



National River Conservation Directorate

Ministry of Jal Shakti,

Department of Water Resources,

River Development & Ganga Rejuvenation

Government of India

Revenue Map of Periyar River Basin

September 2025



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National River Conservation Directorate (NRCD)

The National River Conservation Directorate, functioning under the Department of Water Resources, River Development & Ganga Rejuvenation, and Ministry of Jal Shakti providing financial assistance to the State Government for conservation of rivers under the Centrally Sponsored Schemes of 'National River Conservation Plan (NRCP)'. National River Conservation Plan to the State Governments/ local bodies to set up infrastructure for pollution abatement of rivers in identified polluted river stretches based on proposals received from the State Governments/ local bodies.

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The Center for Periyar River Basin Management Studies (cPeriyar) is a Brain Trust dedicated to River Science and River Basin Management. Established in 2024 by IIT Palakkad and NIT Calicut, under the supervision of cGanga at IIT Kanpur, the center serves as a knowledge wing of the National River Conservation Directorate (NRCD). cPeriyar is committed to restoring and conserving the Periyar River and its resources through the collation of information and knowledge, research and development, planning, monitoring, education, advocacy, and stakeholder engagement.

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cGanga is a think tank formed under the aegis of NMCG, and one of its stated objectives is to make India a world leader in river and water science. The Centre is headquartered at IIT Kanpur and has representation from most leading science and technological institutes of the country. cGanga's mandate is to serve as think-tank in implementation and dynamic evolution of Ganga River Basin Management Plan (GRBMP) prepared by the Consortium of 7 IITs. In addition to this, it is also responsible for introducing new technologies, innovations, and solutions into India.

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Acknowledgment

This report is a comprehensive outcome of the project jointly executed by IIT Palakkad (Lead Institute) and NIT Calicut (Fellow Institute) under the supervision of cGanga at IIT Kanpur. It was submitted to the National River Conservation Directorate (NRCD) in 2024. We gratefully acknowledge the individuals who provided information and photographs for this report.

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Preface

In an era of unprecedented environmental change, understanding our and resources and their patterns of use has never been more critical. This report aims to provide a comprehensive overview of our rivers, highlighting their importance, current health, and the challenges they face. As we explore the various facets of river systems, we aim to equip readers with the knowledge necessary to appreciate and protect these vital waterways.

Throughout the following pages, you will find an in-depth analysis of the principles and practices that support balanced land use in the basin. Our team of experts has meticulously compiled the data which includes spatial data, census details, and field insights to illustrate the significant impact of land-use changes on both ecological systems and human communities. By sharing these insights, we hope to inspire and empower our readers to engage in sustainable land management efforts.

This report is not merely a collection of statistics and theories; it is a call to action. We urge all stakeholders to recognize the value of land resources and to take proactive steps to ensure their efficient and equitable utilization. Whether you are an environmental professional, a policy maker, a researcher, or simply someone concerned about resource conservation, this guide is designed to support you in efforts to protect and manage land effectively.

We extend our heartfelt gratitude to the numerous contributors who have generously shared their stories and expertise. Their invaluable input has enriched this report, making it a beacon of knowledge and a practical resource for all who read it. It is our hope that this report will serve as a catalyst for positive environmental action, fostering a culture of stewardship that benefits both current and future generations.

As you delve into this overview of our rivers, we invite you to embrace the opportunities and challenges that lie ahead. Together, we can ensure that our rivers continue to thrive and sustain life for generations to come.

Centres for Periyar River Basin
Management and Studies (cPeriyar)
IIT Palakkad & NIT Calicut

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List of Abbreviations

PRB	Periyar River Basin
LULC	Land Use Land Cover
NRSC	National Remote Sensing Center
IDRB	Irrigation Design and Research Board
PTR	Periyar Tiger Reserve
NSA	Net Sown Area

1. Introduction

1.1 A brief overview of revenue mapping

Revenue mapping refers to the systematic process of classifying, documenting, and valuing land and property for purposes such as taxation, land administration, planning, and management. It helps government authorities to efficiently manage land resources and generate revenue through land taxes. It serves as an essential tool for decision-making in urban planning, infrastructure development, and natural resource management.

Revenue maps represent financial data linked with geographical locations. This can be used to understand revenue distribution, identify areas of economic strength and weakness, and allocate resources. This report provides an overall analysis of the Revenue mapping of the Periyar River Basin (PRB). The basin includes areas ranging from densely forested highlands to urban and agricultural lowlands, where land values and uses vary significantly. Primarily, this report focuses on major land revenue categories, demographic distribution, and areas affected by environmental degradation.

1.2 Study area

The PRB is in the central part of Kerala, extending across the districts of Idukki, Ernakulam, and Thrissur. The Periyar is the longest river in Kerala with a total length of 244 km, originating from the Sivagiri hill range in the Western Ghats and draining into the Arabian Sea. The total basin area is approximately 5,216 km². Figure 1 represents the boundary of the PRB used for present study is shown in Figure 1.

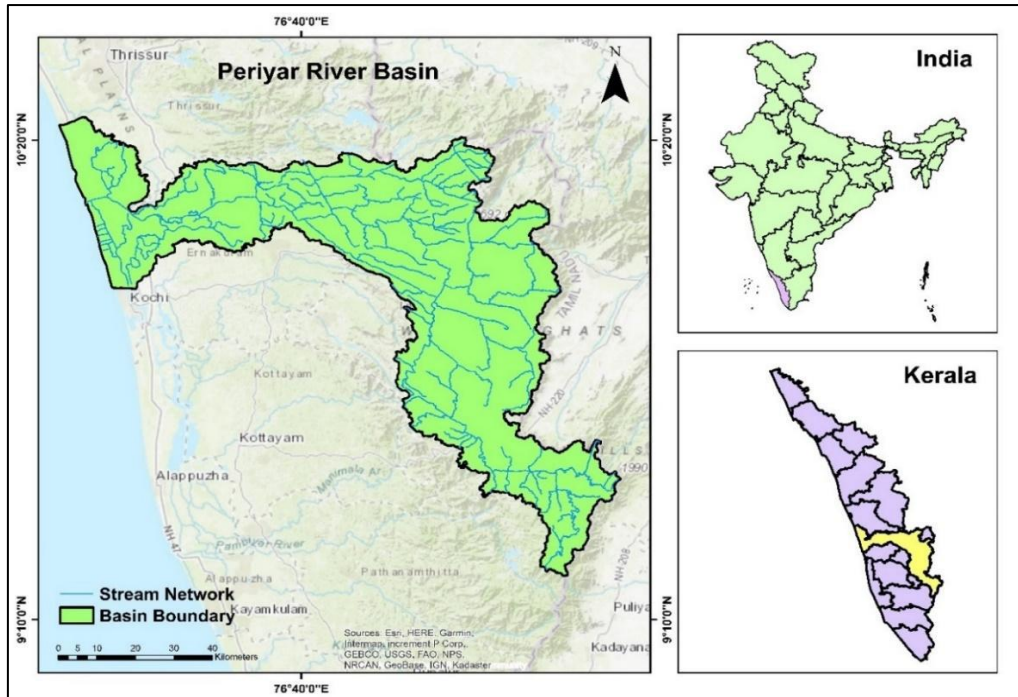


Figure 1. Boundary of the PRB

For mapping and spatial analysis, the study area is represented according to the revenue administration hierarchy of Kerala. In Kerala, the Revenue Administration hierarchy follows the structure from state to district to sub-district and then village. The sub-district boundaries within the PRB are mapped and presented in Figure 2.

