

Landuse Pattern of Neyyar River Basin (2015-2016), Kerala, India

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Abstract- In order to understand the landuse pattern of Neyyar river basin, very extensive field investigation was conducted, and the findings were cartographically illustrated with the help of Geographic Information System (GIS), to provide an applicable outlook for a better landuse framing, as landuse has an inevitable role in the mere existence of the river. Geospatial pattern of the present landuse of the study area indicated that the sustainability of this river ecosystem is in danger due to unscientific landuse practices such as deforestation, reclamation of paddy fields, extensive rubber cultivation, sand mining, pollution and agglomerated settlements. The major landuse category observed in this region is settlement with mixed tree crops.

Index Terms- Landuse, GIS, Reclamation, Neyyar.

I. INTRODUCTION

Neyyar is the southern-most river of Kerala State has a total basin area of 483sq.km lies between 8°15' to 8°40'-N latitudes and 77°00' to 77°20'-E longitude. The basin covers 24 grama panchayats in Thiruvananthapuram District. The river's main tributaries are Chittar, Kallar, Karavaliar, Mullar, Aruvikod thodu, Maruthur thodu, Edamalai thodu and Talakke thodu. This southern most small river originates from Agasthya malai in the Western Ghat mountain ranges and flows through extremely mottled geologic and physiographic provinces of the area for a length of about 56km.

As far as the landuse pattern and change of Neyyar river basin is concerned, the cultural, socio-economic and population density in the basin has a decisive influence in framing the landuse. The existence of aquatic ecosystem and prosperity in biodiversity is clearly under the impacts that have shaped by landuse (Turner *et al.*, 2001). It is therefore inevitable to describe the landuse regularly, which helps in better conservation and management of natural resources. The foremost hinder for implementing such strategies is the lack of regular monitoring in the study area. In this context, the present study aims to investigate the landuse pattern of Neyyar river basin in meticulous.

II. METHODOLOGY

The landuse pattern of Neyyar basin is prepared using Survey of India Topographic Sheets (Nos.58 H/2 and 58 H/3) of 1:50,000 scale surveyed during 1966-68 (Brigadier Paintal, 1969), Google satellite images and with the help of extensive field visits during the period May 2015 to April 2016 to understand the landuse pattern of the basin in general and that of the six sites such as Neyyar Dam, Kallikadu,

Mandapathinkadavu, Aruvipuram, Neyyattinkara and Poovar in particular. The sites are fixed representatively covering three physiographic components such as high land, mid land and low land. The current landuse pattern is input in the GIS software version Arc GIS 10.1 and a map is prepared. There are fourteen categories of landuse are designed in the map (Fig-1). The stream order map of Neyyar River basin was also prepared by using GIS (Fig-2). The latitude and longitude obtained by using Global Positioning System receiver was input in GIS for locating sites in the prepared map.

III. RESULTS AND DISCUSSION

The landuse categories in Neyyar river basin mainly constitute forest area, mixed crop, settlement with mixed tree crops, built-up area and reclaimed area. The forest area includes dense forest, fairly dense forest, open forest, grassland, land with or without scrub and forest plantations such as eucalyptus, teak etc. The major landuse change observed in the forest area is deforestation and the cultivation of plantations. In Neyyar river basin the forest area is disperses in the highland physiographic region. The region well known for its biodiversity is under the verge of degradation. Forest fire and deforestation are the main threat for the biodiversity. Landslides and widening of river valleys due to physical weathering during the heavy rainy season are also common in the forest area.

Mixed crop category includes all type of agricultural crops and other tree crops. In the mixed tree crops category, the settlement or built up area will be minimal. Mixed crops are mainly concentrated at the midland physiographic area of the Neyyar basin which is dispersed mainly at the moderate relief area. In settlement with mixed tree crops category, settlements are found intercalated with the mixed crops including tree crops. In Neyyar basin majority of the area comes under this category.

Built-up are non-agricultural usage areas with buildings, transport network, communication utilities and other engineering structures. The mere ignorance of the people to consider the construction of huge buildings, transport network, communication utilities and other engineering structures, without considering sustainable ecosystem, as the symbol of development is the main ill-effect in the landuse change of our small and sensitive state. As the paddy fields and wetlands were low cost and easily available, people used to purchase and reclaim it for constructions thereby converting them into built-up areas. In Neyyar river basin majority of built-up areas are dispersed mainly at the lowland area.

