed works in Upper Ridge	0	0	0
Proposed works in Middle Ridge	0	0	0
Proposed works in Lower Ridge	12	77	8
Total works	12	77	8

TABLE 44. RIDGE WISE TREATMENT AREA ESTIMATED COST AND PERSON DAYS REQUIRED- KILIYUR, A. PANAIYUR, AND SIRUVAYAL GPs

Ridge Type	Kiliyur GP	A. Panaiyur GP	Siruvayal GP
Lower Ridge			
Estimated cost for Lower Ridge area (INR in Lakhs)	16.34	110.24	18.24
Total area in ha of Lower ridge	89.39	367	54.2
Estimated Person days generated for Treatment of Lower Ridge	**5,726**	**27,284**	**6,100**
Treatment cost of Lower Ridge (Lakhs/ha)	**0.183**	**0.30**	**0.337**

Kiliyur GP	Treatment cost (INR in lakhs)	Estimated person days
Upper Ridge	NA	NA
Middle Ridge	NA	NA
Lower Ridge	0.183 lakh/ha	5,726
	0.183 lakh/ha	5,726

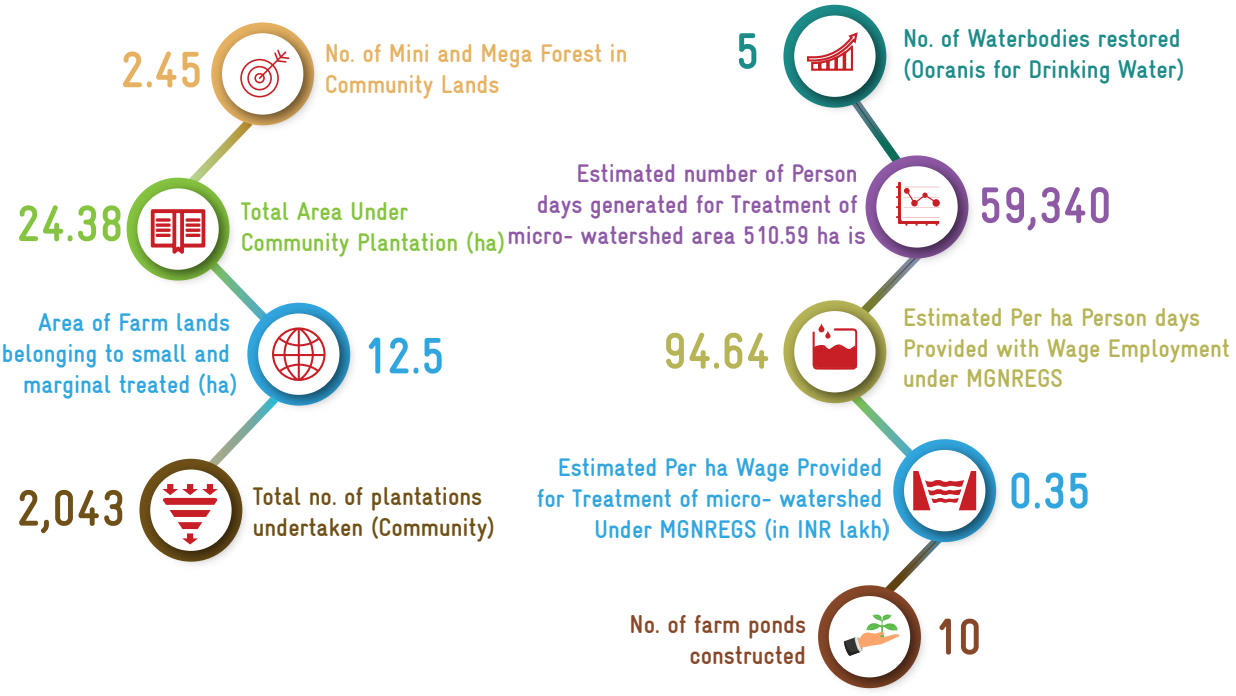
A. Panaiyur GP	Treatment cost (INR in lakhs)	Estimated person days
Upper Ridge	NA	NA
Middle Ridge	NA	NA
Lower Ridge	0.30 lakh/ha	27,284
	0.30 lakh/ha	27,284

Siruvayal GP	Treatment cost (INR in lakhs)	Estimated person days
Upper Ridge	NA	NA
Middle Ridge	NA	NA
Lower Ridge	0.337 lakh/ha	6,100
	0.337 lakh/ha	6,100

TABLE 45. NATURE AND NO. OF WORKS IN MICRO-WATERSHED

Description	Number
Total No. of works in Micro-watershed area (Arable, Non arable & DLT)	61
Total No. of works in Micro-watershed including livelihood Activities	12
Total No. of works in Micro-watershed including Rural Greywater Management Activities	77

TABLE 46. KEY OUTCOMES OF INTERVENTION



Expenditure for FY 2020-21 (in INR lakh)

Kiliyur GP	41.68 lakh
A. Panaiyur GP	18.72 lakh
Siruvayal GP	79.94 lakh

TABLE 47. ESTIMATES OF MICRO-WATERSHED IN KILIYUR GP

Proposed Work	Ridge Type	Status of Work	Quantity (Area or No.)	No. of works as per KML	Estimate cost (INR in Lakhs)	Person days
NRM works in Public and Community Lands						
Afforestation (ha)	Lower	Not commenced	2.14	1	4.43	1,616
Sub total				**1**	**4.43**	**1,616**
Works in Individual Farmer lands (Agriculture and Allied Activities)						
Recharge Shaft for borewell farmers for Salinity Reduction (No.)	Lower	Not commenced	2	2	0.54	24
Farm Bunding with Boundary Trenches - Individual (ha & No.)			5	2	7.5	2,711
			2	2		
Construction of Farm Ponds - Individual (No.)			2	2	3.6	1,282
Composting (No.)			3	3	0.27	93
Sub total				**11**	**11.91**	**4,110**
Total				**12**	**16.34**	**5,726**

TOTAL ESTIMATES OF MICRO-WATERSHED IN KILIYUR GP

	No. of works as per KML	Estimate cost in INR (Lakhs)	Person days
			
Kiliyur GP	12	16.34	5,726

TABLE 48. ESTIMATES OF MICRO-WATERSHED IN A. PANAIYUR GP

Proposed Work	Ridge Type	Status of Work	Quantity (Area or No.)	No. of works as per KML	Estimate cost (INR in Lakhs)	Person days
NRM works in Public and Community Lands						
Restoration of Traditional water bodies: (Oorani & Tank) (No.)	Lower	Not commenced	4	4	28	10,256
Oorani bund Plantation (No.)			342	4	1.57	540
Avenue plantation (Km)			2.68	1	2.47	888
Block Plantation (ha)			4.63	1	13.31	4,859
Roof Rain Water Harvesting in GP Building (No.)			1	1	0.3	15
Mini Forest (No.)		Completed	1,000	2	4.6	3,160
Sub total				**13**	**50.25**	**19,718**
Works in Individual Farmer lands (Agriculture and Allied Activities)						
Recharge Shaft for bore well farmers for Salinity Reduction (No.)	Lower	Not commenced	4	4	1.08	48
Farm Bunding with Boundary Trenches - Individual (ha & No.)			10	4	15	2,344
			4	4		
Construction of Farm Ponds - Individual (No.)			7	7	12.6	4,340
Composting (No.)			5	5	0.45	155
NADEP Vermi compost (No.)			2	2	0.24	10
Fodder development - Individual (No.)			2	2	12.38	216
Sub total				**28**	**41.75**	**7,113**
Total				**41**	**91.998**	**26,831**
Livelihood enhancement activities for Individual Farmers (Coastal Area)						
Azolla Production Unit (No.)	Lower	Not commenced	2	2	0.3	28
Cattle Shelters (No.)			2	2	3.2	99
Poultry Shed (No.)			5	5	10	110
Goat Sheep Shelters (No.)			2	2	2.3	90
Cattle Trough (No.)			1	1	0.2	11
Sub total				**12**	**15.7**	**310**
Rural Greywater and Rooftop Rainwater Management						
Soak Pits (Individual) (No.)	Lower	Not commenced	21	21	2.268	126
Soak Pits (Community) (No.)			2	2	0.26	16
Nutri Garden (No.)			1	1	0.01	1
Sub total				**24**	**2.538**	**143**
Total				**77**	**110.24**	**27,284**

TOTAL ESTIMATES OF MICRO-WATERSHED IN A. PANAIYUR GP

	No. of works as per KML	Estimate cost in INR (Lakhs)	Person days
			
A. Panaiyur GP	77	110.24	27,284

TABLE 49. ESTIMATES OF MICRO-WATERSHED IN SIRUVAYAL GP

Proposed Work	Ridge Type	Status of Work	Quantity (Area or No.)	No. of works as per KML	Estimate cost (INR in Lakhs)	Person days
NRM works in Public and Community Lands						
Restoration of traditional water bodies: (Oorani & Tank) (No.)	Lower	Not commenced	1	1	10.5	3,810
Oorani bund Plantation (No.)			163	1	0.75	258
Sub total				**2**	**11.25**	**4,068**
Works in Individual Farmer lands (Agriculture and Allied Activities)						
Recharge Shaft for bore well farmers for Salinity Reduction (No.)	Lower	Not commenced	2	2	0.54	24
Farm Bunding with Boundary Trenches - Individual (ha & No.)			2.5	1	3.75	1357
			1	1		
Construction of Farm Ponds - Individual (No.)			1	1	1.8	620
Composting (No.)			1	1	0.9	31
Sub total				**6**	**6.99**	**2,032**
Total				**8**	**18.24**	**6,100**

TOTAL ESTIMATES OF MICRO-WATERSHED IN SIRUVAYAL GP

	No. of works as per KML	Estimate cost in INR (Lakhs)	Person days
			
Siruvayal GP	8	18.24	6,100

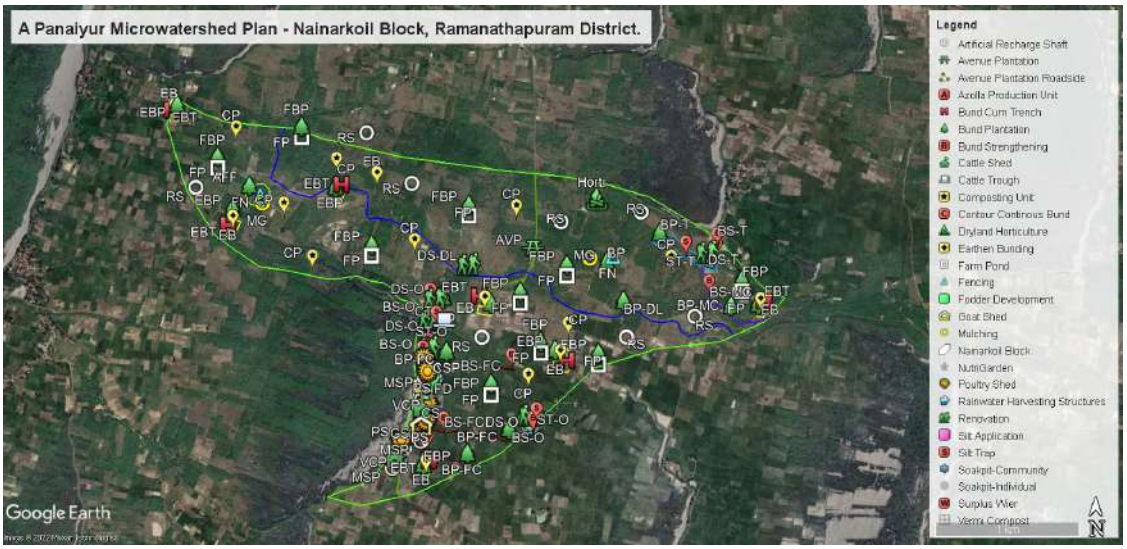


Figure 8.4. Proposed activities in A. Panaiyur micro-watershed

8.3 MODEL GP – KULATHUR

BACKGROUND OF GRAM PANCHAYAT - KULATHUR

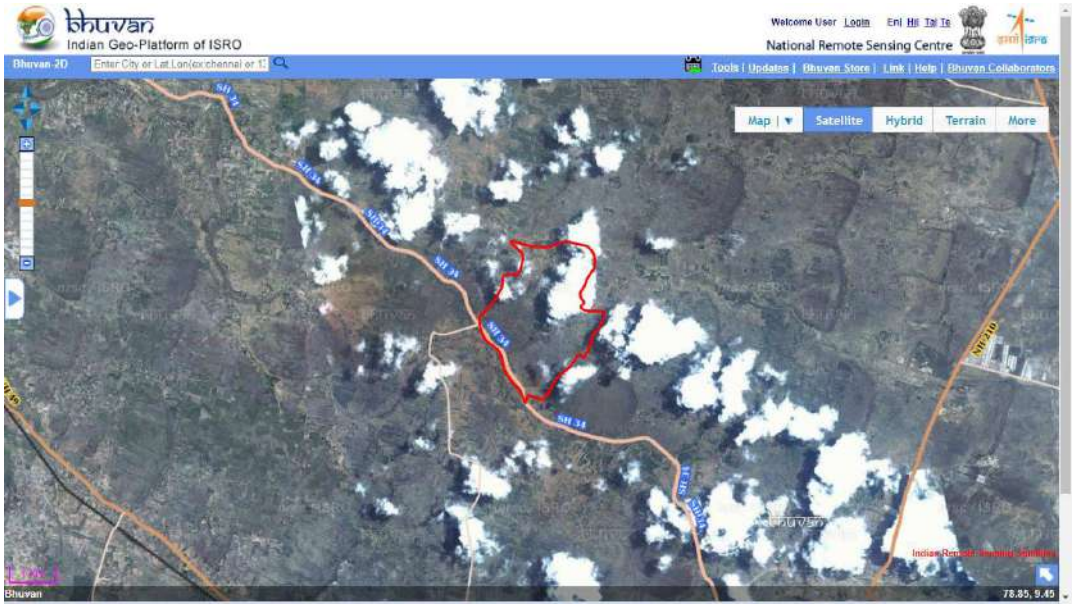
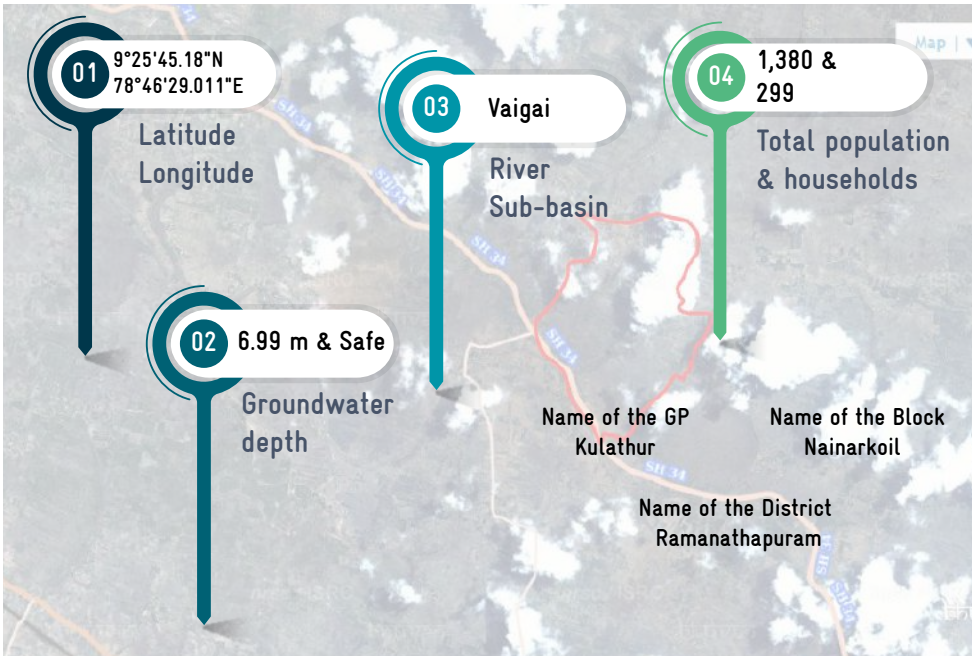


Figure 8.5. Satellite image of Kulathur GP

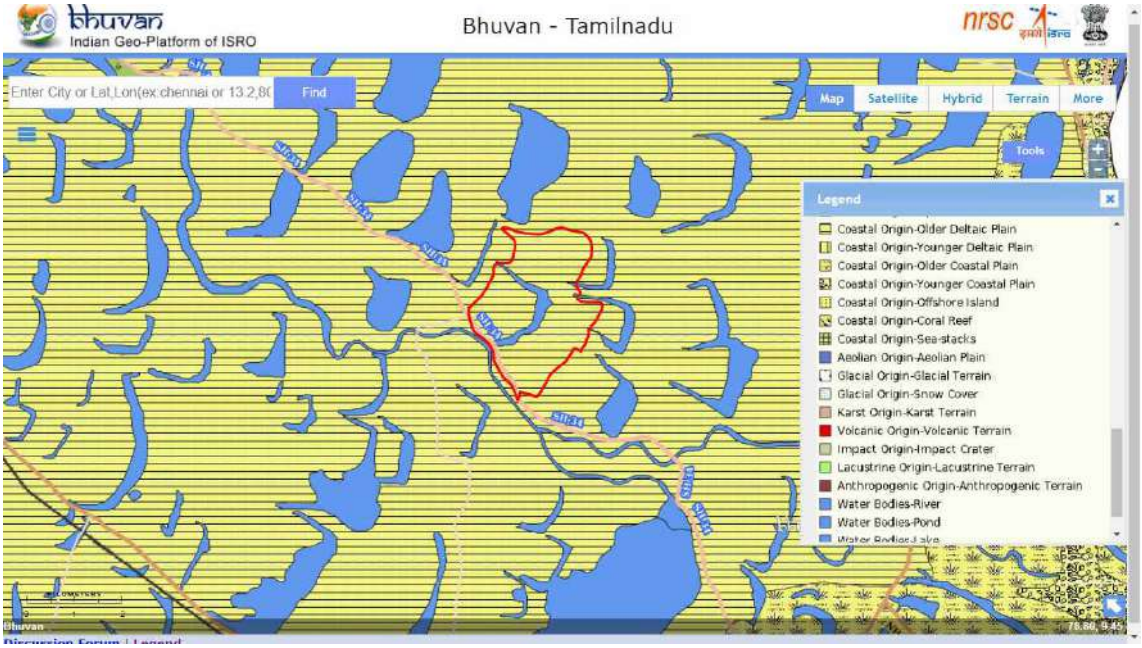
Kulathur GP is situated near the coast of the Bay of Bengal, in the Nainarkoil Block of Ramanathapuram District, Tamil Nadu (Figure 8.5). The total geographical area of the village is about 607 ha. It has a population of 1380. The male and female population is 709 and 671 respectively. 71.66% of the population comprises of SC population and no ST population. The total number of households in the village is 299. The general description of the GP is given in (Table 50).