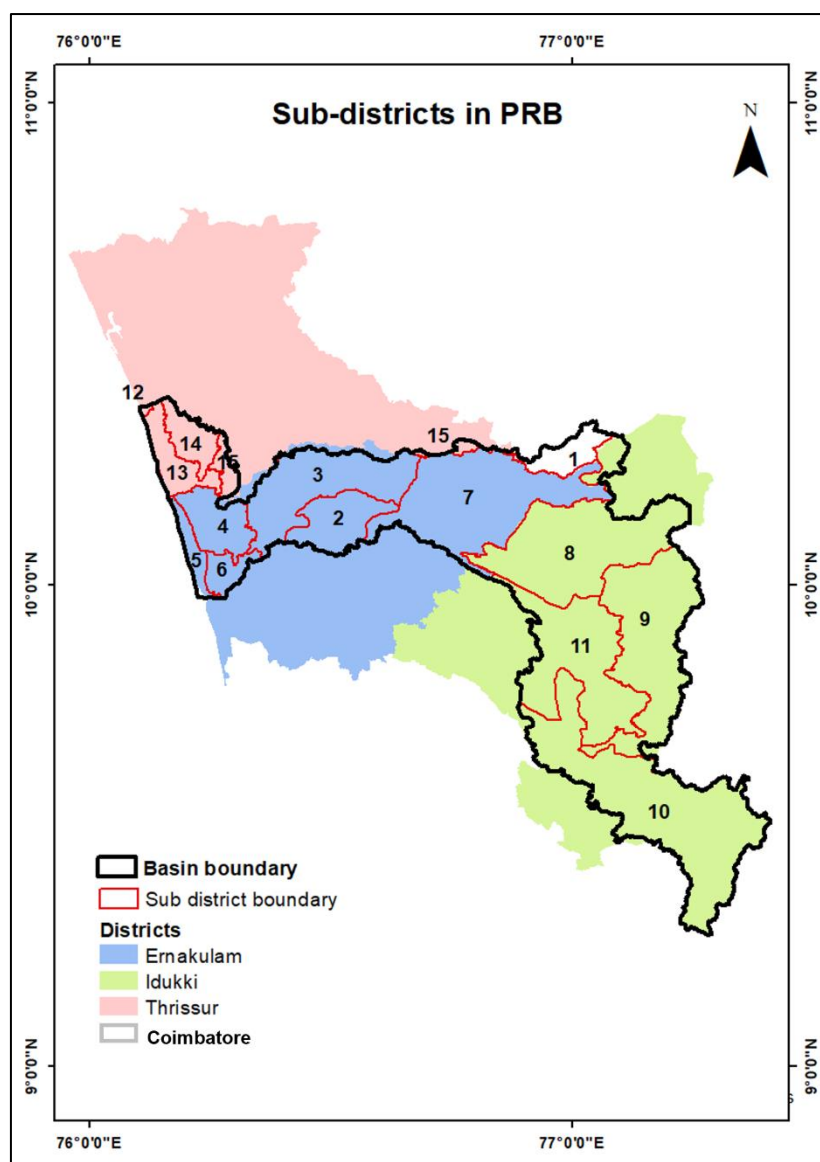


Figure 2. Sub-districts in the PRB

The PRB spans across three districts of Kerala - Idukki, Ernakulam, and Thrissur - and extends into a small portion of the Coimbatore district in Tamil Nadu, encompassing a total of fifteen sub-districts. These administrative units form the basis for spatial and revenue map analysis in the study. The names of each sub-district are provided in Table 1, with the serial numbers in the table corresponding to those marked on the map.

Table 1. List of sub-districts in the PRB

Sl no.	District	Sub-district
1	Coimbatore (Tamil Nadu state)	Valparai
2		Kunnathunad
3	Ernakulam	Aluva
4		Paravur

5		Kochi
6		Kanayannur
7		Kothamangalam
8		Devikulam
9	Idukki	Udumbanchola
10		Peerumade
11		Idukki
12		Chavakkad
13	Thrissur	Kodungallur
14		Mukundapuram
15		Chalakkudy

1.3 Data used for revenue mapping

The preparation of the revenue map was done by collecting data from both primary and secondary sources. A combination of geospatial data, official agricultural statistics, and supporting secondary reports was utilized in the mapping process. Details about the data used are presented in Table 2.

Table 2. Data used for revenue mapping in PRB

Sl no	Data type	Source	Format
1	LULC Data	NRSC LULC 2018	Shapefile
		IDRB	Shapefile
2	Agricultural Data	Principal Agricultural Office, Idukki	PDF
3	Secondary data	Various reports	PDF

All land use categories which are discussed in this report (forest area, agricultural land, fallow land, net sown area, irrigated land, area not available for cultivation, water bodies, built-up land area, and production of different crops) were mapped using the Land Use and Land Cover (LULC) data for the year 2018, obtained from the National Remote Sensing Centre (NRSC, 2018). The LULC classification provides a detailed breakdown of land use types.

2. Land revenue categories

Land in the basin is classified into revenue categories based on use and value, as follows.

- a) Area under forest

- b) Agricultural land area
- c) Area under waterbodies
- d) Area under built-up land
- e) Area under barren land

Each category reflects major land use and its corresponding economic value to the state. In PRB, the diversity of terrain and land use results in various revenue categories, from high-value urban plots in the downstream plains to ecologically sensitive forest and plantation areas in the upstream highlands.

2.1 Area under forest

Forest area covers a significant portion of the PRB, contributing to land resources, ecological stability and biodiversity conservation. The forest area classified under reserved forest is exempt from agricultural or commercial taxation. The upstream portion of the Periyar River, which is in Idukki district is dominated by extensive forest cover including parts of Periyar Tiger Reserve (PTR) and other ecologically sensitive zones. These forests play a crucial role in soil and water conservation, wildlife habitat protection, and sustaining the basin's perennial water flow. Figure 3 illustrates the spatial distribution of forest cover across the PRB.

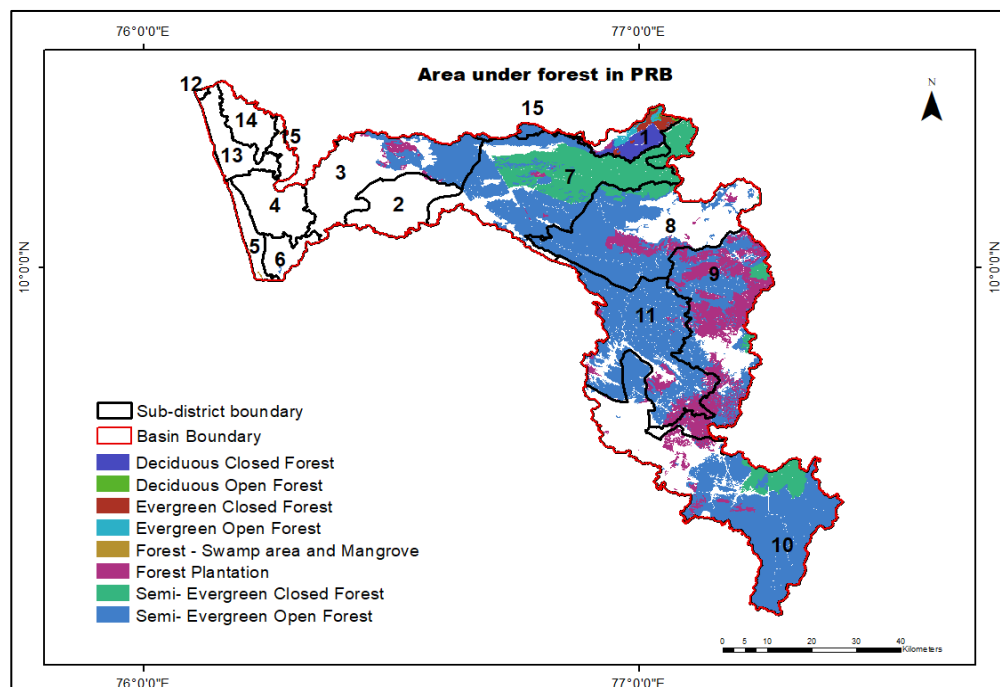


Figure 3. Area under forest PRB

The PRB is largely covered by semi-evergreen forests, both in open and closed forms. These forest types are predominant in the upper catchment areas, particularly around the PTR and

the Mullaperiyar dam catchment, located in the sub-districts of Idukki, Devikulam, Peerumade, and Udumbanchola in Idukki district, as well as Valparai in Coimbatore district (Tamil Nadu), which also form part of the Western Ghats. Deciduous forests, both closed and open, are extensively distributed across the midland regions, with notable stretches in Kothamangalam (Ernakulam) and Chalakkudy (Thrissur). Forest plantations are mainly observed in the Neriamangalam range, the Munnar foothills, and in the sub-districts of Udumbanchola and Peerumade. These plantations are composed of teak, hardwood species, and pulpwood species, and medicinal plants cultivated for timber, industrial raw materials, and forest products. They constitute one of the major sources of revenue for the public through the forest department (Government of Kerala, 2022). In addition, small pockets of swamp and mangrove forests are found in the downstream reaches, particularly near the Periyar floodplains and estuarine areas in sub-districts such as Paravur, Kodungallur, and coastal Kochi. Table 3 details the areas under different forest types in the PRB, calculated from the NRSC LULC 2018 dataset to analyze forest cover composition.

Table 3. Area under forest types in PRB (NRSC LULC 2018)

Sl no.	Forest type	Area (Ha)
1	Deciduous closed forest	4,900
2	Deciduous open forest	2,800
4	Evergreen closed forest	2,500
5	Evergreen open forest	4,000
6	Forest - Swamp area and Mangrove	200
7	Forest Plantation	51,400
8	Semi-Evergreen closed forest	61,000
9	Semi-Evergreen open forest	3,90,400

2.2 Agricultural land

Agricultural land within the PRB contributes a significant share to revenue generation, as well as supporting the livelihoods of a large section of the population. The fertile alluvial plains and valley regions along the river and its tributaries are extensively utilized for the cultivation of paddy, which remains the predominant crop. Also, cash crops such as rubber, pepper,

cardamom, arecanut, and coconut occupy significant portions of the midland and highland areas, particularly in the Idukki and Ernakulam districts. The basin's diverse topography and climatic variations allow for multiple cropping patterns, ranging from wetland rice cultivation in the low-lying stretches to plantation crops in the elevated terrains.