The other landuse change is the extensive reclamation of paddy fields and wetlands for agricultural crops, plantation crops and other tree crops. These areas are called reclaimed area.

The dramatic change of agricultural practices during the last 50 years is one of the main driving forces for environmental degradation (George Zalidis *et al.*, 2002). In Neyyar river basin majority of paddy fields and wetlands are reclaimed. In low land physiographic area, the paddy fields are totally reclaimed. In the highland areas also most of the paddy fields are reclaimed with plantation and other agricultural crops mainly by rubber.

In Neyyar reservoir (Plate-1a&b), physiographically highland area mainly constitutes forest area, plantations including rubber, mixed crop and settlement with mixed crops. Extensive forest area can be seen at the upstream of the Neyyar basin and around the Neyyar reservoir as well. The forest area includes the dense forest, fairly dense forest, open forest, reserve forest, shrub forest, forest plantations etc. Deforestation and plantation of tree crops like eucalyptus and rubber is more common in this area. The widening of drainages is more evident in these areas due the erosion caused by huge amount of water flowing through drainage in rainy season. This storm water drainage within the forest area may cause not the destruction of forest only but also may trigger the landslides. Reclaimed paddy fields are occupied mainly by rubber. Bathing at the side of Neyyar dam and disposal of waste water including latrine waste directly into dam are noticed during our field visit, which is quite shocking and should be restricted.

The population density in the highland is less compared to midland and low land areas. Due to the fairly low population density, the struggle for existence of life is less. The paddy fields and wetlands are almost reclaimed with banana, tapioca, rubber and other mixed crops. The wetland land areas near to the roads are all reclaimed. The paddy fields are sparse. Extensive rubber plantation on reclaimed wetlands is so alarming because of the peculiarity of rubber to absorb abundant water. The agglomerated settlement area on the reclaimed wetlands is less in this area.

Due to the extensive reclamation in this area almost all the first order streams and few second order streams in the highland area below the Neyyar dam are reclaimed (Fig-2). Destruction of the basin through reclamation at the source itself is so distressing. This will adversely affect the biodiversity, sustainable ecosystem, and surface and groundwater resources of the entire basin as well. As paddy fields are well known as pollution sinks and media for filtering the ground and surface water, reclamation of them will have an adverse impact on the ecosystem. But due to the less population density, the fresh surface and groundwater in the highland is less polluted compared to midland and lowland. According to Bolstad and Swank, 1997; Liu *et al.*, 2000 and Tong and Chen, 2002, the landuse of high land especially forest area category is associated with minimal pollution threats.

Kallikadu (Plate-2a&b) is located at the highland region with extensive rubber plantation. The reclaimed area in this region is mainly occupied by rubber plantation. Rubber extract lot of water from this reclaimed paddy area is the main reason for water shortage in the highland. This also contributes to enhance the pollution of water in the area. Prior to the reclamation the wetlands and paddy fields of highland and midland contribute as a fresh water resource to the low land. Water in this region is almost stagnant due to the extensive sand mining activities. As the site is located at fairly low population density area, the

chance of heavy contamination is less. Due to the extensive reclamation of paddy field, built-up area generation and conversion to other tree crops in the highland will widely damage the drainage system and sustainable ecosystem of the drainage basin. Highland as the more sensitive area, well known for its biodiversity, good, abundant surface and groundwater, any activity that destructs the area will not only affect its ecosystem, but also damage the sustainable ecosystem of the midland and low land as well.

Mandapathinkadavu (Plate-3a&b) is located in transition area of highland and midland. Here reclamation of paddy fields is mainly concentrated in valley heads and near to the roads. The presence of paddy fields is more in the midlands compared to highland or low land. Banana and tapioca are the major crops in the reclaimed land. Drainage carrying waste water from the settlement of a micro watershed is directly debouching into the river site (Plate-3b). Construction of bunds at the site regulates river water flow. The major landuse categories at Mandapathinkadavu and surroundings are mixed crops including the tree crops, settlement with mixed tree crops, Banana, Tapioca, Rubber etc.

Deforestation and extensive cultivation of rubber plantation is observed at Aruvipuram area. The paddy reclamation is so intense and is mainly occupied by rubber. They are also occupied by crops such as banana, tapioca and the disperse presents of settlements (Plate-4a&b). The first and second order streams are being abandoned due to the crazy reclamation (Fig-2). The unscientific and extensive construction of bunds across the river is very common. All these factors will arrest the natural flow and self purification capacity of the river. Due to reclamation of wetlands, the extensive lateritic hillocks which are the major water holding formations are being derelicted in this region.