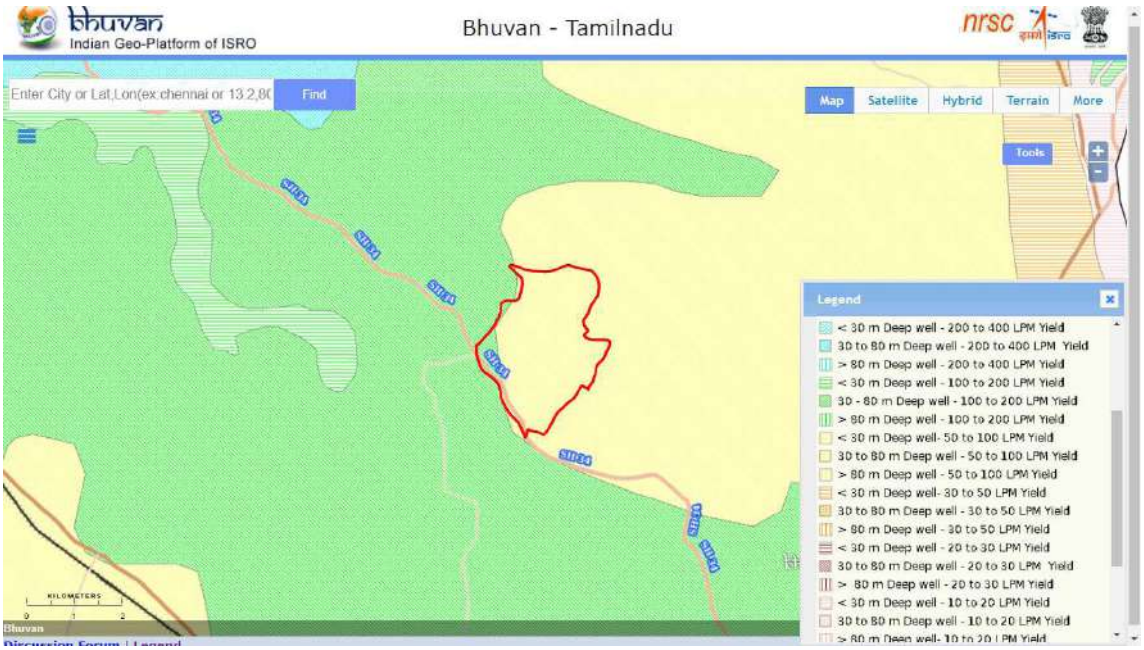
TABLE 50. GENERAL DESCRIPTION OF KULATHUR GP, NAINARKOIL BLOCK



8.3.1 CWRM PLANNING - SPATIAL DATA

CWRM adapted the geospatial technologies in its process of plan preparation towards climate-resilient infrastructure, Water Conservation Water Harvesting etc. at cadastral levels. Geospatial datasets allow players to understand the study area in terms of geomorphology, lineaments, salt-affected area, erosion, watershed, LULC, and wasteland. In some cases, spatial data serves as a direct input for a particular activity to be implemented towards conservation of resources. Various thematic datasets for Kulathur GP are shown in Figure 8.6 (A, B, C,D, E) and discussed below.

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Bhuvan - Tamilnadu
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Hybrid
Terrain
More
Tools
Legend
< 30 m Deep well - 200 to 400 LPM Yield
30 to 80 m Deep well - 200 to 400 LPM Yield
> 80 m Deep well - 200 to 400 LPM Yield
< 30 m Deep well - 100 to 200 LPM Yield
30 - 80 m Deep well - 100 to 200 LPM Yield
> 80 m Deep well - 100 to 200 LPM Yield
< 30 m Deep well- 50 to 100 LPM Yield
30 to 80 m Deep well - 50 to 100 LPM Yield
> 80 m Deep well - 50 to 100 LPM Yield
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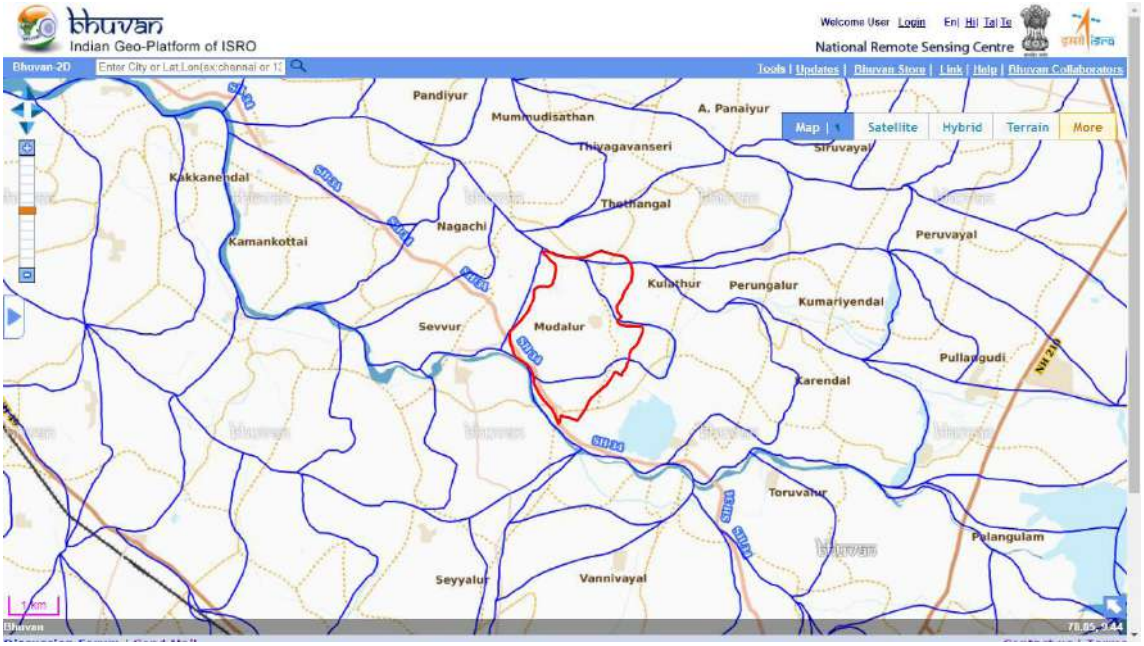
KILOMETERS
Bhuvan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Thivagavanseri
Kakkanendal
Thattangal
Nagachi
Kamankottai
Peruvayal
Kulathur
Perungalur
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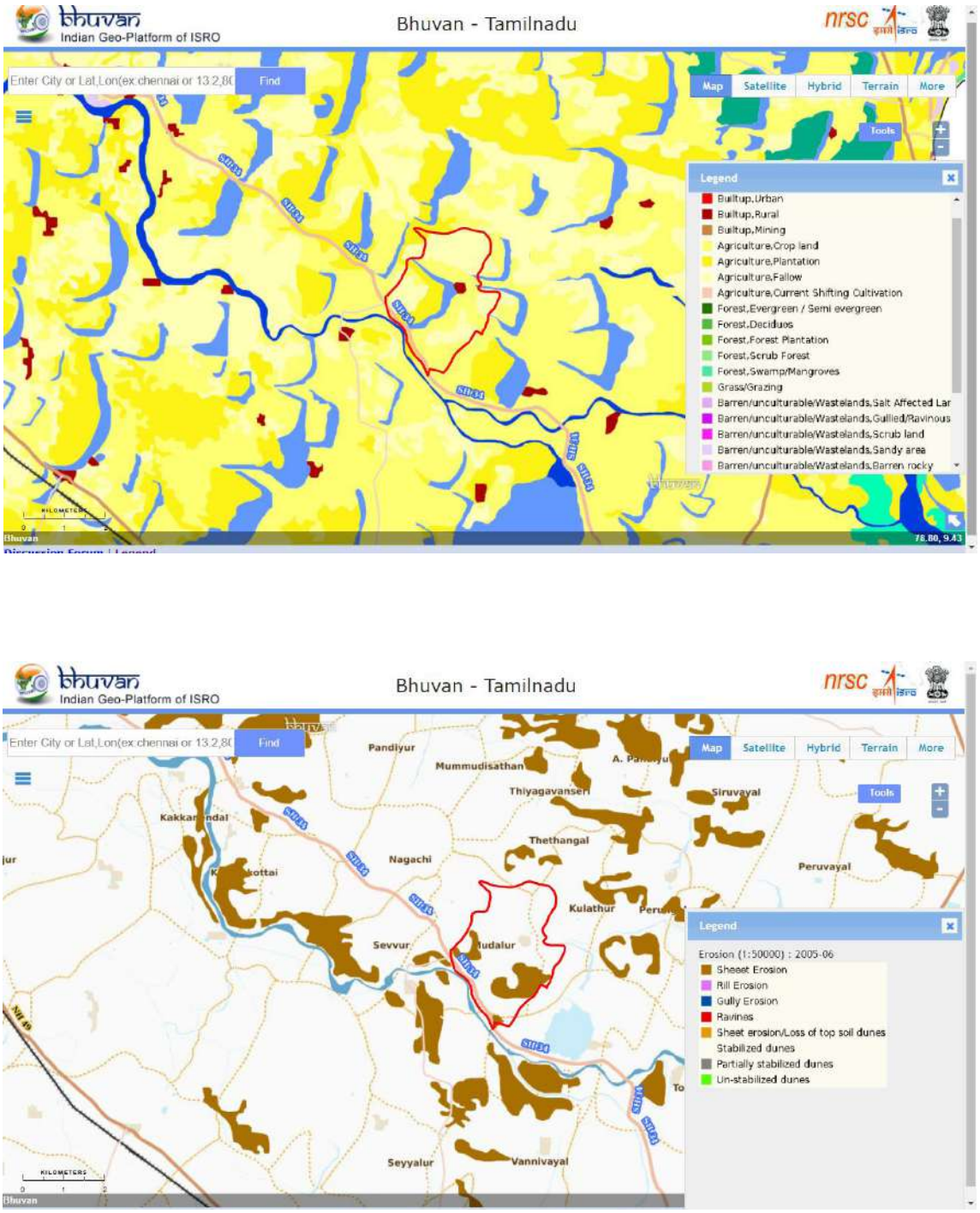


Figure 8.6. Spatial thematic maps of Kulathur GP. A. Geomorphology, B. GW prosperity, C. Watershed, D. LULC, E. Soil erosion area

Kulathur GP is engrossed with Coastal Orgin- Deltaic Plain (A). The groundwater prospectus of the GP at the west side is 30-80 m deep well and 100 to 200 liters per minute yield and 30 to 80 m deep well and 50 – 100 liters per minute yield potential is in the east part of this GP (B). GP area falls under five micro-watershed units (C). Most of the land area is under barren waste land and fallow land in the GP (D). There is no Salinity in the GP (E).

8.3.2 CWRM PLANNING- NON-SPATIAL DATA

The non-spatial data covers four important themes – socio economic, climate, water and agriculture with 116 parameters (Table 51). These non-spatial data are concurrently used for analysis along with the spatial data mentioned above to identify the key water challenges, prepare water budget by understanding the supply and demand and develop water actions to the different land use and slope categories. The process starts with mapping of the administrative (habitations/panchayat/revenue village, Block/taluk), agro-ecological (regional and sub-regional, climatic and agricultural zonation's) and hydrological (drainage points/watersheds/sub basin) units keeping the GP as the lowest unit of planning and execution.

TABLE 51. NON-SPATIAL DATA- KULATHUR GP

Key CWRM Parameter	Details
Climate Vulnerability Area (CVA) 1: Socio-Economic	
Geographical Area (ha)	607
Male Population	709
Female Population	671
Total Population	1,380
SC Population	989
ST Population	0
Vulnerable Population	989
Households (HH's)	299
Only one room HH's (SECC)	3
Female Headed HH's (SECC)	19
Vulnerable Households (SECC)	8
% of Vulnerable Households	3
Registered MGNREGA Job cards	475
The active person working in job Cards	354
Drinking Water Sources	5
HH's dependent on other sources for drinking water	460
Annual Greywater Generation (ha.m)	2.52
Climate Vulnerability Area (CVA) 3: Water Resources	
Canal Network (m)	
Length of Main Canal (Km)	6,000
Water Courses (Field Channels) (Km)	500
No.of Tanks (PWD & Union)	1
No. of Ooranis	4
Irrigation Facilities (ha)	
Area under Tank Irrigation	168.47
Area under Open & Tube Well Irrigation	116.89

Catchment Area wise Available Runoff (ha.m)	
Good Catchment Area	21.7
Bad Catchment Area	57.9
Watershed and Drainage Networks	
Length of Natural Drainage Lines (Km)	3,611
No. of Natural Drainage Lines	4
No. of Micro Watersheds	5
Water Demand (ha.m)	
Water Demand for Humans	4
Water Demand for Agriculture	305
% G.W Utilization for Drinking	80
% G.W Utilization for Livestock	82
% G.W Utilization for Agriculture.	41
% SW Utilization for Drinking	20
% SW Utilization for Livestock	18
% SW Utilization for Agriculture	59
Climate Vulnerability Area 4: Agriculture	
Area Under Land Resources (ha)	
Non-Agricultural Uses	97.93
Cultivable Waste Land	0.23
Fallows Land other than Current Fallows	0.79
Current Fallow land	168.47
Unirrigated Land	223.14
Area Irrigated by Source	116.89
Catchment Area (ha)	
Good Catchment	97.93
Average Catchment	0.23
Bad Catchment	509.29
Crop Details (ha)	
Irrigated Area	84.5
Rainfed area	188.3
Area under Paddy Cultivation	251.2
Crop Water Requirement - Irrigated condition (ha.m)	123.25
Crop Water Requirement - Rainfed condition (ha.m)	181.74
Soil Resources: Status of Available Nitrogen (%)	
Very Low (VL)	13
Low (L)	87
Status of Organic Carbon (%)	
Very Low (VL)	26
Low (L)	74

Status of Soil Micro Nutrients (%)	
Sufficient	67
Deficient	33
Status of Physical condition of the soil (%)	
Moderately Acidic	2
Slightly Acidic	2
Moderately Alkaline	54
Strongly Alkaline	42
Soil Texture	
Fine Soil	84
Soil Water Permeability	Moderate to Low (5-20 mm/hr)
Soil moisture and ET	
Volumetric Soil Moisture	17
Estimated Soil Moisture	86.62
ET Losses	177.5
Means of Water Extraction (%)	
Gravity	2
Lifting	98
Irrigation Methods (%)	
Wild Flooding	59
Control Flooding	41
Livestock (No)	
Cattle Population	71
Sheep Population	21
Goat Population	121
Poultry	463
Livestock Water Requirement (ha.m)	0.32

8.3.3 KEY WATER CHALLENGES

Socio-Economic

1. Female population is less than male population
2. 71.66% percent of the population belong to SC category
3. Near to 3 % of the households are vulnerable, 19 HH are female headed
4. 3 HH have only one room.
5. 2.52 ha.m grey water from 299 households living in the coast needs attention
6. No drinking water connections

Water

1. 4 Ooranis and 1 tank in the GP
2. 80 % Drinking water requirement depends on Ground Water
3. 59 % of Surface Water and 41% Ground Water utilized for agriculture
4. More water for agriculture (305 ha.m)
5. 79.6 ha.m of water is an available runoff in which 72.73% of the runoff is from Bad catchment
6. 85.97% of the conservation is from the bad catchment

Agriculture and Allied Sector

1. 85.10 % is under Individual lands
2. More bad catchment area (83.84%)
3. Rain fed area (69%)
4. Low soil Nitrogen and Carbon
5. 54 % moderately alkaline soil
6. 84% fine soil
7. 59% Wild flooding
8. Area under paddy cultivation 251.2 ha

8.3.4 PERSPECTIVE PLAN - WORKS PROPOSED: WATER ACTIONS

The appropriate and site-specific works are identified for the development of public and common land, agriculture and allied activities, rural infrastructures, and climate-resilient measures to reduce the vulnerability in the GP. About 2.8 % of the total land area is taken for WASCA activities like plantation, conservation works. The total proposed area for treatment is 17.14 ha out of which 89 % of the proposed work in under individual lands. (Figure 8.7). Through the proposed conservation activities, 12.69 ha.m run off would be harvested in which, about 85.97 % of the run-off is from the good catchment area, 14% of the run off is from the bad catchment area (Figure 8.8).

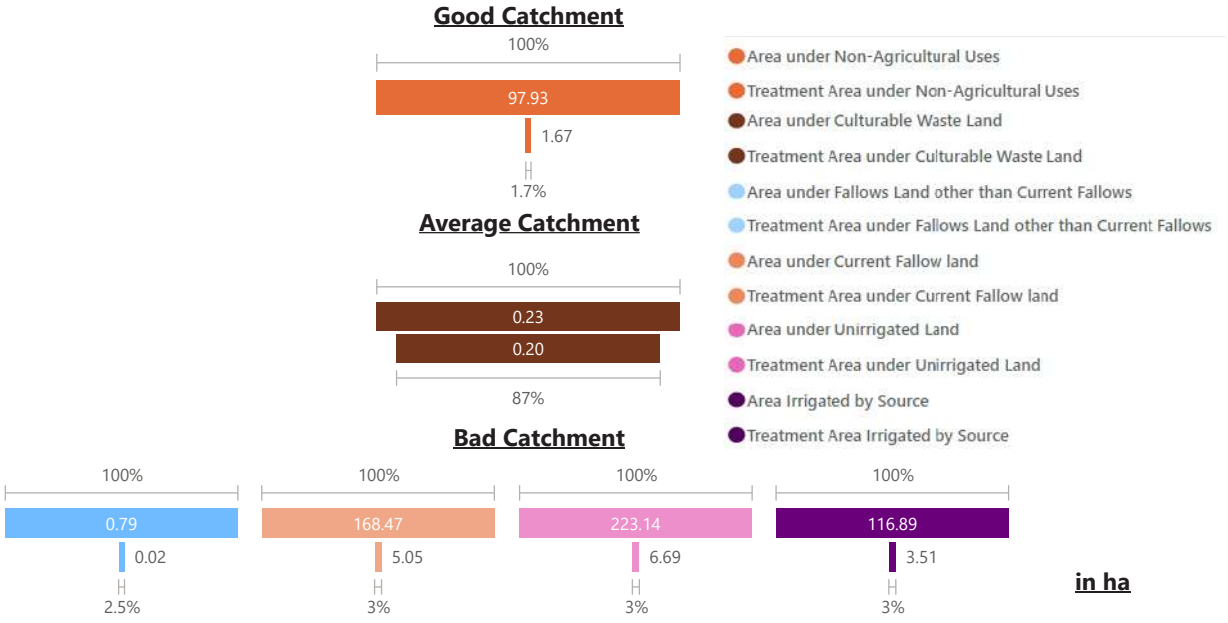


Figure 8.7. Proposed land resource treatment area in Kulathur GP

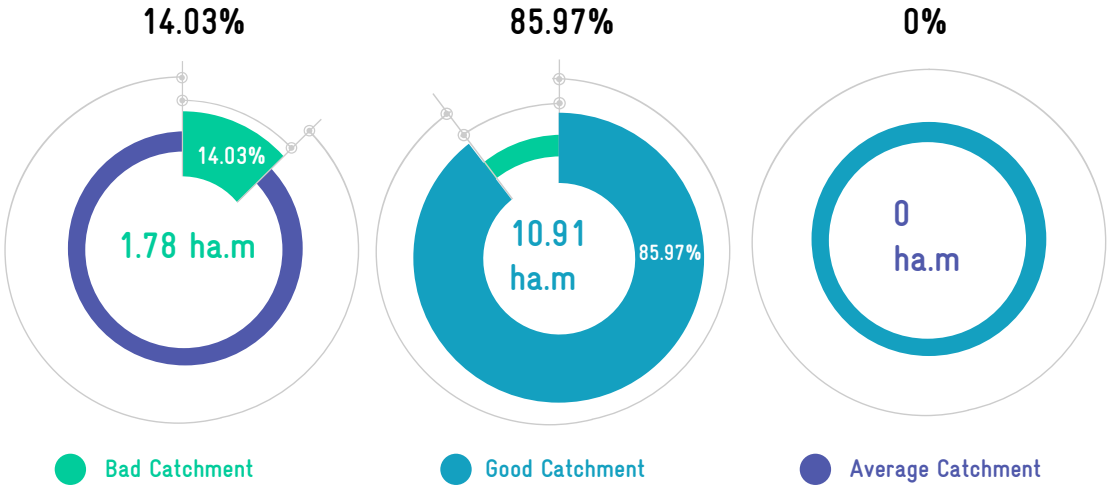


Figure 8.8. Expected run off conservation after treatment in Kulathur GP

Based on the above key water challenges, relevant site-specific works are identified for the development of public and common land, agriculture and allied activities, rural infrastructure, and climate-resilient measures to reduce the vulnerability in the GP. Table 52 shows the detailed perspective plan and estimates of the work, budget, and person-days for three years from 2021-2022 to 2023-2024 for Kulathur GP. Since it is a vulnerable village, attention was given to include appropriate works to improve the common and public land development.