Agricultural land in the PRB can be further classified into three categories based on its utilization and cropping status

- i. Fallow land
- ii. Net sown area
- iii. Irrigated land

This classification provides a clearer understanding of how land resources are managed, the intensity of cultivation, and the role of water availability in agricultural productivity and revenue generation. The distribution of agricultural land within the PRB is shown in Figure 4.

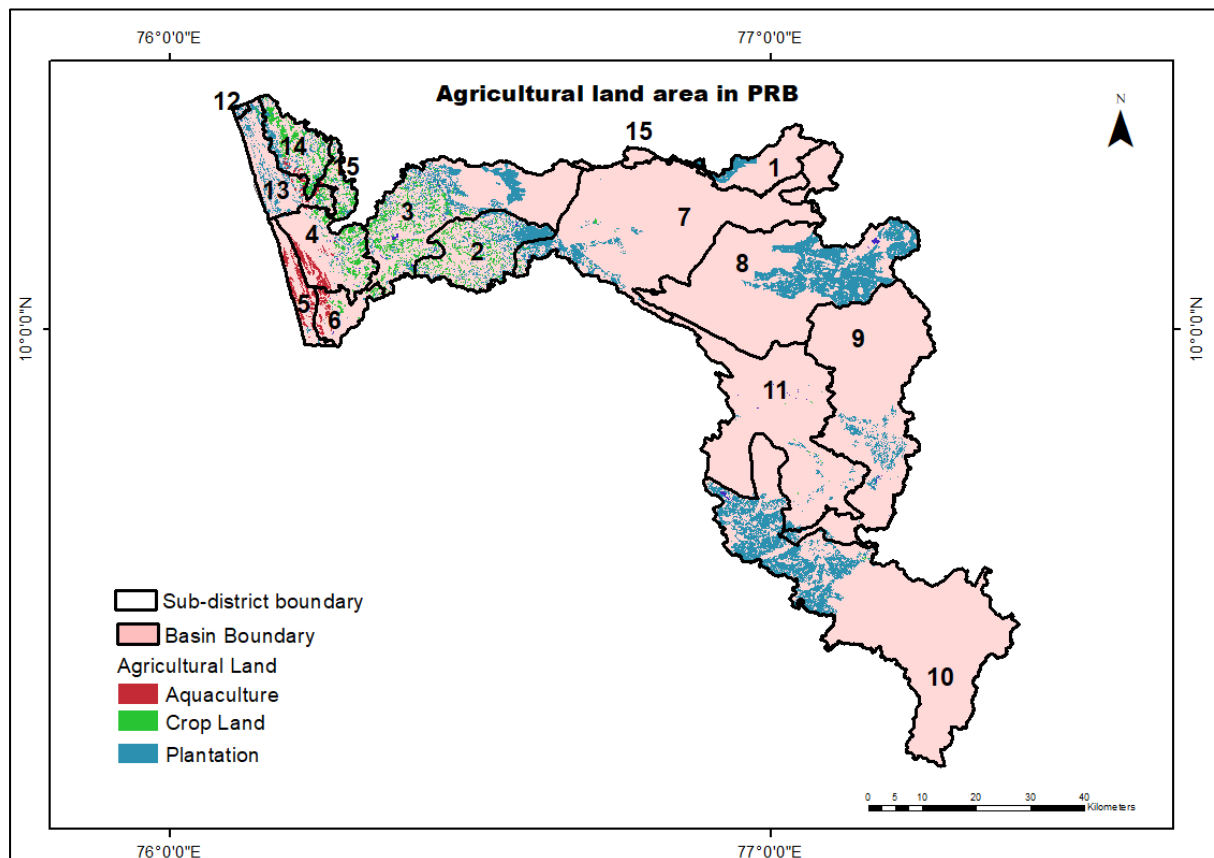


Figure 4. Agricultural land areas in PRB

The map delineates major categories of agricultural land use, including aquaculture, cropland, fallow land, and plantations. Plantations are the majority throughout the basin, particularly dominating the highland and midland regions, especially in the Idukki district. Croplands are predominantly concentrated in the western and central portions of the basin, particularly

along the fertile alluvial plains of Ernakulam district. Aquaculture is mainly confined to localized pockets in the lower basin. The district also practices a unique form of paddy cultivation known as Pokkali, which is integrated with prawn farming to provide additional income (Government of India, 2017). Details of the agricultural land area are given in Table 4.

Table 4. Agricultural land areas in PRB (NRSE LULC 2018)

Sl no.	Forest type	Area(km ²)
1	Aquaculture	47,00
2	Crop land	15,100
3	Plantation	81,100

2.2.1 Fallow land

Fallow land refers to agricultural land being kept uncultivated for a specific period of not less than one year and not more than five years due to factors such as poverty of cultivators, inadequate water supply, or silting of canals and rivers is classified as fallow land. Also, land that is kept fallow from the net area sown in the previous year is classified as current fallow (Government of Kerala, 2024). As per the document of the Agricultural Development and Farmers Welfare Department, the total current fallow land area in the Idukki district is estimated at 1326 hectares, while the fallow land other than the current fallow accounts for 1049 hectares. The current fallow for Ernakulam district was 10,835 Ha, and other fallows were 6472 Ha (Government of India, 2019). Reasons for classifying fallow in Ernakulam district were listed below (Government of India, 2019).

- i. Non-release of water in canals under the delayed onset of monsoon in the catchment.
- ii. Lack of inflows into tanks due to the insufficient delayed onset of the monsoon.
- iii. Insufficient groundwater recharge due to low rainfall.

The PRB experiences both wet and dry seasons, which influence agricultural operations and land use stability. Dry seasons followed by minimal rainfall, along with heavy monsoon showers during peak periods, lead to waterlogged conditions in low-lying areas. These conditions force farmers to postpone planting and temporarily leave the land fallow. Reducing the extent of fallow land through improved irrigation facilities, crop diversification, and soil fertility management could enhance the basin's overall agricultural output.

2.2.2 Net sown area

Net Sown Area (NSA) refers to the actual area of land cultivated with crops during a given agricultural year. Area sown more than once in the same year is counted only once. It measures the land actively utilized for agricultural production, which is an important source of revenue generation in the basin. The details of agricultural sown areas across the districts within the PRB are summarized in Table 5.

Table 5. Agricultural sown area details of districts in PRB
(Principal Agricultural Officer, Idukki 2024, Government of India, 2019)

Sl no	Type of area	Ernakulam (Ha)	Idukki (Ha)
1	Net sown area	1,59,200	2,06,196
2	Areas sown more than once	19,900	56,401
3	Gross cropped area	17,910	2,65,981
4	Cropping Intensity	113%	129%

In PRB, the Idukki district has the largest net sown area, but commercial plantations dominate over food crop cultivation. In Ernakulam district, taluks such as Aluva, Paravur, Kunnathunad, and Kanayannur contain most of the basin's cropland (Figure 4), contributing significantly to the NSA. Large stretches of paddy fields, coconut groves, and mixed cropping systems dominate these areas. The major crops occupying the net-sown area in the PRB are summarized in Table 6.

Table 6. Crops dominating the net-sown area
(Principal Agricultural Officer, Idukki 2024, Government of India, 2019)

Sl no.	Crop	Idukki (Ha)	Ernakulam (Ha)
1	Paddy	488	12966
2	Coconut	15305	54710
3	Arecanut	1748	4908
4	Pepper	40780	6637
5	Cardomom	50348	-
6	Tea	25508	2
7	Coffee	13240	-
8	Cashew	867	948
9	Ginger	470	396

10	Turmeric	192	629
11	Nutmeg	3846	-
12	Cocoa	9617	-
13	Rubber	40570	57565
14	Tapioca	5553	6117
15	Banana	3534	6385
16	Plantain	3200	4268
17	Pineapple	1225	7489
18	Papaya	748	1177
19	Jack	16652	3831
20	Sugarcane	838	-
21	Vegetables	4748	1287
22	Tuber crops	1212	-
23	Pulses	85.3	262
24	Mango	5054	3892

In Ernakulam district, coconut (54,710 ha) is the most dominant crop. Paddy cultivation also plays a significant role, covering 12,966 ha, concentrated mainly in Aluva, Paravur, and Kanayannur sub-districts, where fertile alluvial plains and floodplains exist. Other important crops include rubber, pineapple, banana, and plantain. Cash crops such as arecanut, pepper, and turmeric further diversify the cropping system. The presence of perennial crops like coconut and rubber indicates the commercial orientation of agriculture in Ernakulam, making a significant contribution to the district's agricultural revenue.

Idukki district is dominated by plantation and spice crops due to its high-altitude terrain and favorable climate. The largest land use is for cardamom (50,348 ha) and pepper (40,780 ha), both of which are high-value export crops followed by rubber, tea, and coffee. Nutmeg (3,846 ha), cocoa (9,617 ha; table 6), and ginger (470 ha) also contribute significantly. Food crops like paddy (488 ha) and pulses (85 ha) occupy very limited areas, highlighting the district's dependence on spice and plantation crops for revenue.

2.2.3 Irrigated land area in PRB

The irrigation in agricultural land in the PRB enhances cropping intensity and productivity of the region. Irrigated land refers to the area supplied with water through canals, wells, tanks, reservoirs, or modern micro-irrigation systems, while unirrigated land depends on seasonal rainfall.

In Ernakulam District, water is primarily supplied through three major projects, namely Periyar Valley irrigation project, Moovatupuzha Irrigation project, and Idamalayar irrigation project (Government of India, 2017). Also, Ernakulam district consists of 136 lift irrigation schemes on which major agricultural activities depend. Total length of canal network is 335 kms and ayacut (the command area that is irrigated by an irrigation project) 12552 Hectares. These schemes were designed for irrigating 5878.50 hectares of ayacut area. (Government of Kerala, 2022). Table 7 presents the irrigated land area in Idukki and Ernakulam district along with the respective sources of irrigation.

Table 7. Irrigated land area & source in Idukki district
(Principal Agricultural Officer, Idukki (2024), Government of India, 2019)

Sl no.	Source	Idukki (Ha)	Ernakulam (Ha)
1	Small streams (Thodu/Canal)	785.5	12,984 (Canal)
2	Pond/Tanks	23,050	1,559 (Tank)
3	Well	7,345	10,419
4	Borewell	13,021	
5	River & lake	1325	-
6	Other sources	7598	2714
7	Micro-irrigation	-	3493

The PRB has a diverse irrigation system due to the physiographic variations of the basin and the agricultural practices followed across its districts. In Idukki district, irrigation primarily depends on ponds and tanks and borewells. River and lake water support a small share of irrigated land, while other sources include minor lift irrigation and localized structures designed to meet water requirements in scattered settlements. Ernakulam district shows higher utilization of canal irrigation. Groundwater sources also play an important role, with wells irrigating 10,419 ha. This district-wise comparison highlights that while Idukki relies heavily on groundwater, ponds, and borewells to sustain irrigation in its fragmented hilly

terrain, Ernakulam benefits from an organized canal network and modern irrigation technologies.

2.3 Area not available for cultivation

The land area that cannot be used for agricultural purposes is coming under the category of areas not available for cultivation. These areas, which cannot be used for agriculture, are due to permanent non-agricultural uses or inherent unsuitability. In PRB, the land types that are permanently converted to non-agricultural purposes are,

- a) **Urban Settlements:** Urban and rural housing, townships, and villages. Major concentration in the Ernakulam district.
- b) **Infrastructure:** Roads, railways, airports, power stations. Cochin International Airport at Nedumbassery, a major land used under this category.
- c) **Industrial Areas:** Small and medium industries along the Periyar near Eloor–Edayar.
- d) **Water-related structures:** Dams, reservoirs, canals, and hydropower stations come under this category. Idukki Hydroelectric Project (Idukki Arch Dam, Cheruthoni Dam, Kulamavu Dam) and Idamalayar Dam occupy substantial land.
- e) **Public and commercial spaces:** educational institutions, markets, office complexes, and recreational areas mainly spread across Ernakulam and Thrissur districts.

Also, naturally unsuitable areas are spread in the basin. These barren & unculturable lands include:

- a) **Western Ghats:** Steep slopes, rocky terrain, and shallow soils that prevent cultivation.
- b) **Quarrying and mining areas:** Granite and laterite quarrying is widespread in Idukki and Ernakulam districts.

The extent and distribution of land not available for cultivation and the types of land are shown in Figure 5.

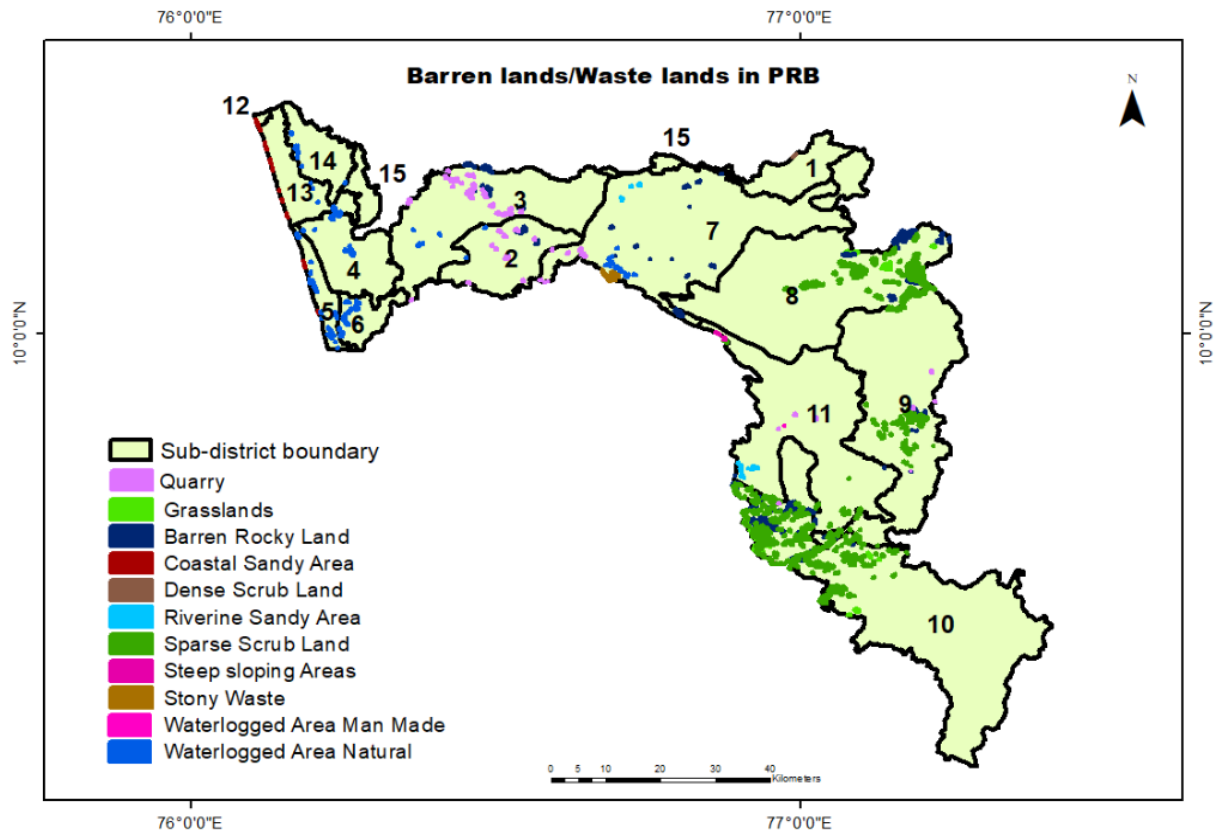


Figure 5. Types of land area not available for cultivation in PRB

In the high land regions of Idukki (Devikulam, Udumbanchola, Peerumade, and Idukki sub-districts), the barren rocky land and scrublands are mostly seen. Along the subdistricts of Ernakulam (Kunnathunad, Aluva, Paravur, Kochi, Kanayannur, and Kothamangalam) the non-agricultural land areas extend through the land types such as quarries, riverine sandy areas, patches of grassland also appear. The lowland stretches of Thrissur (Chavakkad, Kodungallur, Mukundapuram, and Chalakkudy) contain coastal sandy areas, waterlogged zones (both natural and man-made), and sparse scrublands, reflecting the coastal and floodplain influence of the Periyar system. The area details of land not available for cultivation within the PRB, based on NRSC LULC 2018 data, are summarized in Table 8.

Table 8. Details of the land area not available for cultivation in PRB (NRSE LULC 2018)

Sl no.	Type of area	Area(km ²)
1	Quarry Area	6
2	Grasslands / Grazing Lands	7
3	Barren Rocky	34
4	Coastal Sandy Area	1.5

5	Dense Scrub Land	1.3
6	Riverine Sandy Area	0.2
7	Sparse Scrub Land	74
8	Steep sloping areas	0.85
9	Stony Waste	4.81
10	Waterlogged Area Man-made	0.01
11	Waterlogged Area Natural	7

The assessment of wastelands and barren areas in PRB shows that the sparse scrub land (land with a low density of scattered shrubs and bushes) occupies most of the area, followed by barren rocky land. Other notable categories include grasslands/grazing lands, natural waterlogged areas, quarry areas, and stony waste. Coastal sandy areas and natural waterlogged zones restrict agriculture in the lower basin, especially in Thrissur. The natural and human-induced activities together represent a permanent reduction in cultivable land and pose challenges for sustainable land and water resource management.

2.4 Area under water bodies

The PRB contains a diverse network of water bodies that comprises a combination of rivers, reservoirs, ponds, and tanks. The Periyar itself stretches about 244km in length, making it the longest river in Kerala. These water bodies form an integral part of the basin's land use and revenue landscape, providing multiple ecological and socio-economic functions. They not only serve as the primary sources of irrigation, drinking water, and hydropower generation, but also sustain inland fisheries, aquaculture, and traditional livelihoods. The distribution of water bodies within the basin is strongly influenced by its physiography, with large reservoirs dominating the highland regions of Idukki, river channels and canals are more prominent in the midlands of Ernakulam, while wetlands and estuarine backwaters characterize the lowlands of Thrissur. To analyze surface water distribution in the PRB, the areas of waterbodies, including reservoirs, rivers, streams, canals, lakes/ponds, and wetlands, were mapped from NRSC LULC 2018 and are presented in Figures 6a and 6b.