TABLE 52. PERSPECTIVE PLAN OF KULATHUR GP - FY (2021-2024)

CWRM Water Action 1: Improvement of Public & Common Lands Development				
CWRM Water Action 1: Works in Upper& Middle Ridge				
Name of the Work	**Ridge Type**	**No of Works**	**Estimated cost (INR in Lakhs)**	**Estimated Person Days**
Afforestation in Public/common lands (ha)	Lower	1.67	14.36	5,584.48
Contour Continuous Bunds (CCB) for Afforestation area (m)		6.66	0.17	66.6
Composting (No.)		5	0.85	75
Avenue plantation (Km)		1.399	2.52	983.497
Block Plantation (Community) (ha)		0.2	2.22	864
Restoration of water bodies (No.)		5	22	3,400
Artificial Recharge Structure (No.)		47	117.5	18,377
Canal Bund Plantation		12	90	35,160
WC - Irrigation channels - Desilting		35.6	0.27	106.8
Subtotal Water Action - I		**115**	**250**	**64,617**
CWRM Water Action 2: Agricultural and allied Sector development				
CWRM Water Action 2: Works in Lower Ridge				
Farm Bunding	Lower	15	22.92	8,954
Micro Irrigation		1	1	0
Construction of farm ponds (No.)		5	10	3,905
Land development (ha)		6	58.9	23,006
Cattle Shelters (No.)		2	4.24	662
Goat Sheep Shelters (No.)		13	29.51	4,615
Fodder development for cattle (No.)		2	2.96	4,688
Azolla units (No.)		2	0.3	46
Cattle Trough (No.)		2	0.1	12
Poultry shed (No.)		12	1.08	120
Dry land Horticulture/Agro-forestry		8	68	26,568
Vermi Compost		2	0.36	54
Subtotal Water Action - II		**70**	**199**	**72,630**

CWRM Water Action 3: Rural Water Management				
CWRM Water Action 3: Works in Lower Ridge				
Soak pits (Community) (No.)	Lower	3	0.39	60
Soak pits (Individual) (No.)		31	3.1	496
Roof rain Water Harvesting (No.)		2	8	1,250
Community Tanka (Rajasthan Model) (No.)		1	30	300
Subtotal Water Action - III		**37**	**41.49**	**2,106**
Overall Total GP		**222**	**491**	**1,39,354**

Water actions

Regarding CWRM themes, of the total number of projects identified, 51.80 percent works are in public and common land, 31.53 percent in agriculture and allied sector while it is 16.66 percent under rural infrastructure. (Table 53).

TABLE 53. SUMMARY OF WORKS IDENTIFIED AND ESTIMATED PERSON-DAYS FOR 2021-2024

CWRM themes	No of works	Estimated budget (INR in lakhs)	Estimated person days
Public and common land development	115	250	64,617
Agriculture and Allied sector development	70	199	72,630
Rural water management	37	41.49	2,106
TOTAL	222	491	1,39,354

8.3.5 IMPACTS

The proposed water actions based on the above key water challenges cover three years from 2021-2022 to 2023-2024. At the end of the implementation period the following impacts are envisaged (Table 54). It is expected that the impacts will potentially reduce the vulnerability and improved the resilience of the system to the projected climatic change events and ensures water security.

TABLE 54. WASCA- WATER ACTIONS AND INDICATORS

WASCA CWRM ACTION PLAN

DEVELOPMENT OF PUBLIC AND COMMON LAND

	INDICATOR		OUTCOMES/ IMPACT
1	Number of water bodies restored in the village	1	5 water bodies restored
2	Quantum of water harvested/recharge	2	12.7 ha.m surface runoff is harvested due to WASCA interventions
3	The proportion of land treated under WASCA	3	16.12 percent of the total area treated under WASCA (97.93 ha)
4	Area under afforestation	4	1.67 ha area under afforestation
5	Length of drainage line treated	5	Nil

5
TRADITIONAL WATER BODIES RESTORED

1.67 ha
AFFORESTATION

12.7 ha.m
RUNOFF HARVESTED

16.12 %
AREA OF THE VILLAGE TREATED

WASCA CWRM ACTION PLAN

DEVELOPMENT OF AGRICULTURE AND ALLIED ACTIVITIES

	INDICATOR		OUTCOMES/ IMPACT
1	Assessment of sources of water for live-stock and agriculture demand	1	15 farm ponds established
2	No structures were established for on-farm (in-situ) water harvesting in drylands	2	15.28 ha Farm bunding with trenches
3	Improvement in soil health	3	5 compost units for soil health improve-ment
4	Changes in the irrigation practices	4	3.51 ha covered under micro-irrigation
5	Dryland development with agro-forestry	5	8 ha under dryland horticulture
6	Households established fodder plots	6	18 vulnerable households established fodder plots

15
FARM PONDS

5
VERMI COMPOST

15.28 ha
FARM BUNDING

8 ha
DRYLAND HORTICULTURE

18
FODDER PLOTS

WASCA CWRM ACTION PLAN

DEVELOPMENT OF RURAL INFRASTRUCTURE

	INDICATOR
1	Number of villages having complete solid and liquid waste management systems
2	Greywater drains
3	Roof rainwater harvesting measures
4	Nutri gardens

	OUTCOMES/ IMPACT
1	3 common and 31 individual soak pits were established for recycling greywater benefiting 307 households
2	2 common roof rainwater harvesting and storage and 307 individual level roof rainwater harvesting
3	307 Households established Nutri-gardens in homesteads

3 COMMUNITY & **31** INDIVIDUAL SOAK PITS

2 COMMON & **307** INDIVIDUAL ROOF RAINWATER HARVESTING

307 NUTRI-GARDENS

Table 55 provides both the prospective plan for three years and the annual plan for the one year from 2021-2022 on the shelf of projects/number of works and number of person-days.

TABLE 55. PROPOSAL FOR THE MGNREGS, KULATHUR GP, NAINARKOIL BLOCK

	No of works	No of person days
Perspective plan	222	139,354
Annual plan	89	55,742

8.3.6 PROPOSED ACTIVITY MAP

The proposed activity map (Figure 8.9) for Kulathur GP, Nainarkoil Block shows a shelf of projects for all three year works from 2021-2024.

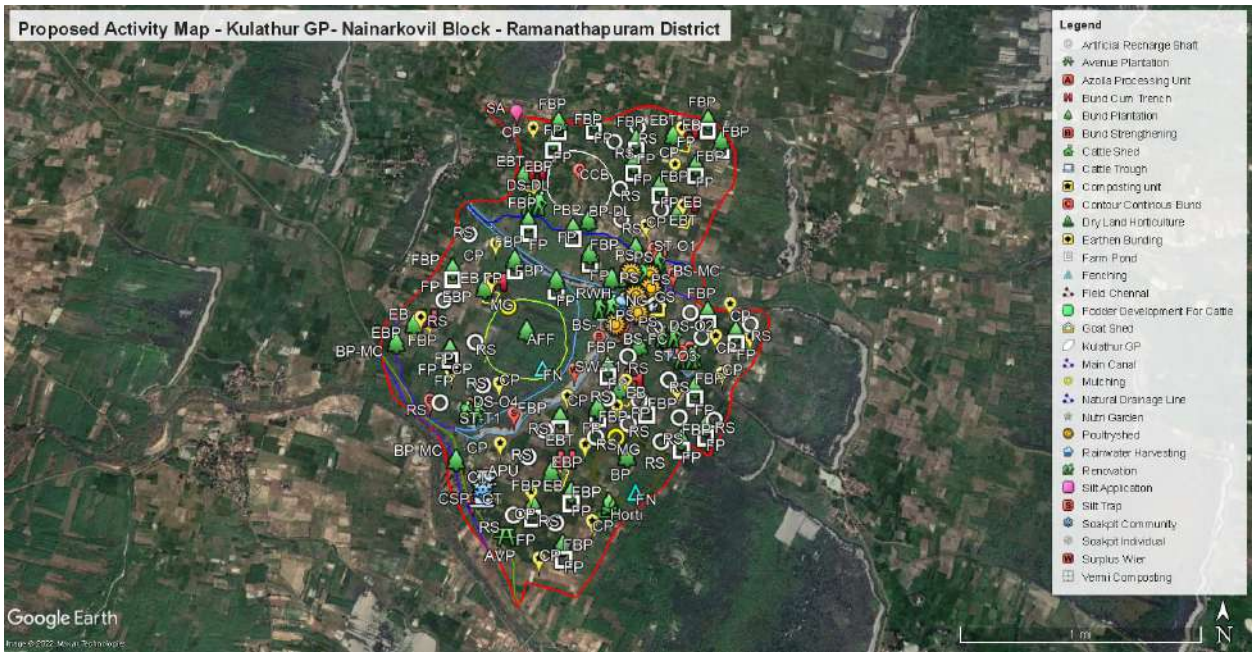
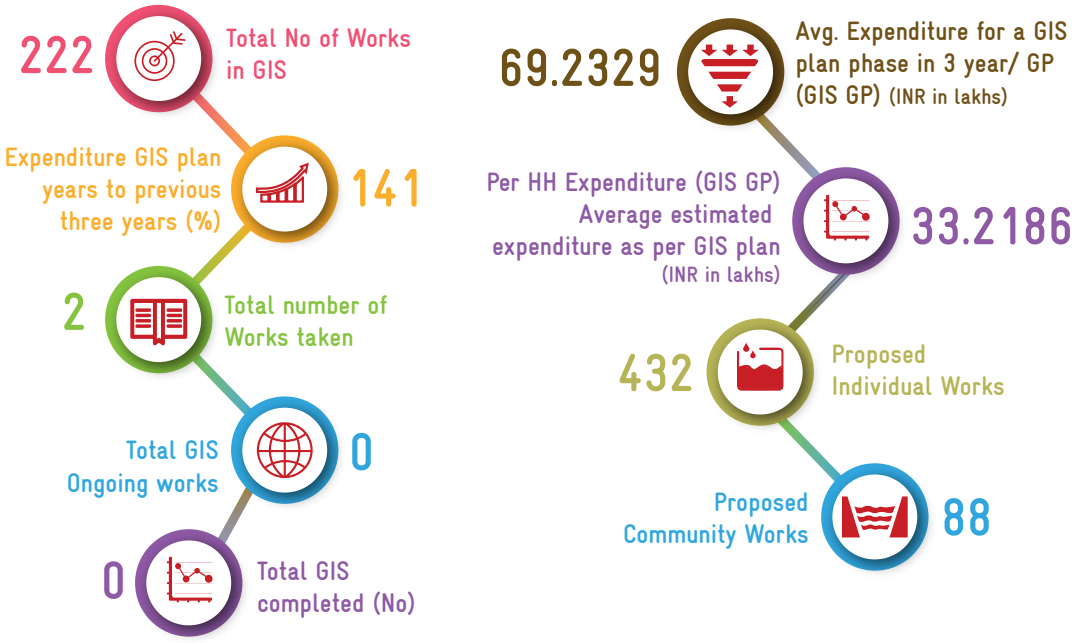


Figure 8.9. Proposed action plan of Kulathur GP

8.3.7 GIS PLAN IMPLEMENTATION AND KEY PARAMETERS

The GIS plan implementation and performance of Kulathur GP, Nainarkoil Block is represented in Table 56.

TABLE 56. GIS PLAN IMPLEMENTATION, KEY PARAMETERS PERFORMANCE IN NUMBERS



நீர்இன்று அமையாது உலகெனின் யார்யார்க்கும்
வான்இன்று அமையாது ஒழுக்கு

குறள் - 20

Water is life that comes from rain
Sans rain our duties go in vain

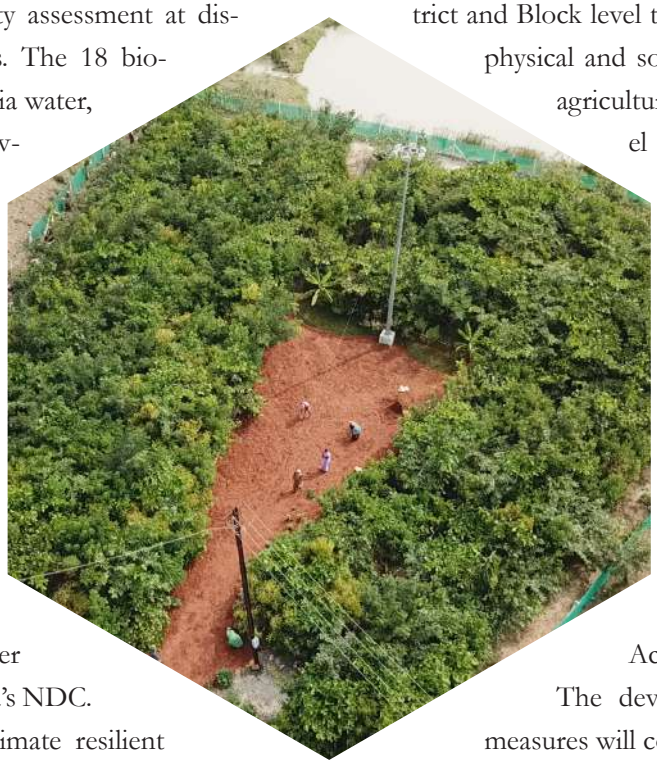
Thirukkural - 20

CHAPTER 9

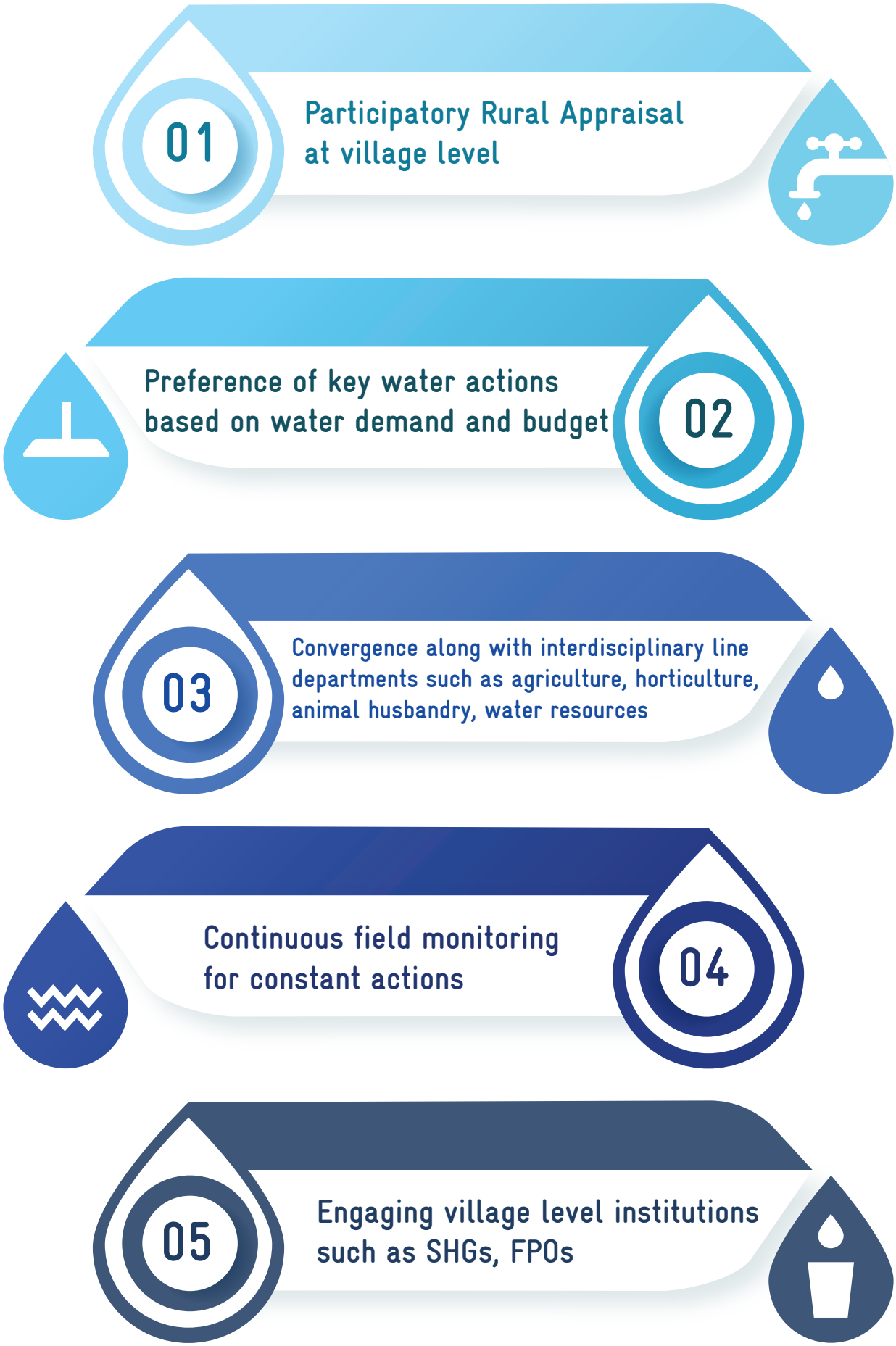
CONCLUSION

> **"WASCA TN took an initiate to address the problem holistically through comprehensive vulnerability assessment at district and block level to identify the vulnerable area and its key problems"**

In recent decades, the demand for water is increasing at a fast rate due to rapid increase in population, industrial and economic growth. The evident changes in climate and its extremities are bringing more threats to water security. Frequent monsoon failures lead to acute water scarcity and severe droughts. Thus, dependency on ground water has increased many folds during recent years which resulted in lowering of ground water levels and even drying up of wells. WASCA TN took an initiative to address the problem holistically through comprehensive vulnerability assessment at district and Block level to identify the vulnerable area and its key problems. The 18 bio-physical and socio-economic indicators of four interrelated areas via water, agriculture, socio economic and climate used at district level are further expanded to 110 parameters at Block level. The spatial and non-spatial CWRM parameters for the above mentioned four interrelated areas are used to represent risk, sensitivity and adaptive capacity of the GPs, which eventually reflects rural water security. The key problems of the Blocks are identified and the best possible adaptation options 'Key Water Actions' are drawn up under WASCA initiatives in public and common land, agriculture and allied sector, rural infrastructure areas. All the indicators/parameters and Key Water Action are aligned to the appropriate SDG and India's NDC. The developmental activities in the 3 areas along with climate resilient measures will contribute in reducing the vulnerability and building the resilience of the local communities at the GP level. The GP based planning and integration at the Block level based on macro and micro-watershed enables to adopt an ecosystem approach in promoting nature-based solutions. The productive impacts are visualized through a convergence approach by mobilizing necessary finance, knowledge and technologies at the end of the three years of implementation. This integrated Block level approach will be more effective with Block level climate information which is not currently available.



Recommendations towards stable development and its progressive outcome are:


01
Participatory Rural Appraisal at village level
Preference of key water actions based on water demand and budget
02
03
Convergence along with interdisciplinary line departments such as agriculture, horticulture, animal husbandry, water resources
Continuous field monitoring for constant actions
04
05
Engaging village level institutions such as SHGs, FPOs

ANNEXURES

ANNEXURE 1

TYPES OF GPs

Type of GP	Description
I	Both GP and revenue village data and boundary match
II	Having more than one GPs in one Revenue Village
III	One GP is falling under more than Type 1 one Revenue Village
IV	GPs having more than one GP, one Revenue Villages data, boundary
V	Newly formed GP after 2011 census publication

* Note: The CWRM uses spatial and non-spatial data for developing Gram Panchayat level plans. Most of the data for non-spatial are available at revenue village level in the project area. To synchronize planning at GP keeping data availability and administrative boundary for GIS planning, various GP's are categorized based on revenue village boundaries, for collecting and organizing the datasets. Based on the above factors, five different types of GPs are classified as above.