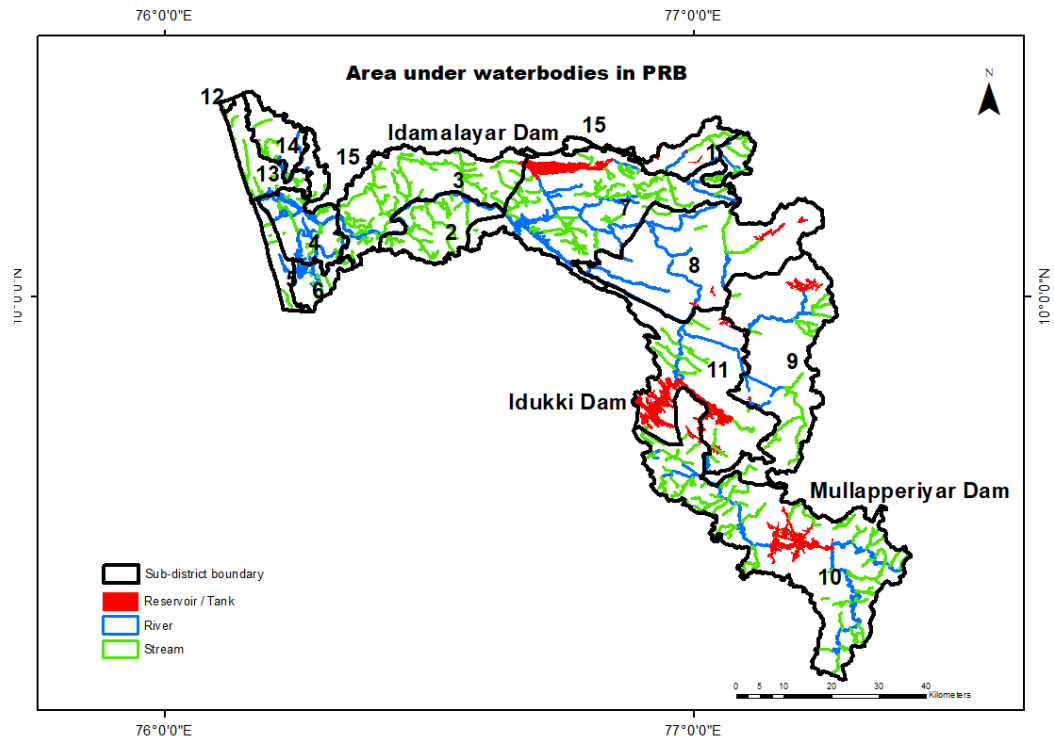


Figure 6a. Area under waterbodies in PRB – Reservoir, River, Streams

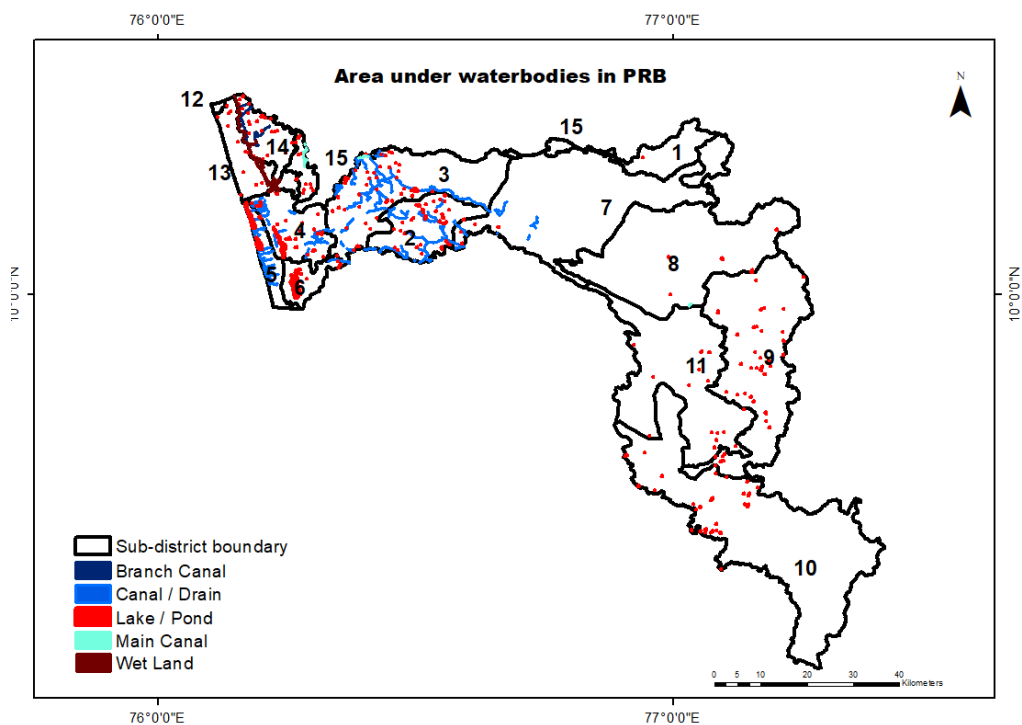


Figure 6b. Area under waterbodies in PRB – Canal, Lake/Pond, Wet land

Perennial water bodies include the main river channel, reservoirs, and major canals that sustain flow throughout the year. The river channels and streams dominate the midland and lowland sub-districts, including Aluva, Kunnathunad, and Paravur, while the reservoirs are

concentrated in the highland sub-districts of Idukki, such as Devikulam, Udumbanchola, and Peerumade, which support large-scale canal irrigation schemes in the midland zones.

The seasonal water bodies ponds, tanks, canals, and wetlands that fill during the monsoon but shrink in the dry season, provide localized irrigation for paddy and plantation crops. The canals are part of the Idamalayar irrigation project, which is one of the major irrigation projects that draw water from the Bhoothathankettu Barrage. This scheme irrigates cultivable lands in the sub-districts of Mukundapuram, Aluva, and Paravur (Government of Kerala 2022). Numerous lakes and ponds are scattered across the highland sub-districts of Idukki (Peerumade, Udumbanchola, Devikulam). In the coastal lowlands of Thrissur (Kodungallur, Chavakkad, Mukundapuram, and Chalakkudy), wetlands and backwater-linked canals are prominent, highlighting the estuarine environment where the Periyar meets the Arabian Sea. These wetlands play an important role in flood moderation, aquaculture, and maintaining brackish-water ecosystems. The spatial distribution of water bodies in PRB is essential for understanding irrigation potential, groundwater linkages, and availability of water for agriculture, domestic supply, and industrial use, enabling better planning for irrigation schemes, groundwater management, and flood mitigation measures. Table 9 presents the areas and types of waterbodies in the PRB.

Table 9. Details of the water bodies in PRB (NRSE LULC 2018)

Sl no.	Type of area	Area(km ²)
1	Branch canal	0.6
2	Canal/Drain	3.45
3	Lake/Pond	12.4
4	Main canal	0.13
5	Wet land	8
6	River	72.65
7	Stream	11

2.5 Area under built-up land

Built-up lands are those areas permanently covered by buildings, roads, railways, industries, and other infrastructure. The built-up land in PRB consists of a mix of villages, towns, industrial areas, and public utilities, reflecting both urban and rural settlement patterns.

Major sub-categories of built-up land relevant to PRB are,

- a) Urban and Rural settlements
- b) Industrial zones
- c) Transportation infrastructure
- d) Institutional and tourism zones

The built-up land areas, specifically settlements, within the PRB are shown in Figure 7a.

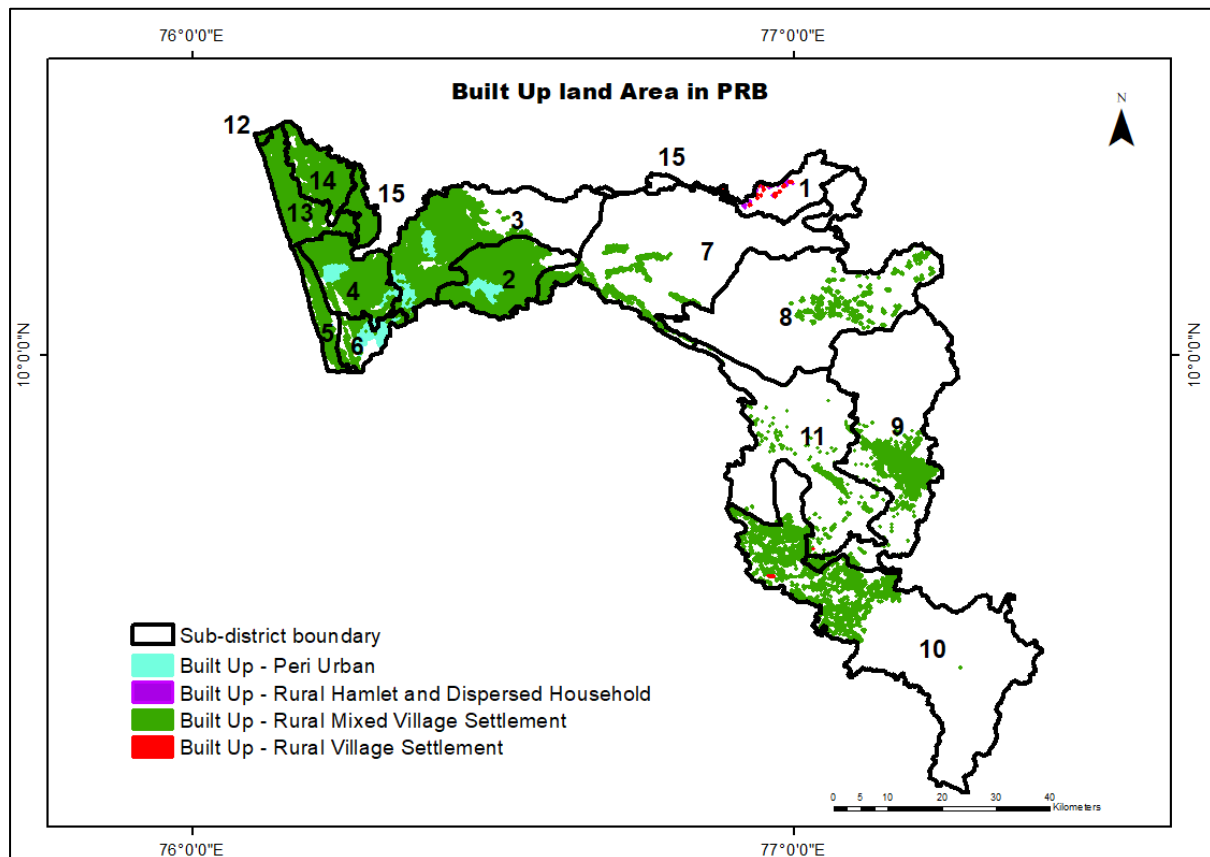


Figure 7a. Built-up land areas in PRB- Settlements

The rural mixed village settlement type dominates in most of the region of the basin. Peri-urban (the increasing development of buildings and infrastructure) built-up areas are concentrated mainly in sub-districts of Ernakulam, which are Kunnathunad, Aluva, Paravur, and Kanayannur. Rural village settlements are limited to extent and are observed in a few areas of the Valparai sub-district. This classification not only provides details on the demographic and economic structure of the basin but also points out the land use pressures caused by urbanization, migration, and agricultural expansion.

Figure 7b clearly shows the major infrastructure and different land use types such as commercial, institutional, and industrial zones.

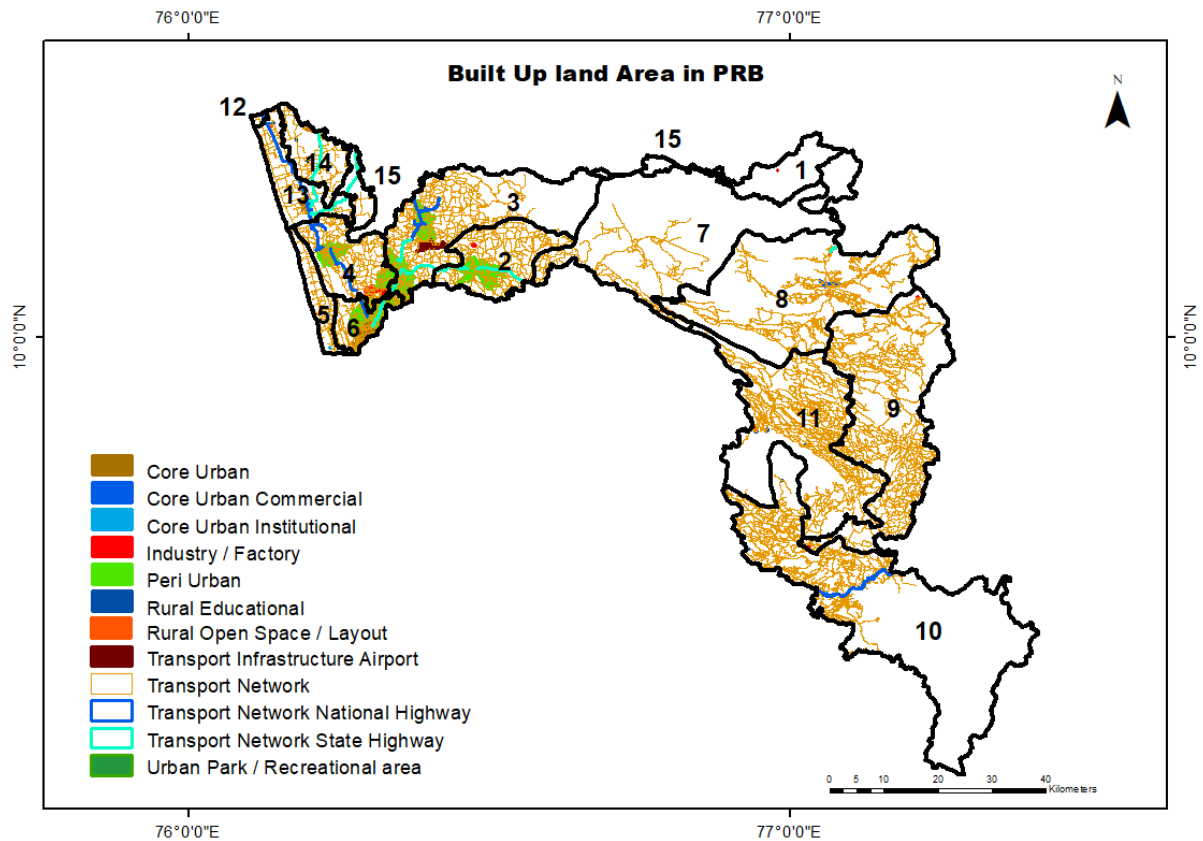


Figure 7b. Built-up land areas in PRB-Major infrastructure and land use types

The core urban area is located in the coastal regions of Ernakulam district, mainly around Kochi and its surroundings. Kochi is one of Kerala's largest metropolitan regions and is important as a port city, commercial hub, and industrial center by which 25% of industries in Kerala are located in the banks of Periyar. The industrial and factory zones are concentrated in the Eloor-Edayar belt, which is Kerala's largest industrial cluster. This zone consists of chemical industries, fertilizer plants, and other manufacturing units that contribute significantly to the state's economy. They are also potential sources of pollution to the Periyar (Government of Kerala, 2022). The rural educational zones represent educational institutions located outside major urban centers. Transport infrastructure also forms a major component of the PRB's built-up area. The transport network represents the extensive network of local roads that connect villages, towns, and cities. A notable feature is the airport infrastructure, which corresponds to Cochin International Airport, one of the busiest airports in India, and a crucial gateway for domestic and international travelers. In conclusion, the classification of built-up land in the PRB highlights the diverse patterns within the basin, like the dense peri-urban development in the western plains and rural settlements in the highlands. This mapping

is important for understanding settlement growth, urban-rural dynamics, and their impact on land use planning and resource management in the basin. The details of built-up land areas within the PRB, based are summarized in Table 10.

Table 10. Details of built-up land area in PRB (NRSE LULC 2018)

Sl no.	Type of area	Area(km ²)
1	Core urban	20.6
2	Core urban commercial	1
3	Core urban institutional	0.2
4	Industry / Factory	4.5
5	Peri urban	99
6	Rural educational	0.7
7	Rural hamlet and dispersed household	0.4
8	Rural mixed village settlement	788
9	Rural open space / Layout	0.4
10	Rural village settlement	0.9
11	Transport infrastructure airport	5.1
12	Transport network	114.3
13	National highway	1.2
14	State highway	0.95
15	Urban Park / Recreational area	0.0004

3 Productions of different crops

The PRB supports a wide range of agricultural activities due to its diverse topography, fertile soils, and favorable climatic conditions. The agriculture sector consists of both food crops and commercially significant plantation and cash crops. While the fertile plains of Ernakulam and Thrissur districts are more suitable for food crops such as paddy, banana, and vegetables, the highland areas of Idukki and adjoining parts of Tamil Nadu (Valparai) are dominated by plantations of tea, cardamom, coffee, and pepper. Rubber, coconut, and arecanut add more economic value of agriculture in the basin.

3.1 Area under the cash crops

The spatial distribution of cash crops in the PRB reflects the influence of topography, rainfall, and soil types on agricultural practices. The spatial extent of cash crops in the PRB, important for agricultural and land use assessment, was mapped using LULC share data from IDRb and is shown in Figure 8.