ANNEXURE 3.1

KEY CWRM PARAMETER FROM SECONDARY SOURCES

Key CWRM Parameter	Secondary Source
Socio economic	
Geographical Area	Census-2011, MoHA, GOI *https://censusindia.gov.in/2011census/dchb/DCHB.html*
Male Population	
Female Population	
Total Population	
SC Population	
ST Population	
Vulnerable population	
Households (HH's)	Socio-economic caste census (SECC) 2011 *https://secc.gov.in/homePageLgd.htm*
Only one room HH's	
Female Headed HH's	
Vulnerable Households	
% of Vulnerable Households	
Registered MGNREGA Job cards	*http://mnregaweb4.nic.in/netnrega/app_issue.aspx?page=s&lflag=eng&state_name=TAMIL%20NADU&state_code=29&fin_year=2020-2021&source=national&Digest=3ics8+9Z9fEQ8yzj5E3qcQ*
Active person working in MGNREGA job Cards	
Water Resources	
Irrigation Facilities	Census-2011, MoHA, GOI *https://censusindia.gov.in/2011census/dchb/DCHB.html*
Area under Tank Irrigation	
Area under Canal Irrigation	
Area under Open & Tube Well Irrigation	
Water Quality	*https://ejalshakti.gov.in/IMISReports/Reports/WaterQuality/WQ/rpt_WQ_DistrictProfile_S.aspx?Rep=0&RP=Y*
Chemical Contaminants	
Bacterial and Other Contaminants	
Watershed and Drainage Networks	NRSC, ISRO, GoI
Length of Natural Drainage Lines	
Number of Natural Drainage Lines	
Number of Micro-watersheds	
Agriculture	
Land Resources	*https://censusindia.gov.in/2011census/dchb/DCHB.html*
Area under Forest land	
Area under Non-Agricultural Uses	
Area under Barren & Un-cultivable Land	
Area under Permanent Pastures and Other Grazing Land	
Area under Land Under Miscellaneous Tree Crops etc.	
Area under Cultivable Waste Land	
Area under Fallows Land other than Current Fallows	

Area under Current Fallow land	*https://censusindia.gov.in/2011census/dchb/DCHB.html*
Area under Unirrigated Land	
Area Irrigated by Source	
Soil Resources: Status of Available Nitrogen	*https://soilhealth.dac.gov.in/NewHomePage/NutriPage*
Very Low (VL)	
Low (L)	
Medium (M)	
High (H)	
Very High (VH)	
Status of Organic Carbon	
Very Low (VL)	
Low (L)	
Medium (M)	
High (H)	
Very High (VH)	
Status of Soil Micro Nutrients	
Sufficient	
Deficient	
Status of Physical condition of the soil	*https://soilhealth.dac.gov.in/NewHomePage/NutriPage*
Acidic Sulphate	
Strongly Acidic	
Highly Acidic	
Moderately Acidic	
Slightly Acidic	
Neutral	
Moderately Alkaline	
Strongly Alkaline	
Soil Texture	NRSC
% of Clay Soil	
% of Fine Soil	
% of Coarse loamy	
Soil Water Permeability	standard table
Soil moisture and ET	*https://indiawris.gov.in/wris/#/*
Volumetric Soil Moisture	
Livestock	*https://farmer.gov.in/livestockcensus.aspx*
Cattle Population	
Sheep Population	
Goat Population	
Poultry	

ANNEXURE 3.2

KEY CWRM PARAMETERS FROM PRIMARY SOURCES

Key CWRM Parameter	Primary Data
Water sources	
Drinking Water Sources	Block level officer/ GP level assistants
HH's have tap water connection for drinking water	
HH's dependent on other sources for drinking water	
Canal network	
Length of Main Canal	Block level officer/ GP level assistants
Length of Minor Canal	
Length of Distributaries	
Water Courses (Field Channels)	
Traditional water bodies	
Number of Tanks (PWD & Union)	Block level officer/ GP level assistants
Number of Ooranis	
Other Surface Water Bodies	
Crop details	
Irrigated Area	Village G return data
Rainfed area	
Area under Paddy Cultivation/irrigated	

ANNEXURE 3.3

KEY CWRM PARAMETER GENERATED -PRIMARY DATA

Key CWRM Parameter	Methods/Formulas Used
Water Demand	Standard Norms are in Annexure 3.4
Water Demand For Drinking	
Water Demand for Livestock	
Water Demand For Agriculture	
% G.W Utilization for Drinking	
% G.W Utilization for Livestock	
% G.W Utilization for Agriculture.	
% SW Utilization for Drinking	
% SW Utilization for Livestock	
% SW Utilization for Agriculture	
Annual Greywater Generation	Standard Norms are in Annexure 3.5
Available Runoff	Strange table method (based on rainfall, land area)
Run Off Conserved	Formula (based on tank storage, built up, linear measurement)
Estimated Soil Moisture	calculation & formula
ET Losses	calculation & formula
Means of Water Extraction (Gravity/ Lifting)	(Number of Gravity or lifting /Total number of extraction)*100
Irrigation Methods (Wild/Control)	(corresponding irrigation area/ total irrigation area)*100

ANNEXURE 3.4

STANDARD NORMS FOR CALCULATING WATER DEMAND

	Water Users	Total Annual Requirement (ha.m)
1	Human	population*0.0027375
2	Animals	Total water requirement for animals
3	Agriculture	Total volume of water in agriculture (Both irrigated and rainfed)
4	Others (Industrial)	
	Total water De-mand	Addition of all 4 category
	Water Users	**Requirement met by Ground Water**
1	Human	water demand for human* Ground water percentage (coming from drinking water sources)
2	Animals	water demand for animals* Ground water percentage (coming from Livestock table)
3	Agriculture	Total volume of water in irrigated source
4	Others (Industrial)	
	Total water De-mand	Addition of all 4 category
	Water Users	**Requirement met by Surface Water**
1	Human	water demand for human* Surface water percentage (coming from drinking water sources)
2	Animals	water demand for animals* surface water percentage (coming from Livestock table)
3	Agriculture	Total volume of water in rainfed source
4	Others (Industrial)	
	Total water De-mand	Addition of all 4 category
	Water Users	**% of Ground Water**
1	Human	Ground water percentage (coming from drinking water sources)
2	Animals	Ground water percentage (coming from Livestock table)
3	Agriculture	(Total volume of water in irrigated source/Total ground water requirement)*100
4	Others (Industrial)	
	Total water De-mand	Addition of all 4 category
	Water Users	**Requirement met by Surface Water**
1	Human	Surface water percentage (coming from drinking water sources)
2	Animals	surface water percentage (coming from Livestock table)
3	Agriculture	(Total volume of water in rainfed source/Total surface water requirement)*100
4	Others (Industrial)	
	Total water De-mand	Addition of all 4 category

* Based on the land use, slope, and soil type, the catchments are classified as good, average and bad. In the CWRM framework, we used land use as a key factor for the classicization of catchments.

Good catchment area: It consists of the runoff generated from sloppy lands with dense forest cover and areas where the ground is covered with a reduced rate of infiltration. It includes area under forest, area under non-agricultural use, barren and un-cultivable lands, and area under permanent pastures and other grazing land areas.

Average catchment area: It denotes the land uses related to the types of land under miscellaneous tree crops, culturable waste, and fallow land other than current fallow areas where the land surfaces are undulated terrain, moderately sloppy along with a medium infiltration rate.

Bad catchment area: It covers the area where the terrain is flat with very less vegetative cover, the land use categories under current fallow, total unirrigated and irrigated area with less surface runoff

ANNEXURE 3.5

STANDARD NORMS FOR GREY WATER GENERATION CALCULATION

	Waste water generation Source	Per day/unit waste water generation in L (Standard Value)
1	Bathing	15
2	Washing	10
3	Toilet	10
4	Cleaning	5
5	Cooking and cleaning Utensils	5
6	Others	5
	Total	**50**
	Waste water generation Source	**Daily volume of Grey water in L**
1	Bathing	Bathing water requirement in litres * Total population
2	Washing	washing water requirement in litres * Total population
3	Toilet	Toilet water requirement in litres * Total population
4	Cleaning	Cleaning water requirement in litres * Total population
5	Cooking and cleaning Utensils	cooking and cleaning utensils water requirement in litres * Total population
6	Others	other purpose water requirement in litres * Total population
	Total	**50*total population**
	Waste water generation Source	**Annual Grey water in CuM**
1	Bathing	(Daily volume of grey water for bathing in litres *365) / 1000
2	Washing	(Daily volume of grey water for washing in litres *365) / 1001
3	Toilet	(Daily volume of grey water for toilet in litres *365) / 1002
4	Cleaning	(Daily volume of grey water for cleaning in litres *365) / 1003
5	Cooking and cleaning Utensils	(Daily volume of grey water for cooking and washing utensils in litres *365) / 1004
6	Others	(Daily volume of grey water for other purposes in litres *365) / 1005
	Total	**(Total daily volume of grey water in litres *365)/ 1000**
	Annual Grey water generated in ha.m	**Annual Grey water in Cum/10000**

ANNEXURE 3.6

WATER QUALITY STANDARDS AND FORMULA USED

RELATIVE WEIGHTS ASSIGNED FOR DIFFERENT WATER QUALITY PARAMETERS

S. No.	Physical and chemical pa-rameters	World Health Organization (WHO 2004)	Weight (w)	Relative weight (wi)
1	pH	8.5	4	0.133
2	Total dissolved solids (mg/l)	500	5	0.167
3	Bicarbonate (mg/l)	200	1	0.033
4	Chloride (mg/l)	200	4	0.133
5	Sulphate (mg/l)	200	3	0.1
6	Nitrate (mg/l)	45	3	0.1
7	Calcium (mg/l)	75	2	0.067
8	Magnesium (mg/l)	30	2	0.067
9	Sodium (mg/l)	200	4	0.133
10	Potassium (mg/l)	100	2	0.067

$$SI_i = W_i \times Q_i \qquad WQI = \sum_{i=1}^{n} SI_i$$

Where qi is the quality rating, Ci is the concentration of individual element in water samples represented in mg/l and Si is the drinking water standard for individual chemical constituents (in mg/l)

Sea water mixing index (SMI) (Park et al. (2005)

$$SMI = a\ X\frac{C\ Na}{T\ Na} + b\ X\frac{C\ Mg}{T\ Mg} + c\ X\frac{C\ Cl}{T\ Cl} + d\ X\frac{CSO_4}{TSO_4}$$

The measurements a, b, c and d represent the relative concentration percentage of Na+, Mg2+, Cl^- and SO_4^{2-} assumed

ANNEXURE 3.7

GP WISE STATUS OF WATER RESOURCE AND ITS SUPPLY AND DEMAND

Gram Panchayat	Canal Irrigation				Tradational Water bodies		
	Length of Main Canal (m)	Length of Minor Canal (m)	Length of Distributaries (m)	Water Courses (Field Channels) (m)	Number of Tanks (PWD & Union) (No.)	Number of Ooranis (No.)	Other Surface Water Bodies (No.)
A.Panayur	4,000	-	-	500	1	4	-
Anjamadai	2,000	-	-	-	4	10	-
Arasanur	2,000	1,500	1,000	500	2	6	-
Ariyankottai	2,600	-	-	2,000	2	10	-
Kiliyur	2,000	-	-	-	1	4	-
Attangudi	2,500	-	-	-	4	13	-
Kottakudi	3,000	1,000	-	-	2	14	-
Koluvur	1,000	-	-	500	2	3	-
Manakudi	2,500	-	-	-	6	8	-
Kullathur	6,000	-	-	500	1	4	-
Mummudisathan	3,000	-	-	-	1	6	-
Thavalaikulam	1,500	-	-	1,500	4	7	-
Pottagavayal	2,250	2,128	-	4,112	4	11	-
Sadurvedamangalam	3,500	-	-	-	1	7	-
P.Kodikulam	2,500	-	-	-	4	7	-
Vagavayal	2,000	-	-	1,800	4	7	-
Vallam	3,000	-	-	2,500	4	9	-
Thalayadikottai	7,000	-	-	2,500	4	9	-
Thenthangal	5,000	-	-	420	2	7	-
Pandiyur	4,000	2,000	-	-	1	2	-
Perungalur	2,500	-	-	407	2	7	-
Nagaramangalam	3,500	-	-	3,454	2	13	-
Nagaram	5,000	-	-	2,561	4	14	-
Siruvayal	5,000	-	-	-	-	18	-

Gram Panchayat	Canal Irrigation				Tradational Water bodies		
	Length of Main Canal (m)	Length of Minor Canal (m)	Length of Distributaries (m)	Water Courses (Field Channels) (m)	Number of Tanks (PWD & Union) (No.)	Number of Ooranis (No.)	Other Surface Water Bodies (No.)
Thiyagavanseri	4,000	-	-	-	1	4	-
Vaniyavallam	3,000	-	-	500	-	9	-
Nainarkoil	2,000	-	-	500	2	4	-
Radhappuli	2,000	-	-	1,000	-	9	-
Keelakavanoor	2,000	-	-	1,000	-	7	-
Siraikottai	2,100	-	-	500	1	5	-
Pagaivendri	4,000	-	-	500	1	2	-
Kalliyadiyendai	3,500	-	-	500	-	2	-
Padappanendal	7,500	-	-	1,500	1	8	-
Karadaranthakudi	2,500	-	-	100	1	6	-
Vadavaneri	5,000	-	-	500	-	7	-
Gangaikondan	1,500	-	-	2,000	1	6	-
Akkiramesai	5,000	-	-	5,000	1	13	-

Gram Panchayat	Irrigation Facilities (ha)			Catchment Area wise Available Runoff (ha.m)			Run Off Conserved (Exisiting) (ha.m)		
	Tank Irrigation	Canal Irrigation	Open & Tube Well Irrigation	Good Catchment Area	Average Catchment Area	Bad Catchment Area	Good Catchment Area	Average Catchment Area	Bad Catchment Area
A.Panayur	104.67	-	37.14	75.40	10.00	40.30	23.43	8.71	0.83
Anjamadai	121.80	-	34.46	47.00	1.70	57.50	15.88	0.76	27.72
Arasanur	109.49	-	32.83	48.90	10.30	50.00	20.81	9.00	1.03
Ariyankottai	88.12	-	34.00	37.10	23.20	76.70	0.50	17.20	-
Kiliyur	136.73	-	38.06	27.90	4.90	65.80	12.51	3.21	13.50
Attangudi	136.73	-	38.06	57.80	18.30	84.50	24.67	14.23	27.75
Kottakudi	46.76	-	24.54	24.20	9.70	42.10	18.69	6.25	2.16
Koluvur	99.10	-	29.86	22.90	14.30	41.90	13.31	12.50	2.58
Manakudi	97.99	-	25.84	37.60	15.40	44.30	25.54	13.25	2.27
Kullathur	168.47	-	116.89	21.70	-	57.90	10.91	-	1.78
Mummudisathan	51.45	-	30.09	22.80	11.30	29.60	1.09	8.12	8.20
Thavalaikulam	46.05	-	49.97	43.90	8.20	28.60	30.79	6.23	1.76
Pottagavayal	105.15	-	50.00	105.70	20.30	84.40	85.26	15.23	74.57
Sadurvedamangalam	124.75	-	4737.00	31.70	10.70	49.00	10.34	8.21	10.35
P.Kodikulam	75.17	-	44.97	27.90	12.80	70.90	20.92	7.89	2.91
Vagavayal	154.73	-	43.12	43.90	13.10	48.20	21.08	6.14	33.34
Vallam	42.13	-	46.16	56.80	14.00	87.20	24.68	7.69	37.20
Thalayadikottai	95.30	-	22.02	54.90	10.80	82.40	2.54	8.23	4.23
Thenthangal	100.69	-	33.58	27.70	17.70	35.30	11.39	15.23	0.73
Pandiyur	39.92	-	19.06	22.80	-	30.70	3.67	-	1.26
Perungalur	63.38	-	22.13	26.20	8.60	44.60	9.44	4.69	0.92
Nagaramangalam	95.85	-	31.54	37.60	3.50	44.90	23.75	3.04	8.30
Nagaram	500.30	-	68.00	54.80	38.60	77.90	28.56	25.69	31.17
Siruvayal	223.43	-	-	68.70	-	143.30	9.86	-	2.94
Thiyagavanseri	55.78	-	37.24	19.10	14.30	25.80	12.36	0.97	11.74

Gram Panchayat	Irrigation Facilities (ha)			Catchment Area wise Available Runoff (ha.m)			Run Off Conserved (Exisiting) (ha.m)		
	Tank Irrigation	Canal Irrigation	Open & Tube Well Irrigation	Good Catchment Area	Average Catchment Area	Bad Catchment Area	Good Catchment Area	Average Catchment Area	Bad Catchment Area
Vaniyavallam	49.33	-	2957.00	30.50	8.20	48.70	6.52	7.13	5.49
Nainarkoil	32.69	-	19.71	20.30	5.40	32.40	15.63	0.87	10.17
Radhappuli	39.42	-	19.71	29.40	-	82.40	9.21	-	12.68
Keelakavanoor	21.22	-	171.30	15.80	-	44.40	9.52	-	6.83
Siraikottai	37.65	-	70.32	27.60	3.50	44.30	16.30	3.07	1.82
Pagaivendri	19.20	-	35.98	14.10	1.80	22.60	9.39	1.57	0.93
Kalliyadiyendai	30.64	-	57.24	22.50	2.90	36.00	7.32	2.49	1.48
Padappanendal	150.00	-	32.00	29.80	1.80	33.20	14.87	0.65	1.02
Karadaranthakudi	194.13	-	82.00	34.10	28.20	93.90	30.54	24.58	36.61
Vadavaneri	37.41	-	17.14	33.40	4.40	20.20	15.41	3.84	5.82
Gangaikondan	54.00	-	26.00	24.20	3.10	29.00	20.36	2.66	2.38
Akkiramesai	20.23	-	5.07	50.40	28.40	103.30	25.95	24.75	8.48