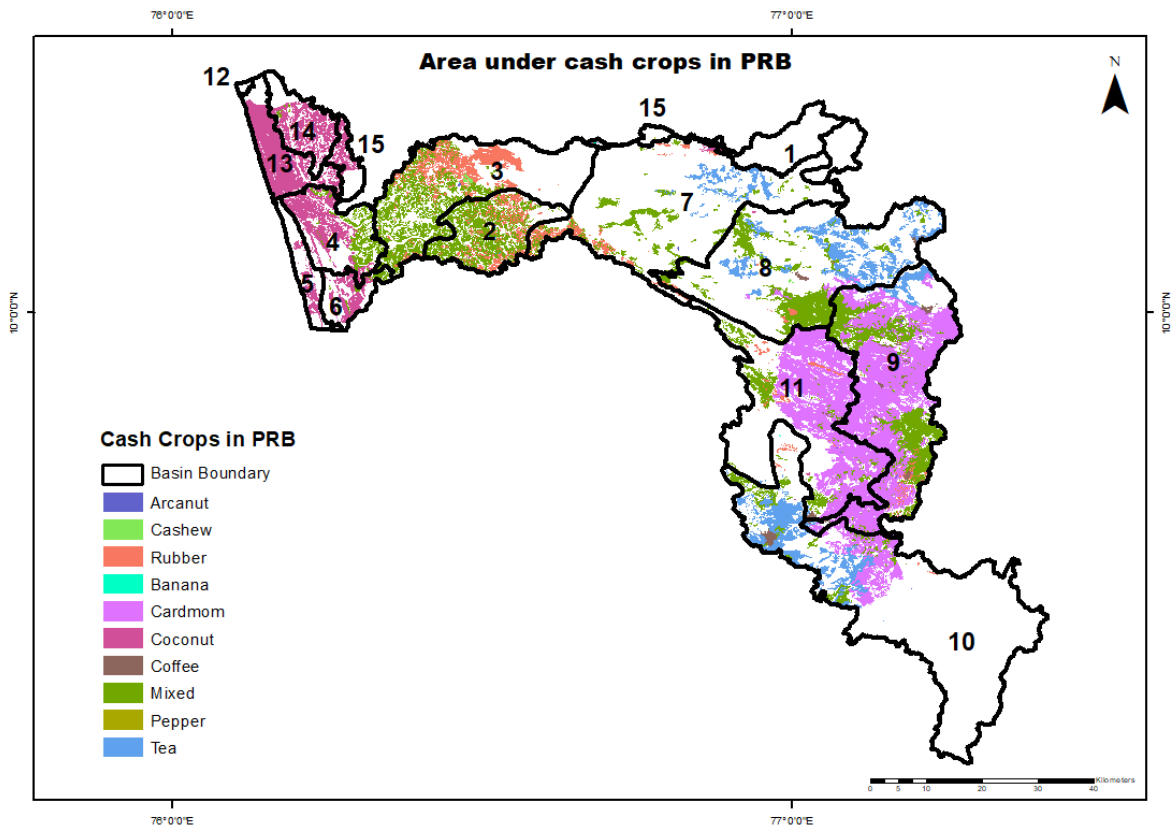


Figure 8. Area under cash crops in PRB

The cardamom occupies the largest area, forming continuous stretches across the hill slopes. Mainly, cardamom plantations are concentrated in the highland sub-districts of Udumbanchola, Devikulam, and Peerumade, which form part of the well-known cardamom hills. Also, the area under the mixed cropping system dominates in the Idukki district, which is the integrated farming where multiple cash crops are cultivated together for increased productivity and income. Usually, they consist of combinations of pepper, coffee, arecanut, and coconut. Coconut cultivation dominates the midland and coastal plains of Ernakulam and Thrissur districts, while tea plantations are clustered mainly in Devikulam (Munnar region), a

globally recognized tea-growing area. The rubber plantations dominate large portions of the western part of the basin. Other crops, such as coffee, arecanut, cashew, and pepper, are grown in smaller pockets but play an important role in supporting smallholder farmers and local markets. Bananas are primarily cultivated as food crops but are also considered a cash crop in local trade. These cash crops have high value in both domestic and export-oriented markets.

Table 11 presents the area and distribution of cash crops in the PRB.

Table 11. Details of the cash-crops area in PRB (IDRB-LULC)

Sl no.	Type of crop	Area(km ²)
1	Rubber	173.6
2	Arecanut	2.9
3	Banana	0.5
4	Cardamom	734.5
5	Cashew	2.5
6	Coconut	304
7	Coffee	17.5
8	Mixed	663.7
9	Pepper	0.8
10	Tea	247.4

3.2 Area under non-cash crops

The non-cash crops of the PRB primarily consist of food crops that are cultivated for local consumption rather than for large-scale commercial trade. These crops support food security, nutritional balance, and livelihood support for the rural population across the basin. The areas of distribution under non-cash crops in the PRB are shown in Figure 9.

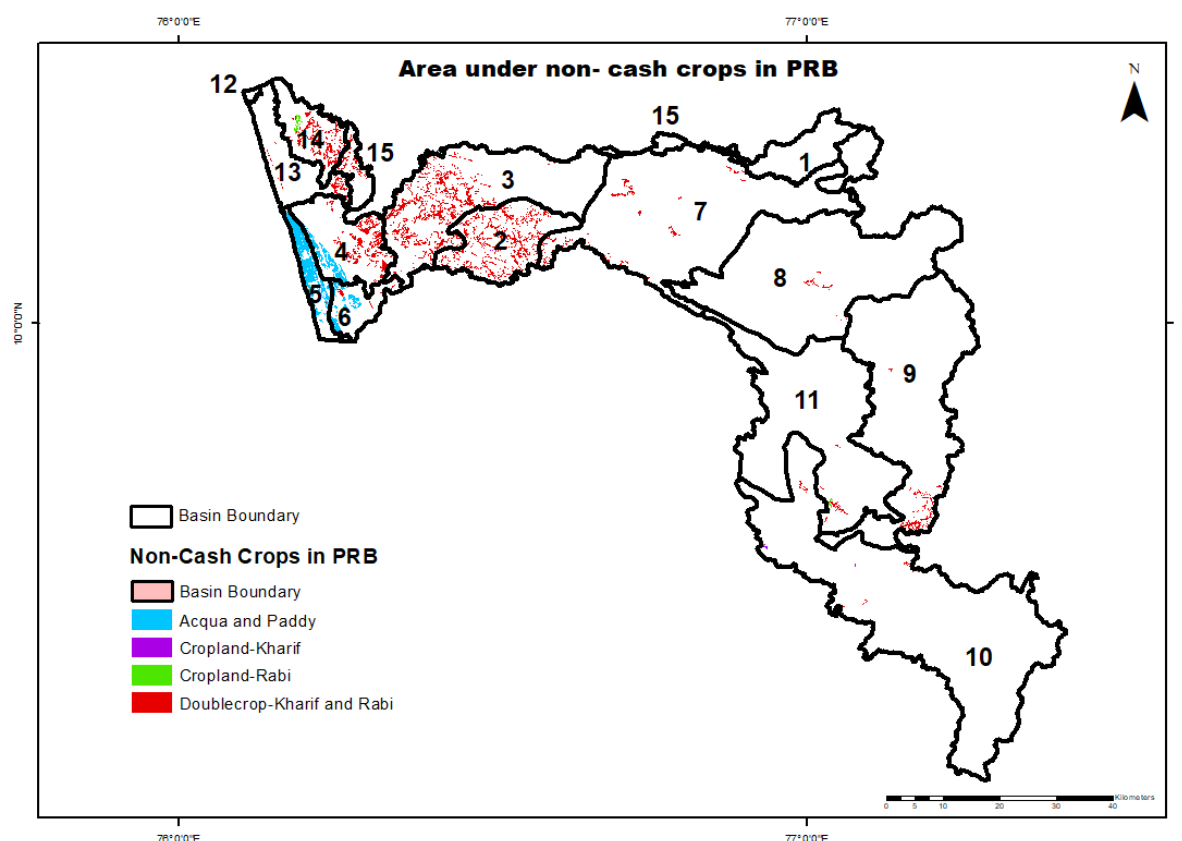


Figure 9. Area under non-cash crops in PRB

The spatial distribution of non-cash crops highlights the dominance of paddy and associated food crops across different sub-regions. Paddy (rice) is the most dominant non-cash crop in the basin. The western part of the basin, in the low-lying parts of Ernakulam and Thrissur districts (Paravur, Kochi, Kanayannur sub-districts), shows extensive areas under aqua–paddy agricultural systems, where traditional rice farming is integrated with aquaculture practices. A large portion of the area in the basin features double-crop areas (Kharif and Rabi: Agricultural practices where two harvests are taken annually to maximize food production). Table 12 represents the area under each type of non-cash crop in PRB.

Table 12. Details of the non-cash crops area in PRB (IDRB-LULC)

Sl no.	Type of crop	Area(km ²)
1	Acqua+Paddy	57
2	Kharif	1
3	Rabi	2.4
4	Kharif+Rabi	151.3

4 People to land ratio

The people-to-land ratio represents the relationship between the total population and the available land area. This ratio acts as an indicator of pressure exerted by human settlement, agriculture, and developmental activities on the limited land resources of the basin. The PRB, spanning across parts of Idukki, Ernakulam, and Thrissur districts, exhibits significant variation in population density due to differences in topography, urbanization, and land use practices. The population density across the PRB is shown in Figure 10.