Gram Panchayat	Watershed and Drainage Networks			Water Demand								
	Length of Natural Drainage Lines (m)	Number of Natural Drainage Lines (No.)	Number of Micro-watersheds (No.)	For Humans (ha.m)	For Livestock (ha.m)	For Agriculture (ha.m)	% GW Utilization for Drinking (%)	% GW Utilization for Livestock (%)	% GW Utilzation for Agriculture. (%)	% SW Utilization for Drinking (%)	% SW Utilization for Livestock (%)	% SW Utilization for Agriculture (%)
A.Panayur	9,313.29	13	5	2.53	0.32	311.79	90	77	26	10	23	74
Anjamadai	878.15	3	8	3.78	0.34	337.50	69	57	22	31	43	78
Arasanur	1,294.75	2	5	2.74	0.21	347.39	36	47	23	64	53	77
Ariyankottai	1,034.80	1	6	4.05	0.69	611.34	84	71	28	16	29	72
Kiliyur	6,202.57	10	6	3.91	0.50	311.31	95	56	22	5	44	78
Attangudi	7,816.41	11	5	4.37	0.87	708.11	25	73	22	75	27	78
Kottakudi	587.78	2	9	1.79	0.31	224.99	85	45	34	15	55	66
Koluvur	2,267.11	4	4	2.22	0.19	270.19	83	70	23	17	30	77
Manakudi	356.91	2	5	1.44	0.17	397.69	14	79	21	86	21	79
Kullathur	3,611.07	4	5	3.78	0.32	304.99	80	82	41	20	18	59
Mummudisathan	6,136.60	6	4	1.81	0.24	161.39	47	46	37	53	54	63
Thavalaikulam	2,675.23	3	5	1.65	0.19	177.78	48	56	52	52	44	48
Pottagavayal	3,250.44	5	6	6.20	0.74	755.05	7	96	32	93	4	68
Sadurvedamangalam	5,875.75	6	3	2.55	1.40	277.00	35	43	28	65	57	72
P.Kodikulam	1,498.92	4	6	3.67	0.52	441.61	22	53	37	78	47	63
Vagavayal	2,111.60	3	3	2.86	0.40	392.76	22	60	22	78	40	78
Vallam	2,742.27	5	5	5.83	1.39	418.57	14	55	48	86	45	52
Thalayadikottai	8,592.57	6	7	5.54	0.15	496.92	12	37	19	88	63	81
Thenthangal	3,923.57	5	6	2.86	0.42	248.87	26	79	25	74	21	75
Pandiyur	8,872.03	6	5	3.74	0.84	118.77	25	66	32	75	34	68
Perungalur	7,187.15	6	4	3.63	0.49	249.44	19	79	26	81	21	74
Nagaramangalam	-	-	3	4.01	0.26	293.76	80	92	25	20	8	75

Gram Panchayat	Watershed and Drainage Networks			Water Demand								
	Length of Natural Drainage Lines (m)	Number of Natural Drainage Lines (No.)	Number of Micro-watersheds (No.)	For Humans (ha.m)	For Livestock (ha.m)	For Agriculture (ha.m)	% GW Utilization for Drinking (%)	% GW Utilization for Livestock (%)	% GW Utilzation for Agriculture. (%)	% SW Utilization for Drinking (%)	% SW Utilization for Livestock (%)	% SW Utilization for Agriculture (%)
Nagaram	512.47	1	6	4.15	0.48	615.03	85	83	12	15	17	88
Siruvayal	13,431.82	7	7	5.70	0.22	835.53	73	94	-	27	6	100
Thiyagavanseri	5,153.65	5	5	1.79	0.33	193.75	83	92	40	17	8	60
Vaniyavallam	6,366.31	3	7	8.51	0.22	272.83	95	75	37	5	25	63
Nainarkoil	-	-	5	8.51	0.15	272.83	95	73	37	5	27	63
Radhappuli	2,545.07	4	7	6.62	0.40	647.88	89	33	33	11	67	67
Keelakavanoor	2,215.70	1	1	6.62	0.21	659.65	89	33	89	11	67	11
Siraikottai	3,057.43	2	10	7.01	0.45	306.48	75	64	65	25	36	35
Pagaivendri	4,191.69	3	5	7.01	0.23	306.48	91	64	65	9	36	35
Kalliyadiyendai	2,417.56	1	5	7.01	0.37	306.48	79	64	65	21	36	35
Padappanendal	1,335.01	2	6	2.92	0.85	306.85	75	35	52	25	65	48
Karadaranthakudi	4,861.66	5	6	6.05	0.69	583.25	91	63	24	9	37	76
Vadavaneri	-	-	3	1.13	0.47	256.80	96	49	31	4	51	69
Gangaikondan	594.77	3	3	5.64	0.71	96.09	92	36	33	8	64	67
Akkiramesai	3,980.29	5	7	7.34	0.69	471.69	86	42	20	14	58	80

ANNEXURE 3.8

LOCATION WISE WATER QUALITY IN NAINARKOIL BLOCK DURING PRE-MONSOON SEASON

GP	Locations	Latitude	Longitude	Well type	pH	Salinity	EC (µS/cm)	TDS (ppm)	TA (mg/l)
A.Kachan	Katchan	E 78° 43' 30.187"	N 9° 33' 16.981"	Bore well	7.14	3	16,250	9,140	326
Akkiramesi	ChinnaAkkiramesi	E 78° 42' 16.607"	N 9° 29' 40.07"	Bore well	7.91	0	485	288	468
Ariyankottai	Ananthanenthal	E 78° 48' 23.576"	N 9° 35' 3.923"	Bore well	7.46	0	1,032	615	397
Ariyankottai	Ariyankottai	E 78° 47' 36.874"	N 9° 34' 27.901"	Bore well	7.78	0	456	268	452
Attangudi	Kuyavanenthal	E 78° 49' 7.673"	N 9° 34' 40.264"	Open well	7.97	0	2,852	1,720	471
Kadaranthakudi	Kaadarnthakudi	E 78° 44' 46.388"	N 9° 33' 56.473"	Bore well	7.52	0	3,673	2,235	406
Kiliyur	Kiliyoor	E 78° 47' 0.679"	N 9° 29' 4.495"	Bore well	7.97	0	995	597	471
Koluvur	Koluoor	E 78° 45' 36.155"	N 9° 30' 46.087"	Bore well	7.63	0	1,085	642	429
Kottakudi	Kottakudi	E 78° 46' 44.749"	N 9° 31' 45.822"	Bore well	7.6	0	3,039	1,820	417
Manakudi	Vagavayal	E 78° 47' 19.59"	N 9° 31' 41.862"	Bore well	7.95	0	997	600	470
Nagaramangalam	Movaloor	E 78° 45' 21.452"	N 9° 32' 59.863"	Bore well	7.74	0	2,983	1,893	445
Nainarkovil	Nainaarkulam	E 78° 41' 53.934"	N 9° 32' 53.426"	Bore well	7.1	5	18,260	11,130	316
Nainarkovil	Nainarkovil	E 78° 41' 23.935"	N 9° 32' 46.59"	Bore well	7.61	0	3,601	2,291	420
P Kodikulam	P Kodikulam	E 78° 47' 37.273"	N 9° 30' 14.447"	Bore well	6.18	4	18,460	10,200	229
P Kodikulam	Thaniyapuli	E 78° 48' 2.308"	N 9° 30' 40.072"	Bore well	6.65	10	34,200	20,130	278
Pandiyur	Lakshmi Mangalam	E 78° 44' 8.542"	N 9° 29' 1.522"	Bore well	7.32	4	9,330	5,740	359
Pandiyur	Pandiyur	E 78° 43' 35.483"	N 9° 28' 58.418"	Bore well	7.71	0	1,265	733	440
Panthapanenthal	Panthapanenthal	E 78° 45' 4.018"	N 9° 30' 41.89"	Bore well	7.88	0	460	260	465
Perungalur	Perungalur	E 78° 48' 14.45"	N 9° 26' 4.236"	Bore well	7.59	0	1,073	639	415
Perungalur	Vayaloor	E 78° 48' 7.682"	N 9° 26' 55.183"	Bore well	7.14	0	6,570	4,180	325
Pottagavayal	Pottagavayal	E 78° 50' 6.616"	N 9° 30' 47.549"	Bore well	7.76	0	1,839	1,019	446
Radhappuli	Radhapuli	E 78° 42' 31.025"	N 9° 35' 32.849"	Bore well	7.7	0	1,917	1,160	439
Radhappuli	Varunthi	E 78° 44' 43.066"	N 9° 35' 14.122"	Open well	7	10	25,150	15,530	310
Sadurvedhamana-galam	SV Mangalam	E 78° 45' 1.933"	N 9° 29' 38.504"	Bore well	7.49	2	8,050	5,050	399

GP	Locations	Latitude	Longitude	Well type	pH	Salinity	EC (µS/cm)	TDS (ppm)	TA (mg/l)
Thalaiyadikottai	Memangalam	E 78° 42' 14.533"	N 9° 34' 0.091"	Open well	7.72	0	848	522	442
Thalaiyadikottai	Paaparkootam	E 78° 42' 27.965"	N 9° 33' 8.975"	Bore well	7.2	5	11,040	6,900	334
Thalaiyadikottai	ThalaiyadiKottai	E 78° 42' 5.954"	N 9° 33' 40.691"	Bore well	7	10	24,570	15,130	309
Thethangal	Thethangal	E 78° 46' 34.334"	N 9° 27' 21.452"	Bore well	7.43	0	2,910	1,758	393
Vagavayal	Kundathur	E 78° 50' 24.871"	N 9° 32' 42.202"	Bore well	7.51	0	1,213	753	427
Vagavayal	Pottagavayal	E 78° 49' 0.397"	N 9° 31' 53.504"	Bore well	8.03	0	1,020	582	475
Vaniyavallam	Puthoorvalasi	E 78° 39' 44.608"	N 9° 32' 47.18"	Bore well	7.25	4	12,010	7,400	345
Vaniyavallam	Valasai	E 78° 39' 30.892"	N 9° 32' 41.968"	Bore well	7.73	0	7,820	4,920	442
Vathavaneri	Vathavaneri	E 78° 46' 2.114"	N 9° 34' 33.668"	Open well	7.42	0	6,350	4,002	392

Gram Panchayat	CO_3 (mg/l)	HCO_3 (mg/l)	TH (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K(mg/l)	$S0_4$ (mg/l)	Cl (mg/l)	NO_3 (mg/l)	WQI	SMI
A.Kachan	39	262	1,937	886	496	856	17	15	4,024	18	836.1	1.91
Akkiramesi	96	344	58	26	15	86	9	26	96	17	45.5	0.12
Ariyankottai	96	283	710	440	202	120	6	8	230	30	147	0.18
Ariyankottai	112	314	54	25	14	48	6	10	53	9	36.1	0.06
Attangudi	93	356	340	155	87	430	12	12	889	13	195.2	0.51
Kadaranthakudi	96	294	438	200	112	335	16	37	1,075	17	229.7	0.60
Kiliyur	96	356	119	54	30	86	6	16	160	6	62.8	0.12
Koluvur	111	293	129	59	33	114	8	17	258	6	73.5	0.17
Kottakudi	115	274	362	166	93	426	26	56	1,015	24	213.9	0.64
Manakudi	98	336	119	54	30	119	14	23	206	18	71.7	0.17
Nagaramangalam	102	325	356	163	91	394	14	27	986	13	207.1	0.56
Nainarkovil	68	235	2,177	995	557	1,120	26	34	4,485	26	977.2	2.21
Nainarkovil	94	293	429	196	110	382	22	48	1,148	18	244.9	0.67
P Kodikulam	63	145	2,201	1,006	563	656	9	13	4,187	11	890.8	1.92
P Kodikulam	65	181	320	80	90	2,856	26	126	4,789	14	1229.4	2.95
Pandiyur	68	263	1,112	508	285	431	13	26	2,323	25	502.6	1.12
Pandiyur	96	316	310	240	45	121	9	11	476	13	111.7	0.25
Panthapanenthal	97	340	55	25	14	88	4	21	86	3	39.9	0.10
Perungalur	106	270	300	160	134	86	2	11	203	34	104.7	0.15
Perungalur	36	261	783	358	201	430	15	22	1,729	57	385.7	0.87
Pottagavayal	111	317	219	100	56	214	8	13	611	8	125.4	0.33
Radhappuli	97	315	229	104	59	248	26	44	536	21	134	0.38
Radhappuli	68	232	2,998	1,371	768	1,560	27	121	6,782	32	1392.3	3.43
Sadurvedhamana-galam	86	298	960	439	246	558	26	13	2,456	17	480.9	1.17
Thalaiyadikottai	107	306	101	46	26	138	6	25	176	11	64.4	0.16
Thalaiyadikottai	58	247	1,316	602	337	1,026	6	23	4,056	14	713.2	1.96
Thalaiyadikottai	59	231	610	240	336	2,480	29	103	5,499	33	1157.7	3.11
Thethangal	121	244	347	159	89	237	3	24	502	18	158.8	0.33

Gram Panchayat	CO_3 (mg/l)	HCO_3 (mg/l)	TH (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K(mg/l)	$S0_4$ (mg/l)	Cl (mg/l)	NO_3 (mg/l)	WQI	SMI
Vagavayal	121	267	338	164	86	134	12	18	468	13	115.3	0.27
Vagavayal	93	359	122	56	31	123	6	17	216	9	69.7	0.16
Vaniyavallam	99	224	1,432	654	367	846	16	63	3,564	15	699.3	1.80
Vaniyavallam	117	306	932	426	239	568	24	45	1,757	22	430.8	0.97
Vathavaneri	152	255	757	160	762	207	9	20	2,586	14	519.5	1.23

ANNEXURE 3.9

LOCATION WISE WATER QUALITY IN NAINARKOIL BLOCK DURING POST-MONSOON SEASON

GP	Locations	Latitude	Longitude	Well type	pH	Salinity	EC (µS/cm)	TDS (ppm)	TA (mg/l)
A.Kachan	Katchan	E 78° 43' 30.187"	N 9° 33' 16.981"	Bore well	7.12	1	7,440	4,613	658
Akkiramesi	ChinnaAkkiramesi	E 78° 42' 16.607"	N 9° 29' 40.07"	Bore well	7.24	0	814	505	138
Ariyankottai	Ananthanenthal	E 78° 48' 23.576"	N 9° 35' 3.923"	Bore well	7.22	0	6,220	3,856	478
Ariyankottai	Ariyankottai	E 78° 47' 36.874"	N 9° 34' 27.901"	Bore well	6.95	0	5,730	3,553	456
Attangudi	Kuyavanenthal	E 78° 49' 7.673"	N 9° 34' 40.264"	Open well	6.96	0	5,630	3,491	443
Kadaranthakudi	Kaadarnthakudi	E 78° 44' 46.388"	N 9° 33' 56.473"	Bore well	6.94	0	3,842	2,382	259
Kiliyur	Kiliyoor	E 78° 47' 0.679"	N 9° 29' 4.495"	Bore well	6.75	0	1,490	924	143
Koluvur	Koluoor	E 78° 45' 36.155"	N 9° 30' 46.087"	Bore well	7.1	0	605	375	134
Kottakudi	Kottakudi	E 78° 46' 44.749"	N 9° 31' 45.822"	Bore well	7.02	0	552	342	122
Manakudi	Vagavayal	E 78° 47' 19.59"	N 9° 31' 41.862"	Bore well	7.57	0	626	388	109
Nagaramangalam	Movaloor	E 78° 45' 21.452"	N 9° 32' 59.863"	Bore well	7.3	0	586	363	129
Nainarkovil	Nainaarkulam	E 78° 41' 53.934"	N 9° 32' 53.426"	Bore well	7.15	0	1,853	1,149	176
Nainarkovil	Nainarkovil	E 78° 41' 23.935"	N 9° 32' 46.59"	Bore well	7.1	0	2,506	1,554	291
P Kodikulam	P Kodikulam	E 78° 47' 37.273"	N 9° 30' 14.447"	Bore well	7.14	2	7,839	4,860	609
P Kodikulam	Thaniyapuli	E 78° 48' 2.308"	N 9° 30' 40.072"	Bore well	7.25	0	733	454	128
Pandiyur	Lakshmi Mangalam	E 78° 44' 8.542"	N 9° 29' 1.522"	Bore well	7.32	0	734	455	168
Pandiyur	Pandiyur	E 78° 43' 35.483"	N 9° 28' 58.418"	Bore well	7.29	0	739	455	171
Panthapanenthal	Panthapanenthal	E 78° 45' 4.018"	N 9° 30' 41.89"	Bore well	7.26	0	740	459	164
Perungalur	Perygalur	E 78° 48' 14.45"	N 9° 26' 4.236"	Bore well	7.33	0	510	316	119
Perungalur	Vayaloor	E 78° 48' 7.682"	N 9° 26' 55.183"	Bore well	7.37	0	3,264	2,024	327
Pottagavayal	Pottagavayal	E 78° 50' 6.616"	N 9° 30' 47.549"	Bore well	7.67	0	598	371	132
Radhappuli	Radhapuli	E 78° 42' 31.025"	N 9° 35' 32.849"	Bore well	6.41	5	19,820	12,288	1,058
Radhappuli	Varunthi	E 78° 44' 43.066"	N 9° 35' 14.122"	Open well	7.02	0	3,588	2,225	307
Sadurvedhamana-galam	SV Mangalam	E 78° 45' 1.933"	N 9° 29' 38.504"	Bore well	7.02	0	735	456	149

GP	Locations	Latitude	Longitude	Well type	pH	Salinity	EC (µS/cm)	TDS (ppm)	TA (mg/l)
Thalaiyadikottai	Memangalam	E 78° 42' 14.533"	N 9° 34' 0.091"	Open well	6.59	5	16,030	9,939	825
Thalaiyadikottai	Paaparkootam	E 78° 42' 27.965"	N 9° 33' 8.975"	Bore well	7.29	0	2,195	1,361	195
Thalaiyadikottai	ThalaiyadiKottai	E 78° 42' 5.954"	N 9° 33' 40.691"	Bore well	6.5	7	19,540	12,115	1,028
Thethangal	Thethangal	E 78° 46' 34.334"	N 9° 27' 21.452"	Bore well	7.07	0	2,066	1,281	169
Vagavayal	Kundathur	E 78° 50' 24.871"	N 9° 32' 42.202"	Bore well	7.35	0	834	517	195
Vagavayal	Pottagavayal	E 78° 49' 0.397"	N 9° 31' 53.504"	Bore well	7.6	0	801	497	146
Vaniyavallam	Puthoorvalasi	E 78° 39' 44.608"	N 9° 32' 47.18"	Bore well	7.14	0	2,390	1,482	266
Vaniyavallam	Valasai	E 78° 39' 30.892"	N 9° 32' 41.968"	Bore well	7.01	0	2,381	1,476	267
Vathavaneri	Vathavaneri	E 78° 46' 2.114"	N 9° 34' 33.668"	Open well	6.87	0	3,703	2,296	345

Gram Panchayat	CO_3 (mg/l)	HCO_3 (mg/l)	TH (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K(mg/l)	$S0_4$ (mg/l)	Cl (mg/l)	NO_3 (mg/l)	WQI	SMI
A.Kachan	113	533	472	240	217	396	72	193	676	42	329.7	1.411
Akkiramesi	12	114	54	32	13	18	7.7	13	56	4.432	41	0.129
Ariyankottai	82	384	401	209	173	269	48	159	616	63	281	0.593
Ariyankottai	78	363	396	193	186	247	51	188	568	47	265.4	0.523
Attangudi	76	355	418	189	216	248	53.5	197	583	52	272.5	0.932
Kadaranthakudi	43	206	283	123	146	162	27	116	353	37	183.8	0.64
Kiliyur	21	114	135	66	53	81	13	98.81	187	13	85.6	0.275
Koluvur	9	125	66	20	28	26	5.7	40.1	54.2	3.291	40.2	0.182
Kottakudi	8	114	53	26	14	21	5.2	36.57	49.4	3.002	35.4	0.494
Manakudi	14	87	51	18	19	17	3.9	19	27	1	35	0.154
Nagaramangalam	13	125	47	22	13	18	5.6	21	46	4	35	0.446
Nainarkovil	27	136	153	60	76	124	17.6	72	230	10.085	102.4	1.332
Nainarkovil	37	237	116	81	117	186	23	93	325	26	146.1	0.65
P Kodikulam	117	481	479	253	211	346	77	210	738	42.656	340	1.252
P Kodikulam	10	109	49	21	14	18	7	27	41	3.985	38.1	2.963
Pandiyur	11	151	42	21	9	17	6	22	46	3.993	37.1	0.484
Pandiyur	34	131	26	12	5	23	5.1	18	41	6	35.6	0.16
Panthapanenthal	15	137	56	22	19	26	7	32	61	4.029	41.6	0.151
Perungalur	18	96	68	36	21	25	9.6	2	48	1.3208	35.8	0.117
Perungalur	47	271	226	94	116	163	31	117	292.5	17.764	155.4	0.703
Pottagavayal	9	112	41	24	8	19	5.7	18	38	3.256	34.1	0.254
Radhappuli	223	823	1,256	606	624	767	68	203	1957	97	830	1.498
Radhappuli	51	249	236	118	101	175	34.1	99	315	28	164.2	1.851
Sadurvedhamana-galam	17	128	55	24	21	17	7	27	65.9	5	41.5	0.629
Thalaiyadikottai	168	644	1,045	536	486	675	63	167	1326	87.233	662.6	1.019
Thalaiyadikottai	31	152	181	76	92	112	23	67	196.7	11.945	112.1	1.217
Thalaiyadikottai	216	795	1,231	633	575	816	77	226	1896	106	818.9	3.761

Gram Panchayat	CO_3 (mg/l)	HCO_3 (mg/l)	TH (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K(mg/l)	$S0_4$ (mg/l)	Cl (mg/l)	NO_3 (mg/l)	WQI	SMI
Thethangal	30	126	144	52	78	82	19.6	36	165	11.243	97.8	0.367
Vagavayal	18	172	72	27	33	36	11	24	74.7	4.538	48.8	0.2
Vagavayal	11	124	67	31	20	26	7.6	21	63	6	44.5	0.178
Vaniyavallam	42	211	167	91	64	172	18	73	267	32	124.1	1.07
Vaniyavallam	34	224	184	96	74	168	22.6	86	318	37	131.6	0.825
Vathavaneri	56	274	247	97	131	184	51	86	346	21	172.7	0.478

ANNEXURE 3.10

GP WISE STATUS OF AGRICULTURE RESOURCE

Gram Panchayat	Land Resources (ha)								
	Non-Agricultural Uses	Area under Barren & Un-cultivable Land	Area under Permanent Pastures and Other Grazing Land	Land Under Miscellaneous Tree Criticalops etc.	Cultivable Waste Land	Fallows Land other than Current Fallows	Current Fallow land	Unirrigated Land	Area Irrigated by Source
A.Panayur	340.07	-	-	57.57	1.04	5.94	10.35	196.51	141.81
Anjamadai	211.86	-	-	10.26	-	-	159.15	190.90	156.26
Arasanur	220.60	-	-	59.33	1.23	9.00	2.42	285.98	142.32
Ariyankottai	167.30	-	-	136.07	-	81.15	228.74	242.77	122.12
Kiliyur	125.56	-	-	28.87	-	131.89	139.82	132.51	174.79
Attangudi	242.76	17.99	-	107.18	-	272.81	15.41	225.56	230.13
Kottakudi	109.23	-	-	57.06	-	68.41	11.73	218.90	71.30
Koluvur	103.32	-	-	84.08	-	54.85	-	185.06	128.96
Manakudi	169.65	-	-	82.63	7.69	118.58	9.24	138.23	123.83
Kullathur	97.93	-	-	-	0.23	0.79	168.47	223.14	116.89
Mummudisathan	102.96	-	-	61.04	5.06	20.04	80.43	78.38	81.54
Thavalaikulam	197.96	-	-	48.09	-	4.14	-	151.69	96.02
Pottagavayal	476.45	-	3.00	107.67	8.45	147.39	150.19	290.02	155.15
Sadurvedamangalam	143.09	-	-	61.57	1.28	53.27	70.77	135.61	172.12
P.Kodikulam	125.73	-	-	67.24	7.64	217.35	139.45	146.80	120.14
Vagavayal	197.89	-	-	73.64	3.05	158.94	66.85	0.43	197.85
Vallam	255.89	-	-	62.89	19.27	188.13	164.63	326.35	88.31
Thalayadikottai	247.35	-	-	62.51	1.04	231.65	87.00	289.80	117.32
Thenthangal	122.05	2.95	-	103.79	-	-	50.81	125.94	134.27
Pandiyur	102.86	-	-	-	-	-	150.97	60.73	58.98
Perungalur	118.05	-	-	50.74	-	75.65	97.48	133.85	85.51
Nagaramangalam	169.67	-	-	20.45	-	46.04	62.39	159.59	127.39

Gram Panchayat	Land Resources (ha)								
	Non-Agricultural Uses	Area under Barren & Un-cultivable Land	Area under Permanent Pastures and Other Grazing Land	Land Under Miscellaneous Tree Criticalops etc.	Cultivable Waste Land	Fallows Land other than Current Fallows	Current Fallow land	Unirrigated Land	Area Irrigated by Source
Nagaram	247.09	-	-	225.10	1.51	-	62.44	54.81	568.30
Siruvayal	309.64	-	-	-	-	4.29	592.59	441.37	223.43
Thiyagavanseri	85.94	-	-	83.19	0.89	30.27	23.66	80.03	93.02
Vaniyavallam	137.59	-	-	47.32	0.64	18.06	45.25	286.10	78.90
Nainarkoil	91.73	-	-	31.54	0.42	12.04	30.16	190.74	52.60
Radhappuli	132.39	-	-	-	-	0.24	318.13	367.48	39.42
Keelakavanoor	71.29	-	-	-	-	0.13	171.30	197.88	21.22
Siraikottai	124.53	-	-	20.63	-	36.10	25.03	220.60	107.98
Pagaivendri	63.70	-	-	10.55	-	18.47	12.80	112.86	55.24
Kalliyadiyendai	101.36	-	-	16.78	-	29.38	20.38	179.56	87.90
Padappanendal	128.37	6.06	-	10.51	-	0.69	32.57	108.57	150.52
Karadaranthakudi	153.90	-	-	164.36	1.02	150.05	68.51	351.76	256.13
Vadavaneri	150.60	-	-	24.78	1.04	54.30	-	69.35	54.55
Gangaikondan	109.13	-	-	8.71	9.21	65.82	52.51	93.95	42.99
Akkiramesai	226.98	-	-	164.66	1.83	80.78	412.27	283.01	132.92

Gram Panchayat	Land under Catchment Area (ha)			Crop Details				
	Good Catchment	Average Catchment	Bad Catchment	Irrigated Area (ha)	Rainfed area (ha)	Paddy Cultivation (ha)	Crop Water Requirement - Irrigated condition (ha.m)	Crop Water Requirement - Rainfed condition (ha.m)
A.Panayur	340.07	58.61	354.61	140.50	137.20	216.50	190.68	121.12
Anjamadai	211.86	10.26	506.31	145.00	120.00	265.00	217.50	120.00
Arasanur	220.60	60.56	439.72	145.01	148.04	261.10	212.21	135.17
Ariyankottai	167.30	136.07	674.78	142.80	415.00	519.78	207.21	404.13
Kiliyur	125.56	28.87	579.01	183.41	104.06	199.99	218.90	92.41
Attangudi	260.75	107.18	743.91	230.04	365.89	589.54	344.13	363.98
Kottakudi	109.23	57.06	370.34	89.56	142.21	161.21	94.58	130.41
Koluvur	103.32	84.08	368.87	132.74	167.26	154.78	136.26	133.93
Manakudi	169.65	90.32	389.88	170.20	194.91	306.51	210.03	187.66
Kullathur	97.93	0.23	509.29	84.50	188.30	251.20	123.25	181.74
Mummudisathan	102.96	66.10	260.39	66.15	97.56	100.87	82.14	79.25
Thavalaikulam	197.96	48.09	251.85	66.67	132.65	106.03	76.36	101.42
Pottagavayal	476.45	119.12	742.75	269.41	373.18	608.47	396.27	358.78
Sadurvedamangalam	143.09	62.85	431.77	185.62	94.18	144.51	212.49	64.51
P.Kodikulam	125.73	74.88	623.74	127.39	302.57	346.67	165.04	276.58
Vagavayal	197.89	76.69	424.07	210.04	82.93	286.80	310.45	82.31
Vallam	255.89	82.16	767.42	155.94	277.41	277.51	184.51	234.06
Thalayadikottai	247.35	63.55	725.77	121.87	361.14	383.61	171.07	325.85
Thenthangal	125.00	103.79	311.02	128.76	91.76	164.24	173.22	75.65
Pandiyur	102.86	-	270.68	38.69	103.10	41.28	42.99	75.78
Perungalur	118.05	50.74	392.49	83.47	163.82	173.89	105.11	144.33
Nagaramangalam	169.67	20.45	395.41	129.21	112.19	225.54	184.21	109.56
Nagaram	247.09	226.61	685.55	213.88	353.29	492.50	274.32	340.72
Siruvayal	309.64	-	1,261.68	235.07	584.07	587.13	333.93	501.60
Thiyagavanseri	85.94	84.08	226.98	99.20	69.00	136.40	129.05	64.70
Vaniyavallam	137.59	47.96	428.31	123.26	247.24	147.26	119.83	153.00

Gram Panchayat	Land under Catchment Area (ha)			Crop Details				
	Good Catchment	Average Catchment	Bad Catchment	Irrigated Area (ha)	Rainfed area (ha)	Paddy Cultivation (ha)	Crop Water Requirement - Irrigated condition (ha.m)	Crop Water Requirement - Rainfed condition (ha.m)
Nainarkoil	91.73	31.96	285.54	123.26	247.24	147.26	119.83	153.00
Radhappuli	132.39	-	725.27	59.00	655.00	464.00	81.50	566.38
Keelakavanoor	71.29	-	390.53	62.56	675.33	464.70	85.04	574.60
Siraikottai	124.53	20.63	389.71	152.13	140.49	193.28	186.31	120.17
Pagaivendri	63.70	10.55	199.37	152.13	140.49	193.28	186.31	120.17
Kalliyadiyendai	101.36	16.78	317.22	152.13	140.49	193.28	186.31	120.17
Padappanendal	134.43	10.51	292.35	122.12	223.95	150.93	147.36	159.49
Karadaranthakudi	153.90	165.38	826.45	204.70	277.33	480.57	306.61	276.64
Vadavaneri	150.60	25.82	178.20	104.40	101.33	204.27	156.16	100.64
Gangaikondan	109.13	17.92	255.27	33.80	60.04	50.35	45.79	50.30
Akkiramesai	226.98	166.49	908.98	118.10	306.30	398.90	177.15	294.54

Gram Panchayat	Soil Resources: Status of Available Nitrogen (%)					Status of Organic Carbon (%)					Status of Soil Micro Nutrients (%)	
	Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	High	Very High	Suffi-cient	Defi-cient
A.Panayur	53.85	46.15	-	-	-	12.82	75.64	11.54	-	-	40.00	60.00
Anjamadai	93.75	6.25	-	-	-	25.00	75.00	-	-	-	65.00	35.00
Arasanur	98.90	-	1.10	-	-	14.29	84.62	-	1.10	-	69.00	31.00
Ariyankottai	99.00	1.00	-	-	-	34.00	66.00	-	-	-	50.00	50.00
Kiliyur	1.85	98.15	-	-	-	12.04	87.96	-	-	-	55.00	45.00
Attangudi	42.96	57.04	-	-	-	5.23	58.72	18.02	18.02	-	72.00	28.00
Kottakudi	98.48	1.52	-	-	-	68.18	31.82	-	-	-	53.00	47.00
Koluvur	91.15	8.85	-	-	-	40.71	59.29	-	-	-	72.00	28.00
Manakudi	87.01	12.99	-	-	-	18.18	81.82	-	-	-	63.00	37.00
Kullathur	13.48	86.52	-	-	-	25.84	74.16	-	-	-	67.00	33.00
Mummudisathan	84.72	15.28	-	-	-	31.51	68.49	-	-	-	76.00	24.00
Thavalaikulam	9.43	90.57	-	-	-	16.98	71.70	11.32	-	-	71.00	29.00
Pottagavayal	82.68	17.32	-	-	-	14.96	85.04	-	-	-	46.00	54.00
Sadurvedamangalam	40.00	60.00	-	-	-	18.10	75.24	4.76	1.90	-	55.00	45.00
P.Kodikulam	67.82	32.18	-	-	-	34.48	64.37	1.15	-	-	67.00	33.00
Vagavayal	100.00	-	-	-	-	63.49	36.51	-	-	-	81.00	19.00
Vallam	100.00	-	-	-	-	69.64	30.36	-	-	-	51.00	49.00
Thalayadikottai	100.00	-	-	-	-	63.44	35.48	1.08	-	-	49.00	51.00
Thenthangal	41.10	58.90	-	-	-	6.85	84.93	5.48	2.74	-	39.00	61.00
Pandiyur	100.00	-	-	-	-	40.00	60.00	-	-	-	61.00	39.00
Perungalur	35.21	64.79	-	-	-	54.23	40.85	4.23	0.70	-	57.00	43.00
Nagaramangalam	100.00	-	-	-	-	20.29	79.71	-	-	-	72.00	28.00
Nagaram	100.00	-	-	-	-	46.23	53.77	-	-	-	70.00	30.00
Siruvayal	71.43	28.57	-	-	-	18.63	80.75	0.62	-	-	58.00	42.00
Thiyagavanseri	-	100.00	-	-	-	3.85	86.54	9.62	-	-	71.00	29.00
Vaniyavallam	61.05	30.53	3.16	5.26	-	3.16	-	-	-	96.84	73.00	27.00

Gram Panchayat	Soil Resources: Status of Available Nitrogen (%)					Status of Organic Carbon (%)					Status of Soil Micro Nutrients (%)	
	Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	High	Very High	Suffi-cient	Defi-cient
Nainarkoil	37.00	60.21	2.24	0.52	0.03	0.72	0.33	0.94	10.08	87.94	61.00	39.00
Radhappuli	87.07	12.93	-	-	-	72.79	27.21	-	-	-	60.00	40.00
Keelakavanoor	87.07	12.93	-	-	-	72.79	27.21	-	-	-	60.00	40.00
Siraikottai	98.59	0.70	-	-	0.70	60.56	38.73	-	0.70	-	52.00	48.00
Pagaivendri	98.59	0.70	-	-	0.70	60.56	38.73	-	0.70	-	52.00	48.00
Kalliyadiyendai	98.59	0.70	-	-	0.70	60.56	38.73	-	0.70	-	52.00	48.00
Padappanendal	94.90	5.10	-	-	-	18.45	64.56	16.50	0.49	-	69.00	31.00
Karadaranthakudi	66.45	31.58	0.66	0.66	0.66	0.66	0.66	-	-	98.68	67.00	33.00
Vadavaneri	65.57	34.43	-	-	-	-	-	-	-	100.00	79.00	21.00
Gangaikondan	87.04	12.96	-	-	-	16.67	83.33	-	-	-	68.00	32.00
Akkiramesai	98.21	1.79	-	-	-	33.93	65.18	-	0.89	-	67.00	33.00

Gram Panchayat	Status of Physical condition of the soil (%)								Soil Texture (%)			
	Mod-erately Acidic	Strongly Acidic	Highly Acidic	Mod-erately Acidic	Slighly Acidic	Neutral	Mod-erately Alkaline	Strongly Alkaline	Clay soil	Fine Soil	Coarse loamy	Soil Water Permeability (Low, Moder-ate, high)
A.Panayur	-	-	-	-	3.85	-	96.15	-	-	80.00	-	Moderate
Anjamadai	-	-	-	-	1.25	-	98.75	-	-	20.00	70.34	High
Arasanur	-	-	-	4.40	5.49	2.20	87.91	-	-	83.00	-	Moderate
Ariyankottai	-	-	-	-	-	-	100.00	-	-	66.00	1.04	Moderate
Kiliyur	0.58	-	-	30.06	30.64	-	38.73	-	-	81.00	-	Moderate
Attangudi	-	-	3.52	22.54	6.34	0.70	66.20	0.70	-	55.00	20.13	Moderate
Kottakudi	-	-	-	-	-	-	56.06	43.94	-	76.00	0.38	Moderate
Koluvur	-	-	10.62	15.04	8.85	-	65.49	-	-	85.00	0.18	Moderate
Manakudi	-	-	-	-	-	-	100.00	-	-	80.00	4.09	Moderate
Kullathur	-	-	-	2.25	2.25	-	53.93	41.57	-	84.00	-	Moderate
Mummudisathan	1.37	-	-	13.70	8.22	-	76.71	-	-	80.00	-	Moderate
Thavalaikulam	-	-	-	11.32	11.32	-	77.36	-	-	5.45	81.01	High
Pottagavayal	-	-	-	4.72	11.02	-	84.25	-	-	56.00	23.86	Moderate
Sadurvedamangalam	-	-	-	-	-	0.95	97.14	1.90	-	55.00	1.13	Moderate
P.Kodikulam	-	-	-	-	-	-	98.92	1.08	-	95.00	-	Moderate
Vagavayal	-	-	-	-	-	-	100.00	-	-	50.00	34.22	Moderate
Vallam	-	-	-	-	1.79	-	98.21	-	-	55.00	0.09	Moderate
Thalayadikottai	-	-	-	-	-	-	100.00	-	-	78.00	-	Moderate
Thenthangal	-	-	-	6.85	4.11	2.74	86.30	-	-	80.00	-	Moderate
Pandiyur	-	-	-	-	-	-	100.00	-	-	81.00	-	Moderate
Perungalur	-	-	-	6.34	17.61	0.70	73.24	2.11	-	79.00	-	Moderate
Nagaramangalam	-	-	4.35	31.88	26.09	-	37.68	-	-	70.67	13.07	Moderate
Nagaram	-	-	-	-	-	-	98.10	1.90	-	77.00	0.88	Moderate
Siruvayal	-	-	-	1.86	29.19	-	68.94	-	-	76.45	-	Moderate
Thiyagavanseri	-	-	-	3.77	30.19	9.43	56.60	-	-	84.00	-	Moderate
Vaniyavallam	-	-	-	3.16	9.47	-	87.37	-	1.98	69.00	-	Moderate

Gram Panchayat	Status of Physical condition of the soil (%)								Soil Texture (%)			
	Mod-erately Acidic	Strongly Acidic	Highly Acidic	Mod-erately Acidic	Slighly Acidic	Neutral	Mod-erately Alkaline	Strongly Alkaline	Clay soil	Fine Soil	Coarse loamy	Soil Water Permeability (Low, Moder-ate, high)
Nainarkoil	0.03	-	0.29	3.64	7.74	0.62	83.81	3.87	-	81.00	-	Moderate
Radhappuli	-	-	-	-	21.77	1.36	62.59	14.29	-	66.00	21.94	Moderate
Keelakavanoor	-	-	-	-	21.77	1.36	62.59	14.29	-	94.00	-	Moderate
Siraikottai	-	-	-	2.11	2.82	0.70	94.37	-	-	73.50	23.31	Moderate
Pagaivendri	-	-	-	2.11	2.82	0.70	94.37	-	-	22.59	77.04	High
Kalliyadiyendai	-	-	-	2.11	2.82	0.70	94.37	-	-	25.00	73.96	High
Padappanendal	-	-	-	5.49	4.40	1.10	84.62	4.40	-	27.00	54.97	High
Karadaranthakudi	-	-	-	1.97	12.50	0.66	82.24	2.63	-	61.05	14.78	Moderate
Vadavaneri	-	-	-	-	1.64	-	96.72	1.64	-	67.36	-	Moderate
Gangaikondan	-	-	1.85	-	5.56	1.85	90.74	-	-	96.62	-	Moderate
Akkiramesai	-	-	-	-	0.89	-	92.86	6.25	3.00	45.67	47.38	High