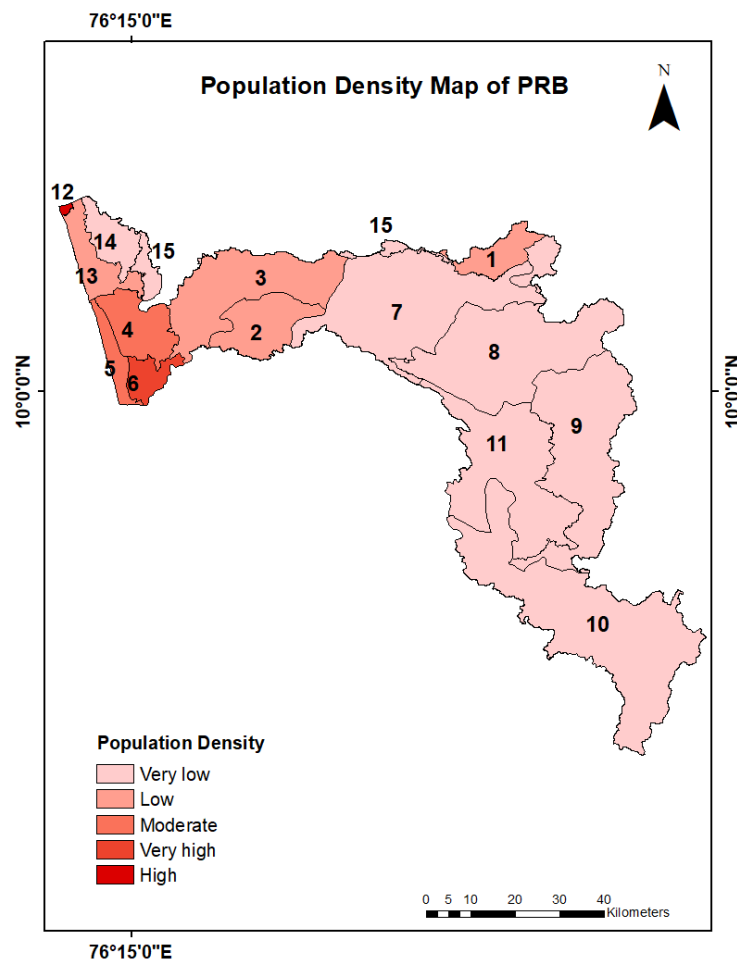


Figure 10. Population density map of PRB

In the highland zones of Idukki, the records show very low population density. According to the 2011 census, Idukki district has a population of 11,08,974. The density of population is 255 per Sq.Km. Agriculture is the main occupation and dairy acts as a supplementary source of income for the farmers in the district. Idukki holds 2nd place in the state in agricultural production (State Planning Board, 2020).

PRB shows higher density in the midland and coastal regions of Ernakulam district, mainly in Aluva, Paravur, Kochi, and Kanayannur sub-districts, where urban expansion and industrial

activities have intensified land pressure. This uneven distribution directly affects landholding patterns within the basin. According to the 2011 census, the total population in the district was 32,79,860. The density of population is 1069 per Sq.Km (State Planning Board, 2020). High population density zones, with scarce cultivable land, experience acute pressure on water and soil resources, while relatively low-density zones retain better ecological balance but face challenges of accessibility and economy.

5 Vulnerable areas in terms of Environmental Degradation

The PRB exhibits several environmentally vulnerable zones, where land use pressures, population density, and resource exploitation have led to degradation of the natural environment.

5.1 Over-exploited areas

These are zones where natural resources are already under high stress, leading to unsustainable conditions. Some major over-exploited areas in PRB are,

- The Idukki sub-districts (Peerumade, Udumbanchola, Devikulam) show large-scale plantation expansion (tea, cardamom, rubber). Generally, in those areas where there is plantation expansion, there are chances for soil erosion, slope instability, and biodiversity loss (Harinarayanan, 2007).
- Quarrying leads to significant land modification, dust pollution, noise pollution, and slope instability (Harinarayanan, 2007).
- Ernakulam district serves as the industrial capital, where industry-related issues are common. Much of the pollution from industrial effluents is associated with surface water bodies (Government of Kerala, 2022).
- The conversion of paddy fields and wetlands leads to soil erosion, waterlogging, water scarcity, mono-cropping, and loss of biodiversity (Harinarayanan, 2007).
- In hilly regions, steep slopes cut for road or building construction increase the risk of landslides and erosion, especially in steeply sloping and rocky areas during intense rainfall (Kerala State Disaster Management Authority, 2015).

5.2 Areas of possibilities

These are zones where natural resources are currently stable, but without proper management, they are likely to face environmental degradation in the future. Some of the key areas of concern in the PRB include,

- Paddy fields and Wetlands in Ernakulam and Thrissur are threatened by urban expansion and real estate development.
- Riverbanks and floodplains of Periyar and its tributaries are vulnerable to unregulated sand mining, industrial effluent discharge, and construction (Government of Kerala, 2022).
- Abandoned quarry sites in Ernakulam and Thrissur are prone to soil instability, water contamination, and waste dumping (Government of Kerala, 2022).

6 Development and sustainable land-use strategies

Sustainable development in the PRB requires a balance between economic growth and environmental conservation. Rapid urbanization and industrial expansion have already exerted pressure on natural resources, making it essential to adopt land-use strategies that minimize ecological degradation. This section explores some of key strategies for achieving sustainable land use and reducing the environmental impacts of development activities in the basin.

- Water resource management: Rainwater harvesting, check dams, watershed development, controlled sand mining, recharge pits in urban Kochi.
- Abandoned quarry sites can be converted to rainwater storage ponds, biodiversity parks, or community spaces.
- Soil conservation: Contour farming, mulching, and organic amendments can be introduced in Idukki slopes to reduce erosion.
- Implement strict wastewater treatment, solid waste segregation, and reuse strategies to prevent contamination of surface and groundwater resources.

7 Challenges in revenue mapping

The revenue mapping in PRB faces several challenges due to the region's complex topography, diverse land-use patterns, and rapid urbanization. Data constraints like encroachment data, digitized land ownership data are a major challenge in revenue mapping. Many land records are outdated, incomplete, or still in the process of digitization. Collecting accurate data on land encroachments is difficult due to the unavailability of records and the undigitized format of existing data, which requires significant time and manpower to process. Addressing data-related challenges is essential for creating accurate mapping for effective land management and planning.

8 Conclusion and recommendations

The revenue map analysis of the PRB indicates the link between land use, population pressure, and ecological sustainability. The study shows that the basin's land is distributed between highlands, midlands, and lowlands, each with unique patterns of cultivation, settlement, and environmental stress. Forests and plantation-based cash crops dominate the highlands of Idukki, while the midlands and coastal plains of Ernakulam and Thrissur support a mix of paddy fields, built-up areas, and industrial zones. The basin is also home to a diverse network of rivers, reservoirs, and wetlands, which serve critical roles in irrigation, groundwater recharge, and ecological balance but face increasing threats from encroachment, pollution, and unregulated land-use changes. Rapid urban expansion, particularly in Kochi and its peri-urban surroundings, has led to the conversion of cultivable land and wetlands, while quarrying and deforestation in the highlands contribute to soil erosion and slope instability. The people-to-land ratio highlights very high population density in Ernakulam and low density in Idukki, creating contrasting patterns of resource pressure and livelihood dependency across the basin.

8.1 Summary of the key findings

The key findings of this report can be summarized as follows: forests and plantations dominate the highland zones, while agriculture and built-up lands are concentrated in the plains. Cash crops such as cardamom, tea, and rubber generate high economic returns but exert considerable ecological stress, whereas non-cash crops like paddy, though shrinking in area, remain vital for food security. Water bodies form the ecological backbone of the basin but are increasingly vulnerable to human activities and land conversion. Built-up areas are expanding rapidly in the western part of the basin. Quarries, steep slopes, and wetlands are identified as over-exploited zones, while marginal paddy fields, abandoned quarry sites, and coastal sandy tracts represent areas of possibility. The demographic analysis highlights uneven population pressures, with dense urbanized belts in Ernakulam contrasting against sparsely populated plantation zones in Idukki, shaping different vulnerabilities and opportunities in land management.

8.2 Recommendations and improvements

Considering the findings, several strategies are recommended to ensure sustainable land use in the PRB. First, digitization and regular updating of revenue maps using GIS software should

be prioritized for accuracy and transparency in tracking land-use changes. Secondly, improvements in the existing condition of the basin which includes wetland and flood plain conservations, revival of paddy cultivation, promotion of organic farming, and rehabilitation of abandoned quarry sites. Third, implementation of improved planning frameworks for urban expansion, especially around Kochi. Together, these measures will ensure that the PRBs' land resources are utilized efficiently, equitably, and sustainably for future generations.

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