Gram Panchayat	Soil moisture and ET			Means of Water Extraction (%)		Irrigation Methods (%)		Livestock (No.)			
	Volumetric Soil Moisture (%)	Estimated Soil Moisture (ha.m)	ET Losses (ha.m)	Gravity	Lifting	Wild Flooding	Control Flooding	Cattle Population	Sheep Population	Goat Population	Poultry
A.Panayur	17.00	70.25	206.65	6.00	94.00	74.00	26.00	67	65	125	184
Anjamadai	17.00	87.82	186.57	63.00	37.00	78.00	22.00	53	160	219	405
Arasanur	17.00	85.05	254.54	29.00	71.00	77.00	23.00	27	115	186	122
Ariyankottai	17.00	137.84	261.50	12.00	88.00	72.00	28.00	136	110	380	145
Kiliyur	17.00	103.34	175.48	25.00	75.00	77.00	23.00	76	219	393	269
Attangudi	17.00	147.74	293.82	67.00	33.00	77.00	23.00	172	432	202	306
Kottakudi	17.00	72.66	181.27	13.00	87.00	66.00	34.00	38	305	171	16
Koluvur	17.00	77.00	207.81	33.00	67.00	77.00	23.00	36	-	149	354
Manakudi	17.00	81.63	179.93	15.00	85.00	79.00	21.00	36	80	16	169
Kullathur	17.00	86.62	177.50	1.96	98.00	59.00	41.00	71	21	121	463
Mummudisathan	17.00	55.50	115.34	50.00	50.00	63.00	37.00	39	97	173	240
Thavalaikulam	17.00	50.99	154.41	58.00	42.00	48.00	52.00	46	-	63	130
Pottagavayal	17.00	146.52	290.15	82.00	18.00	68.00	32.00	141	262	334	749
Sadurvedamangalam	17.00	84.09	192.77	53.00	47.00	73.00	27.00	226	167	1,381	951
P.Kodikulam	17.00	118.77	174.44	50.00	50.00	63.00	37.00	79	299	336	232
Vagavayal	17.00	85.13	141.94	69.00	31.00	78.00	22.00	70	246	145	271
Vallam	17.00	144.43	249.28	76.00	24.00	48.00	52.00	287	448	466	510
Thalayadikottai	17.00	134.18	245.15	73.00	27.00	81.00	19.00	14	59	209	230
Thenthangal	17.00	71.02	190.01	60.00	40.00	75.00	25.00	88	202	76	161
Pandiyur	17.00	46.02	62.49	21.00	79.00	67.00	33.00	124	9	1,020	1,199
Perungalur	17.00	75.35	140.99	64.00	36.00	74.00	26.00	115	42	134	149
Nagaramangalam	17.00	70.70	160.48	42.00	58.00	75.00	25.00	64	32	27	237
Nagaram	17.00	155.07	442.77	27.00	73.00	88.00	12.00	106	33	194	468
Siruvayal	17.00	214.49	347.03	54.00	46.00	100.00	-	55	-	36	404
Thiyagavanseri	17.00	52.88	133.76	22.00	78.00	60.00	40.00	83	15	62	150

Gram Panchayat	Soil moisture and ET			Means of Water Extraction (%)		Irrigation Methods (%)		Livestock (No.)			
	Volumetric Soil Moisture (%)	Estimated Soil Moisture (ha.m)	ET Losses (ha.m)	Gravity	Lifting	Wild Flooding	Control Flooding	Cattle Population	Sheep Population	Goat Population	Poultry
Vaniyavallam	17.00	80.97	215.23	67.00	33.00	63.00	37.00	46	43	104	172
Nainarkoil	17.00	53.98	143.49	67.00	33.00	63.00	37.00	60	29	79	114
Radhappuli	17.00	123.30	212.40	59.00	41.00	67.00	33.00	36	612	111	146
Keelakavanoor	17.00	66.39	114.37	67.00	33.00	63.00	37.00	19	330	60	79
Siraikottai	17.00	69.76	182.29	11.00	89.00	35.00	65.00	78	157	280	202
Pagaivendri	17.00	35.69	93.26	16.00	84.00	35.00	65.00	40	81	143	103
Kalliyadiyendai	17.00	56.78	148.37	11.00	89.00	35.00	65.00	64	129	228	165
Padappanendal	17.00	52.52	140.73	22.00	78.00	82.00	18.00	80	1,017	495	910
Karadaranthakudi	17.00	168.61	403.11	64.00	36.00	76.00	24.00	119	349	331	412
Vadavaneri	17.00	34.68	77.61	60.00	40.00	68.00	32.00	62	331	314	377
Gangaikondan	17.00	46.44	76.03	58.00	42.00	68.00	32.00	70	212	1,010	803
Akkiramesai	17.00	182.83	303.07	67.00	33.00	80.00	20.00	79	378	709	516

ANNEXURE 3.11

GP WISE DEMOGRAPHIC AND SOCIO ECONOMIC STATUS

Gram Panchayat	Geo-graphical Area (ha)	Male Popula-tion (No.)	Female Popula-tion (No.)	Total Popula-tion (No.)	SC Pop-ulation (No.)	ST Pop-ulation (No.)	Vulnera-ble pop-upation (No.)	House-holds (HH's) (No.)	Only one room HH's (SECC) (No.)	Female Headed HH's (SECC) (No.)	Vul-nerable House-holds (SECC) (No.)
A.Panayur	753	489	437	926	104	-	104	206	-	16	5
Anjamadai	728	632	750	1,382	289	-	289	402	32	59	40
Arasanur	712	537	465	1,002	122	-	122	269	1	13	5
Ariyankottai	978	671	807	1,478	203	-	203	456	113	51	94
Kiliyur	733	705	725	1,430	455	-	455	374	99	15	74
Attangudi	1,112	804	791	1,595	102	-	102	437	175	62	141
Kottakudi	537	310	345	655	1	1	2	288	1	44	14
Koluvur	556	405	407	812	200	-	200	246	10	22	14
Manakudi	650	282	244	526	38	-	38	288	1	44	14
Kullathur	607	709	671	1,380	989	-	989	299	3	19	8
Mummudisathan	429	335	328	663	226	-	226	208	72	18	56
Thavalaikulam	498	264	337	601	70	-	70	179	3	28	11
Pottagavayal	1,338	970	1,295	2,265	538	-	538	623	135	46	108
Sadurvedamangalam	638	458	473	931	275	-	275	276	4	28	11
P.Kodikulam	824	669	673	1,342	10	-	10	410	6	39	16
Vagavayal	699	542	503	1,045	210	-	210	240	89	29	71
Vallam	1,105	1,075	1,056	2,131	796	-	796	591	96	124	104
Thalayadikottai	1,037	1,031	991	2,022	150	-	150	522	16	46	25
Thenthangal	540	531	513	1,044	646	-	646	318	4	17	8
Pandiyur	374	679	686	1,365	463	1	464	410	6	39	16
Perungalur	561	662	663	1,325	373	-	373	317	-	23	7
Nagaramangalam	586	731	733	1,464	187	-	187	393	15	38	22

Gram Panchayat	Geo-graphical Area (ha)	Male Popula-tion (No.)	Female Popula-tion (No.)	Total Popula-tion (No.)	SC Pop-ulation (No.)	ST Pop-ulation (No.)	Vulnera-ble pop-upation (No.)	House-holds (HH's) (No.)	Only one room HH's (SECC) (No.)	Female Headed HH's (SECC) (No.)	Vul-nerable House-holds (SECC) (No.)
Nagaram	1,159	716	800	1,516	117	-	117	464	237	57	183
Siruvayal	1,571	1,100	981	2,081	525	-	525	522	4	32	12
Thiyagavanseri	397	350	303	653	417	-	417	151	12	5	10
Vaniyavallam	609	1,573	1,535	3,108	953	-	953	774	89	79	86
Nainarkoil	416	1,573	1,535	3,108	953	-	953	774	89	79	86
Radhappuli	962	1,216	1,201	2,417	593	-	593	591	108	50	91
Keelakavanoor	557	1,216	1,201	2,417	593	-	593	591	108	50	91
Siraikottai	534	1,302	1,259	2,561	192	-	192	647	10	64	26
Pagaivendri	272	1,302	1,259	2,561	192	-	192	647	10	64	26
Kalliyadiyendai	409	1,302	1,259	2,561	192	-	192	647	10	64	26
Padappanendal	514	531	536	1,067	92	-	92	290	8	29	14
Karadaranthakudi	780	1,102	1,107	2,209	271	-	271	593	304	33	223
Vadavaneri	288	194	219	413	126	-	126	125	41	20	35
Gangaikondan	384	1,037	1,023	2,060	272	-	272	713	18	65	32
Akkiramesai	1,340	1,332	1,350	2,682	250	-	250	713	18	65	32

Gram Panchayat	% of Vulnerable Households (%)	Registered MGNREGA Job cards (Persons)	Active person working in MGNREGA job Cards (Persons)	Drinking Water Sources (No.)	HH's have tap water connection for drinking water (No.)	HH's dependent on other sources for drinking water (No.)	Annual Greywater Generation (ha.m)
A.Panayur	2	199	148	10	-	926	2
Anjamadai	10	550	488	13	-	537	3
Arasanur	2	405	331	11	-	479	2
Ariyankottai	21	672	590	64	175	410	3
Kiliyur	20	423	230	19	-	550	3
Attangudi	32	547	449	11	-	615	3
Kottakudi	5	411	341	13	-	375	1
Koluvur	6	237	213	12	-	410	1
Manakudi	5	271	201	7	-	375	1
Kullathur	3	475	354	5	-	460	3
Mummudisathan	27	304	209	7	-	265	1
Thavalaikulam	6	281	221	14	-	190	1
Pottagavayal	17	617	452	9	-	1,125	4
Sadurvedamangalam	4	378	326	6	-	325	2
P.Kodikulam	4	328	310	15	-	440	2
Vagavayal	30	308	251	11	-	345	2
Vallam	18	715	577	21	-	790	4
Thalayadikottai	5	986	545	13	-	915	4
Thenthangal	2	325	273	11	-	487	2
Pandiyur	4	497	424	14	-	660	3
Perungalur	2	462	368	10	-	540	2
Nagaramangalam	6	442	367	15	-	610	3
Nagaram	39	550	462	27	-	575	3
Siruvayal	2	606	527	15	-	535	4
Thiyagavanseri	7	318	174	6	-	275	1
Vaniyavallam	11	524	360	100	600	380	6

Gram Panchayat	% of Vulnerable Households (%)	Registered MGNREGA Job cards (Persons)	Active person working in MGNREGA job Cards (Persons)	Drinking Water Sources (No.)	HH's have tap water connection for drinking water (No.)	HH's dependent on other sources for drinking water (No.)	Annual Greywater Generation (ha.m)
Nainarkoil	11	349	303	100	600	380	6
Radhappuli	15	425	343	79	250	250	4
Keelakavanoor	15	259	241	79	300	250	4
Siraikottai	4	405	303	8	-	300	5
Pagaivendri	4	382	232	11	-	990	5
Kalliyadiyendai	4	275	190	14	-	250	5
Padappanendal	5	414	344	12	-	1,748	2
Karadaranthakudi	38	504	450	69	410	290	4
Vadavaneri	28	516	326	70	350	160	1
Gangaikondan	5	432	282	71	451	421	4
Akkiramesai	5	703	624	37	646	200	5

ANNEXURE 4

IPCC VULNERABILITY ASSESSMENT METHODOLOGY

Normalization of Indicators:

In order to make the indicators free from the units, normalization has done. The normalization process varies depending on the nature of relationship of that particular indicator with the vulnerability. The following formula are used,

- for indicators with positive relationship with vulnerability

$$x_{ij}^{P} = \frac{Xij - Min\, i\{Xij\}}{(Max\, i\{Xij\} - Min\, i\{Xij\}}$$

- for indicators with negative relationship with vulnerability

$$x_{ij}^{n} = \frac{Max\, i\{Xij\} - Xij}{Max\, i\{Xij\} - Min\{Xij\}}$$

Aggregation and categorization of Indicators

The normalized values of indicator sets are aggregated to obtain the vulnerability index and categorized in to high, medium and low vulnerability classes.

$$VI = \frac{\sum_{i}^{N} K_i S_i}{K_i}$$

X_{ij} is the value of j^{th} indicator for i^{th} GP and X^{P}_{ij} is the normalized value

X_{ij} is the value of j^{th} indicator for i^{th} GP and x^{n}_{ij} is the normalized value

ANNEXURE 5.1

GP WISE WASCA PROPOSED TREATMENT AREA

Gram Panchayat	Non-Agricultural Uses	Barren & Un-cultivable Land	Permanent Pastures and Other Grazing Land	Land Under Miscellaneous Tree Criticalops etc.	Cultivable Waste Land	Fallows Land other than Current Fallows	Current Fallow land	Unirrigated Land	Treatment Area Irrigated by Source
A.Panayur	72.77	-	-	48.93	0.88	0.12	0.21	3.93	2.84
Anjamadai	16.36	-	-	8.72	-	-	33.42	40.09	32.81
Arasanur	19.90	-	-	50.43	1.05	0.18	0.05	5.72	2.85
Ariyankottai	2.85	-	-	115.66	-	4.87	13.72	14.57	7.33
Kiliyur	2.14	-	-	24.54	-	26.38	27.96	26.50	34.96
Attangudi	3.79	15.29	-	91.10	-	87.30	4.93	72.18	73.64
Kottakudi	1.86	-	-	48.50	-	3.42	0.59	10.95	3.57
Koluvur	1.76	-	-	71.47	-	3.29	-	11.10	7.74
Manakudi	8.82	-	-	70.24	6.54	5.93	0.46	6.91	6.19
Kullathur	1.67	-	-	-	0.20	0.02	5.05	6.69	3.51
Mummudisathan	3.48	-	-	51.88	4.30	5.41	21.72	21.16	22.02
Thavalaikulam	63.61	-	-	40.88	-	0.25	-	9.10	5.76
Pottagavayal	63.25	-	2.55	91.52	7.18	58.96	60.08	116.01	62.06
Sadurvedamangalam	2.97	-	-	52.33	1.09	2.13	2.83	5.42	6.88
P.Kodikulam	2.14	-	-	57.15	6.49	8.69	5.58	5.87	4.81
Vagavayal	14.02	-	-	62.59	2.59	47.68	20.06	0.13	59.36
Vallam	6.85	-	-	53.46	16.38	33.86	29.63	58.74	15.90
Thalayadikottai	8.13	-	-	53.13	0.88	11.58	4.35	14.49	5.87
Thenthangal	2.71	2.51	-	88.22	-	-	1.02	2.52	2.69
Pandiyur	6.60	-	-	-	-	-	6.04	2.43	2.36
Perungalur	1.04	-	-	43.13	-	1.51	1.95	2.68	1.71
Nagaramangalam	12.96	-	-	17.38	-	8.29	11.23	28.73	22.93
Nagaram	2.76	-	-	191.34	1.28	-	24.35	21.38	221.64

Gram Panchayat	Non-Agricultural Uses	Barren & Un-cultivable Land	Permanent Pastures and Other Grazing Land	Land Under Miscellaneous Tree Criticalops etc.	Cultivable Waste Land	Fallows Land other than Current Fallows	Current Fallow land	Unirrigated Land	Treatment Area Irrigated by Source
Siruvayal	5.27	-	-	-	-	0.09	11.85	8.83	4.47
Thiyagavanseri	1.20	-	-	70.71	0.76	2.12	1.66	5.60	6.51
Vaniyavallam	2.83	-	-	40.22	0.54	1.99	4.98	31.47	8.68
Nainarkoil	1.88	-	-	26.81	0.36	1.32	3.32	20.98	5.79
Radhappuli	2.25	-	-	-	-	0.04	47.72	55.12	5.91
Keelakavanoor	1.21	-	-	-	-	0.02	25.70	29.68	3.18
Siraikottai	3.48	-	-	17.54	-	1.44	1.00	8.82	4.32
Pagaivendri	1.78	-	-	8.97	-	0.74	0.51	4.51	2.21
Kalliyadiyendai	2.83	-	-	14.26	-	1.18	0.82	7.18	3.52
Padappanendal	10.22	5.15	-	8.93	-	0.02	0.98	3.26	4.52
Karadaranthakudi	2.62	-	-	139.71	0.87	57.02	26.03	133.67	97.33
Vadavaneri	28.80	-	-	21.06	0.88	15.20	-	19.42	15.27
Gangaikondan	7.94	-	-	7.40	7.82	5.27	4.20	7.52	3.44
Akkiramesai	3.86	-	-	139.96	1.55	6.46	32.98	22.64	10.63

Land Resources - WASCA Treatment Proposed Area	logic
Treatment Area under Forest Land	40% of the total Area (area after removal of potential voids)
Treatment Area under Non-Agricultural Uses	Identifying Additional Area available for recharge & plantation(if area is above 20 %: consider all the additional area for treatment(ex 24.86 %, 4.86 % is proposed): if the % area is between 15-20 % only, consider 50 % of additional area)
Treatment Area under Barren & Un-cultivable Land	75% of the total Area (area after removal of potential voids)
Treatment Area under Permanent Pastures and Other Grazing Land	75% of the total Area (potential area for treatment after removal of voids)
Treatment Area under Land Under Miscellaneous Tree Crops etc.	75% of the total Area (non- voids area)
Treatment Area under Cultivable Waste Land	75% of the total Area (non- voids area)
Treatment Area under Fallows Land other than Current Fallows	Factor arrived as per Vulnerability Assessment in Table 1 and out of which 50% is for horticulture or AF
Treatment Area under Current Fallow land	Factor arrived as per Vulnerability Assessment in Table 1 and out of which 50% is for horticulture or AF
Treatment Area under Unirrigated Land	Factor arrived as per Vulnerability Assessment in Table 1 and out of which 50% is for horticulture or AF
Treatment Area Irrigated by Source	Bore Well Farmer Factor arrived as per Vulnerability Assessment in Table 1 and out of which 50% is for horticulture or AF

ANNEXURE 5.2

GP WISE EXPECTED RUNOFF CONSERVATION AFTER WASCA TREATMENT

GP	Good Catchment Area	Average Catchment Area	Bad Catchment Area
A.Panayur	23.43	8.71	0.83
Anjamadai	15.88	0.76	27.72
Arasanur	20.81	9.00	1.03
Ariyankottai	0.50	17.20	-
Kiliyur	12.51	3.21	13.50
Attangudi	24.67	14.23	27.75
Kottakudi	18.69	6.25	2.16
Koluvur	13.31	12.50	2.58
Manakudi	25.54	13.25	2.27
Kullathur	10.91	-	1.78
Mummudisathan	1.09	8.12	8.20
Thavalaikulam	30.79	6.23	1.76
Pottagavayal	85.26	15.23	74.57
Sadurvedamangalam	10.34	8.21	10.35
P.Kodikulam	20.92	7.89	2.91
Vagavayal	21.08	6.14	33.34
Vallam	24.68	7.69	37.20
Thalayadikottai	2.54	8.23	4.23
Thenthangal	11.39	15.23	0.73
Pandiyur	3.67	-	1.26
Perungalur	9.44	4.69	0.92
Nagaramangalam	23.75	3.04	8.30
Nagaram	28.56	25.69	31.17
Siruvayal	9.86	-	2.94
Thiyagavanseri	12.36	0.97	11.74
Vaniyavallam	6.52	7.13	5.49
Nainarkoil	15.63	0.87	10.17
Radhappuli	9.21	-	12.68
Keelakavanoor	9.52	-	6.83
Siraikottai	16.30	3.07	1.82
Pagaivendri	9.39	1.57	0.93
Kalliyadiyendai	7.32	2.49	1.48
Padappanendal	14.87	0.65	1.02
Karadaranthakudi	30.54	24.58	36.61
Vadavaneri	15.41	3.84	5.82
Gangaikondan	20.36	2.66	2.38
Akkiramesai	25.95	24.75	8.48

ANNEXURE 5.3

GP WISE PROPOSED WORKS BASED ON WATERSHED AND LIVELIHOOD APPROACH (AREA IN ha / LENGTH IN m / PLANTS IN No.)

Gram Panchayat	Aff		ARS	AVP		Az	BP		CBP		CS
	No.	Area	No.	No.	Length	No.	Plants	Area	No.	Length	No.
A.Panayur	58,215	73	15	350	1,399	2	39,855	50	1,000	4,000	2
Akkiramesai	3,091	4	2	2,508	10,032	2	113,214	142	1,052	4,207	2
Anjamadai	13,088	16	14	261	1,045	1	1,744	9	760	3,041	1
Arasanur	15,922	20	44	350	1,399	1	41,181	51	875	3,500	1
Ariyankottai	2,278	3	14	1,045	4,180	3	92,528	116	381	1,525	3
Attangudi	15,264	19	15	138	553	4	72,882	91	434	1,737	4
Gangaikondan	6,348	8	10	816	3,265	2	12,160	15	474	1,896	2
Kalliyadiyendal	2,265	3	6	1,010	4,038	2	2,853	14	594	2,374	2
Karadaranthakudi	2,096	3	21	1,652	6,606	3	112,458	141	691	2,762	3
Keelakavanoor	971	1	-	930	3,720	-	-	-	262	1,048	-
Kiliyur	1,710	2	15	1,734	6,937	2	19,632	25	431	1,725	2
Koluvur	1,407	2	12	350	1,399	1	57,174	71	904	3,615	1
Kottakudi	1,487	2	10	1,668	6,673	1	38,801	49	1,209	4,836	1
Kulathur	1,333	2	47	350	1,399	2	156	0	807	3,226	2
manakudi	7,052	9	10	1,390	5,560	1	61,418	77	467	1,866	1
Mummudisathan	2,786	3	33	503	2,012	1	44,948	56	981	3,925	1
Nagaram	2,211	3	27	272	1,089	3	154,095	193	2,673	10,691	3
Nagaramangalam	10,370	13	51	1,150	4,600	2	13,906	17	788	3,151	2
Nainarkoil	1,508	2	8	1,367	5,469	-	5,435	27	-	-	-
P.Kodikulam	1,712	2	48	684	2,737	2	50,918	64	662	2,649	2
Padappanendal	12,297	15	-	1,545	6,181	2	7,147	9	179	717	2
Pagaivendri	1,423	2	4	556	2,224	1	1,794	9	455	1,818	1
Pandiyur	5,278	7	24	637	2,546	3	-	-	1,181	4,724	3
Perungalur	830	1	34	1,177	4,707	3	34,503	43	135	540	3
Pottagavayal	50,603	63	-	684	2,737	4	26,090	101	1,071	4,285	4

Gram Panchayat	Aff		ARS	AVP		Az	BP		CBP		CS
	No.	Area	No.	No.	Length	No.	Plants	Area	No.	Length	No.
Radhappuli	1,803	2	-	663	2,653	1	-	-	262	1,048	1
Sadurvedamangalam	2,375	3	-	756	3,023	6	11,337	53	1,122	4,486	6
Siraikottai	2,783	3	3	958	3,830	2	3,507	18	1,272	5,086	2
Siruvayal	4,216	5	-	384	1,535	1	-	-	-	-	1
Thalayadikottai	6,500	8	47	684	2,737	-	43,214	54	-	-	-
Thavalaikulam	50,891	64	38	144	577	1	32,701	41	373	1,491	1
Thethangal	4,175	5	54	601	2,402	2	70,577	88	-	-	2
Thiyagavanseri	964	1	-	168	671	2	14,748	71	132	529	2
Vadavaneri	23,036	29	7	1,175	4,699	2	17,558	22	397	1,588	2
Vagavayal	11,215	14	17	985	3,939	2	52,149	65	588	2,353	2
Vallam	5,483	7	18	1,844	7,375	7	55,869	70	-	-	7
Vaniyavallam	2,262	3	40	-	-	1	8,152	41	429	1,716	1

Gram Panchayat	CT	Co		FP	CCBF		DLT		DLHAI		FBBTI		FD
	No.	No.	Area	No.	No.	Area	Plants	Length	No.	Area	No.	Area	No.
A.Panayur	2	2	7	2	14,554	73	-	-	1	4	3	7	2
Akkiramesai	2	25	73	25	773	4	-	-	15	36	29	73	2
Anjamadai	1	74	106	29	3,272	16	-	-	21	53	43	106	1
Arasanur	1	2	9	2	3,980	20	324	1,294	2	4	4	9	1
Ariyankottai	3	13	40	13	569	3	344	1,374	8	20	16	40	3
Attangudi	4	66	238	66	3,816	19	575	2,298	48	119	95	238	4
Gangaikondan	2	7	20	7	1,587	8	402	1,606	4	10	8	20	2
Kalliyadiyendal	2	4	13	4	566	3	758	3,030	3	6	5	13	2
Karadaranthakudi	3	87	314	87	524	3	543	2,173	63	157	126	314	3
Keelakavanoor	-	22	59	22	243	1	468	1,870	12	29	23	59	-
Kiliyur	2	81	116	32	427	2	1,141	4,564	23	58	46	116	2
Koluvur	1	6	22	6	352	2	-	-	4	11	9	22	1
Kottakudi	1	6	19	6	372	2	147	588	4	9	7	19	1
Kulathur	2	5	15	5	333	2	-	-	3	8	6	15	2
manakudi	1	5	19	5	1,763	9	522	2,087	4	10	8	19	1
Mummudisathan	1	8	70	19	697	3	448	1,790	14	35	28	70	1
Nagaram	3	18	267	18	553	3	-	-	53	134	107	267	3
Nagaramangalam	2	19	71	19	2,592	13	-	-	14	36	28	71	2
Nainarkoil	-	10	31	10	377	2	-	-	6	16	13	31	-
P.Kodikulam	2	8	25	8	428	2	-	-	5	12	10	25	2
Padappanendal	2	4	9	2	3,074	15	208	832	2	4	4	9	2
Pagaivendri	1	2	8	2	356	2	730	2,920	2	4	3	8	1
Pandiyur	3	3	11	3	1,319	7	-	-	2	5	4	11	3
Perungalur	3	2	8	2	207	1	183	731	2	4	3	8	3
Pottagavayal	4	94	297	94	12,651	63	995	3,980	59	149	119	297	4
Radhappuli	1	41	109	41	451	2	675	2,701	22	54	44	109	1
Sadurvedamangalam	6	4	17	4	594	3	-	-	3	9	7	17	6
Siraikottai	2	5	16	5	696	3	289	1,154	3	8	6	16	2

Gram Panchayat	CT	Co		FP	CCBF		DLT		DLHAI		FBBTI		FD
	No.	No.	Area	No.	No.	Area	Plants	Length	No.	Area	No.	Area	No.
Siruvayal	1	4	25	8	1,054	5	1,088	4,353	5	13	10	25	1
Thalayadikottai	-	12	36	12	1,625	8	1,168	4,670	7	18	15	36	-
Thavalaikulam	1	4	15	4	12,723	64	90	359	3	8	6	15	1
Thethangal	2	1	6	1	1,044	5	-	-	1	3	2	6	2
Thiyagavanseri	2	4	16	4	241	1	386	1,545	3	8	6	16	2
Vadavaneri	2	14	50	14	5,759	29	-	-	10	25	20	50	2
Vagavayal	2	27	127	27	2,804	14	401	1,602	25	64	51	127	2
Vallam	7	49	138	49	1,371	7	-	-	28	69	55	138	7
Vaniyavallam	1	15	47	15	565	3	974	3,897	9	24	19	47	1

Gram Panchayat	GSS	ICP		LDI		LP		MI		NADEP		ND		PS
	No.	Plants	Length	No.	Area	Plants	Length	No.	Area	No.	Extent	Plants	HHs	No.
A.Panayur	14	125	500	1	2	98	394	1	3	2	17	1,025	205	5
Akkiramesai	80	-	-	12	31	395	1,581	4	11	2	20	3,485	697	13
Anjamadai	26	756	3,023	15	37	186	745	13	33	1	13	2,040	408	10
Arasanur	21	250	1,000	1	3	256	1,024	1	3	1	7	1,330	266	3
Ariyankottai	38	717	2,869	7	17	167	669	3	7	3	1	2,255	451	4
Attangudi	4	363	1,451	33	82	253	1,010	29	74	4	43	2,195	439	2
Gangaikondan	106	176	702	3	8	410	1,641	1	3	2	18	2,765	553	20
Kalliyadiyendal	-	86	343	2	5	94	375	1	4	2	16	3,250	650	4
Karadaranthakudi	42	402	1,606	43	108	472	1,888	39	97	3	30	2,895	579	10
Keelakavanoor	14	-	-	11	28	86	345	1	3	-	5	3,060	612	2
Kiliyur	5	652	2,608	16	40	183	732	14	35	2	19	1,875	375	1
Koluvur	15	-	-	3	7	203	814	3	8	1	9	1,175	235	9
Kottakudi	3	781	3,125	3	7	892	3,569	1	4	1	10	990	198	-
Kulathur	13	89	356	7	6	165	660	1	4	2	18	1,535	307	12
manakudi	1	723	2,892	3	7	591	2,365	2	6	1	9	720	144	1
Mummudisathan	2	175	698	10	24	93	372	9	22	1	10	880	176	1
Nagaram	2	640	2,561	9	23	566	2,265	89	222	3	27	2,215	443	2
Nagaramangalam	4	811	3,245	10	24	533	2,130	9	23	2	16	1,965	393	1
Nainarkoil	9	78	310	5	13	416	1,663	2	6	-	-	3,975	795	-
P.Kodikulam	5	417	1,669	4	10	298	1,193	2	5	2	20	1,695	339	1
Padappanendal	10	255	1,020	1	2	171	685	2	5	2	20	1,530	306	5
Pagaivendri	-	-	-	1	3	131	525	1	2	1	10	3,250	650	3
Pandiyur	10	162	648	2	4	26	103	1	2	3	31	2,010	402	6
Perungalur	2	102	407	1	3	134	538	1	2	3	29	1,625	325	1
Pottagavayal	5	1,028	4,112	47	118	635	2,542	25	62	4	35	3,170	634	4
Radhappuli	26	-	-	21	51	289	1,155	2	6	1	9	3,060	612	4
Sadurvedamangalam	15	392	1,568	2	5	148	593	3	7	6	57	1,330	266	5
Siraikottai	-	282	1,126	2	6	244	975	2	4	2	20	3,250	650	5

Gram Panchayat	GSS	ICP		LDI		LP		MI		NADEP		ND		PS
	No.	Plants	Length	No.	Area	Plants	Length	No.	Area	No.	Extent	Plants	HHs	No.
Siruvayal	1	-	-	4	10	670	2,679	2	4	1	14	2,720	544	2
Thalayadikottai	2	-	-	6	15	592	2,368	2	6	-	4	2,525	505	1
Thavalaikulam	1	177	709	2	5	281	1,123	2	6	1	12	890	178	1
Thethangal	2	-	-	1	2	156	622	1	3	2	22	1,385	277	1
Thiyagavanseri	1	129	514	2	5	453	1,810	3	7	2	21	765	153	1
Vadavaneri	40	169	676	7	17	345	1,380	6	15	2	16	2,065	413	9
Vagavayal	3	315	1,259	14	34	276	1,106	24	59	2	18	1,285	257	1
Vallam	7	-	-	24	61	365	1,462	6	16	7	72	2,920	584	3
Vaniyavallam	-	102	409	8	19	344	1,375	3	9	1	12	3,975	795	4

Gram Panchayat	RPWDT	Roo	RP	RRWH	SPD		SPC	SPI	WCICD
	No.	No.	No.	No.	No.	Area	No.	No.	Length
A.Panayur	1	4	-	2	-	-	2	21	500
Akkiramesai	1	13	-	2	-	-	7	70	-
Anjamadai	4	10	-	2	-	-	4	41	3,023
Arasanur	2	6	-	2	-	-	3	27	1,000
Ariyankottai	2	10	-	2	-	-	5	45	2,869
Attangudi	4	13	-	2	-	-	4	44	1,451
Gangaikondan	1	6	-	2	-	-	6	55	702
Kalliyadiyendal		2		2			7	65	343
Karadaranthakudi	1	6	-	2	-	-	6	58	1,606
Keelakavanoor		7		2			6	61	-
Kiliyur	1	4	-	2	-	-	4	38	2,608
Koluvur	2	3	-	2	-	-	2	24	-
Kottakudi	2	14	-	2	-	-	2	20	3,125
Kulathur	1	4		2			3	31	356
manakudi	6	8	-	2	-	-	1	14	2,892
Mummudisathan	1	6	-	2	-	-	2	18	698
Nagaram	4	14	-	2	-	-	4	44	2,561
Nagaramangalam	2	13	-	2	-	-	4	39	3,245
Nainarkoil	2	4		2			8	80	310
P.Kodikulam	4	7	-	2	-	-	3	34	1,669
Padappanendal	1	8	-	2	-	-	3	31	1,020
Pagaivendri	1	2		2			7	65	-
Pandiyur	1	2	-	2	-	-	4	40	648
Perungalur	2	7	-	2	-	-	3	33	407
Pottagavayal	4	11	-	2	2,040	3	6	63	4,112
Radhappuli		9		2			6	61	-
Sadurvedamangalam	1	7	-	2	-	-	3	27	1,568
Siraikottai	1	5		2			7	65	1,126

Gram Panchayat	RPWDT	Roo	RP	RRWH	SPD		SPC	SPI	WCICD
	No.	No.	No.	No.	No.	Area	No.	No.	Length
Siruvayal	-	18	-	2	-	-	5	54	-
Thalayadikottai	4	9	-	2	-	-	5	51	-
Thavalaikulam	4	7	-	2	-	-	2	18	709
Thethangal	2	7		2			3	28	-
Thiyagavanseri	1	4	-	2	-	-	2	15	514
Vadavaneri	-	7	-	2	-	-	4	41	676
Vagavayal	4	7	-	2	-	-	3	26	1,259
Vallam	4	9	-	2	-	-	6	58	-
Vaniyavallam		9		2			8	80	409

ANNEXURE 7.1

GP WISE WASCA RECOMMENDATION AND WORKS UPLOADED

GP	WASCA Recommendation for 3 Years	WASCA Uploaded for FY-2021-22 as on 14-03-2022 FY-2021-22 as on 02/02/2022
Akkiramesi	285	3
Anjamadaikatchan	512	4
A. Panaiyoor	225	173
Arasanur	130	4
Ariyankottai	204	3
Attangudi	378	4
Gangaikondan	246	11
Kalliyadiyenthal	292	4
Karadarnthakudi	420	3
Keelakavnur	424	142
Kiliyur	478	4
Koluvur	418	213
Kottakudi	247	20
Kulathur	334	60
Manakudi	178	210
Mummudi Chathan	125	45
Nagaram	211	4
Nagaramangalam	411	3
Nainarkovil	525	4
Pagaiventri	279	139
Pandiyur	213	3
Panthappanenthal	289	107
Perungalur	199	185
P. Kodikulam	389	3
Potagavayal	862	7
Radhappuli	228	4
Sadurvedamangalam	339	177
Sirakikottai	261	302
Siruvayal	156	242
Thaliyadikottai	2,678	7
Thavalaikulam	257	49
Thethangal	393	3
Thiyagavanseri	167	90
Vadhavanery	301	3
Vagavayal	389	3
Vallam	615	3
Vaniyavallam	130	331

ANNEXURE 7.2

GP WISE ONGOING WORKS IN NAINARKOIL BLOCK

GP	Work Category	No of ongoin works
A.Panaiyoor	Water Conservation and Water Harvesting	3
Akkiramesi	Water Conservation and Water Harvesting	2
Anjamadaikatchan	Water Conservation and Water Harvesting	1
Arasanur	Drought Proofing	1
	Water Conservation and Water Harvesting	1
Ariyankottai	Water Conservation and Water Harvesting	2
Attangudi	Water Conservation and Water Harvesting	2
Gangaikondan	Water Conservation and Water Harvesting	2
Kalliyadiyenthal	Water Conservation and Water Harvesting	1
Keelakavnur	Water Conservation and Water Harvesting	1
Kiliyur	Water Conservation and Water Harvesting	2
Koluvur	Rural Connectivity	1
	Water Conservation and Water Harvesting	1
Kottakudi	Water Conservation and Water Harvesting	1
Kulathur	Water Conservation and Water Harvesting	4
Manakudi	Water Conservation and Water Harvesting	3
Mummudi Chathan	Water Conservation and Water Harvesting	2
Nagaram	Water Conservation and Water Harvesting	3
	Works on Individuals Land (Category IV)	7
Nagaramangalam	Drought Proofing	1
	Water Conservation and Water Harvesting	2
Nainarkoil	Water Conservation and Water Harvesting	1
P.Kodikulam	Drought Proofing	1
	Water Conservation and Water Harvesting	2
Pagaiventri	Land Development	1
	Water Conservation and Water Harvesting	1
Panthappanenthal	Water Conservation and Water Harvesting	3
Perungalur	Water Conservation and Water Harvesting	2
Potagavayal	Water Conservation and Water Harvesting	1
Radhappuli	Water Conservation and Water Harvesting	2
Sadurvedamangalam	Water Conservation and Water Harvesting	2
Sirakikottai	Water Conservation and Water Harvesting	1
Siruvayal	Water Conservation and Water Harvesting	2
Thaliyadikottai	Water Conservation and Water Harvesting	2
Thavalaikulam	Water Conservation and Water Harvesting	2
Thethangal	Water Conservation and Water Harvesting	1
Thiyagavanseri	Water Conservation and Water Harvesting	1
Vagavayal	Water Conservation and Water Harvesting	1
Vallam	Water Conservation and Water Harvesting	2
Vaniyavallam	Anganwadi/Other Rural Infrastructure	1
Vathavanerry	Water Conservation and Water Harvesting	2

ANNEXURE 8

CWRM KEY INDICATORS FOR GPs IN A.PANAIYUR MICRO-WATERSHED

CWRM Parameter	Siruvayal	Kiliyur	A.Panayur
Soil Resources: Status of Available Nitrogen (%)			
Very Low	71.43	1.85	53.85
Low	28.57	98.15	46.15
Status of Organic Carbon (%)			
Very Low	18.63	12.04	12.82
Low	80.75	87.96	75.64
Medium	0.62	0.00	11.54
Status of Soil Micro Nutrients (%)			
Sufficient	58.00	55.00	40.00
Deficient	42.00	45.00	60.00
Status of Physical condition of the soil (%)			
Moderately Acidic	0.00	0.58	0.00
Moderately Acidic	1.86	30.06	0.00
Slighly Acidic	29.19	30.64	3.85
Moderately Alkaline	68.94	38.73	96.15
Soil Texture (%)			
Fine Soil	76.45	81.00	80.00
Soil Water Permeability (Low, Moderate, high)	Moderate	Moderate	Moderate
Soil moisture and ET			
Volumetric Soil Moisture (%)	17.00	17.00	17.00
Estimated Soil Moisture (ha.m)	214.49	103.34	70.25
ET Losses (ha.m)	347.03	175.48	206.65
Means of Water Extraction (%)			
Gravity	54	25	6
Lifting	46	75	94
Irrigation Methods (%)			
Wild Flooding	100	77	74
Control Flooding	0	23	26
Livestock (No.)			
Cattle Population	55	76	67
Sheep Population	0	219	65
Goat Population	36	393	125
Poultry	404	269	184
Land Resources (ha)			
Non-Agricultural Uses	309.64	125.56	340.07
Land Under Miscellaneous Tree Criticalops etc.	0.00	28.87	57.57
Cultivable Waste Land	0.00	0.00	1.04
Fallows Land other than Current Fallows	4.29	131.89	5.94
Current Fallow land	592.59	139.82	10.35
Unirrigated Land	441.37	132.51	196.51
Area Irrigated by Source	223.43	174.79	141.81

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