The province at Neyyattinkara, located at the lowland area is a municipal region. Due to the presence of the agglomerated settlement and industrial effluence, the site is highly polluted (Plate-5a&b). The constructions of bunds across the river in this region arrest the self purification capacity of the river and thereby enhance its pollution. It is not advisable to build the bunds across the river at the low land where the stream flow will be minimal compared to highland and midland. Consequent to such arrest in the water flow, concentration of pollutants in surface and groundwater may take place. The major landuse category in this region is settlement with mixed tree crops. Paddy and wetland reclamations are most common in this region. The reclaimed area is mainly occupied by banana, tapioca and mixed crops. The residential and other build up areas on reclaimed paddy fields and wetlands are very intense compared to that of Aruvipuram.

Due to the increase in the population density majority of newly constructed roads are laid on the reclaimed area. Most of the houses have water pumps which may reduce the ground water level to a great extent. Sand and clay mining were also intense in 1990's. First, second and even the portions of the third order streams are being reclaimed (Fig-2). Due to these factors, flash floods on the bank of the river are most often during the heavy rainfall. The widening of the river channel and physical weathering of the banks including the vegetation and settlements is another threat in the area. The reclaimed area near the main

course of the river has become water logged, marshy land especially in the area from Thirupuram to Poovar. Poovar is located near the Coast of Lakshadweep Sea where the river water is stagnant. The water is highly polluted (Plate-6a&b). All the pollutants from the upstream are concentrated in this region. The major landuse around this area is coconut plantation with mixed tree crops.

Most of the drainages in this region are converted into waste water drainage. As the groundwater and surface water are being interrelated, the chance of polluting underground water in this region is very huge. Due to complete reclamation of paddy fields and extensive sand mining most of the low land areas are being converted into areas logged with waste water. This may enhance water borne diseases. The emission of methane, carbon dioxide and hydrogen sulphide from this waste water may also cause the rise in the atmospheric temperature. All these factors trigger the extensive spread of disease in the low land compared to the midland and highland areas.

IV. CONCLUSION

In general, during our filed visits we can feel that Neyyar river basin is in the verge of total destruction due to all the above mentioned factors. The existence of a sustainable ecosystem is in danger. The surface as well as the groundwater pollution is more intense in the low land compared to the midland and high land. This reflects in the water quality as well. Human intervention enhances the pollution of Neyyar river and it will be very much high in the region at Neyyattinkara and Poovar. As paddy fields can act as water holding and water purifying region, the extensive reclamation of them will enhance the pollution of the river basin. Most of the first and second order streams especially in mid and lowland almost abandoned, point towards the intensity of damage of the basin as well as landuse scenario. All the above mentioned factors are the main reason for the flash floods at the low land region.

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REFERENCES

- [1] Bolstad, P. V. and Swank, W. T. (1997). Cumulative impacts of land use on water quality in a southern Appalachian watershed. *J. Am. Water Res. Assoc.*, 33 (3): 519-534.
- [2] Brigadier Paintal, J. S. (1969). Topographic Sheets (Kerala and Tamil Nadu). Published under the direction of Surveyor General of India. Printed at the 104 (HBD) printing group of Survey of India, Sheet No. H/2 and H/3 (First Edition).
- [3] George Zalidis., Stamatis Stamatidis., Vasilios Takavakoglou., Kent Eskridge and Nikolaos Misopolinos. (2002). Impacts of agricultural practices on soil and water quality in the Mediterranean region and proposed assessment methodology. *Elsevier-Agriculture, Ecosystems and Environment*, 88: 137-146.
- [4] Liu, A. J., Tong, S. T. Y. and Goodrich, J. A. (2000). Land use as a mitigation strategy for the water-quality impacts of global warming: a scenario analysis on two watersheds in the Ohio River Basin. *Environ. Eng. Policy*, 2: 65-76.
- [5] Tong, S. T. Y. and Chen, W. (2002). Modeling the relationship between land use and surface water quality. *J. Environ. Manage*, 66 (4): 377-393.
- [6] Turner, M. G., Gardner, R. H. and O'Neill, R. V. (2001). Landscape Ecology in Theory and Practice Pattern and Process. *Springer-Verlag*, New York, pp. 401.

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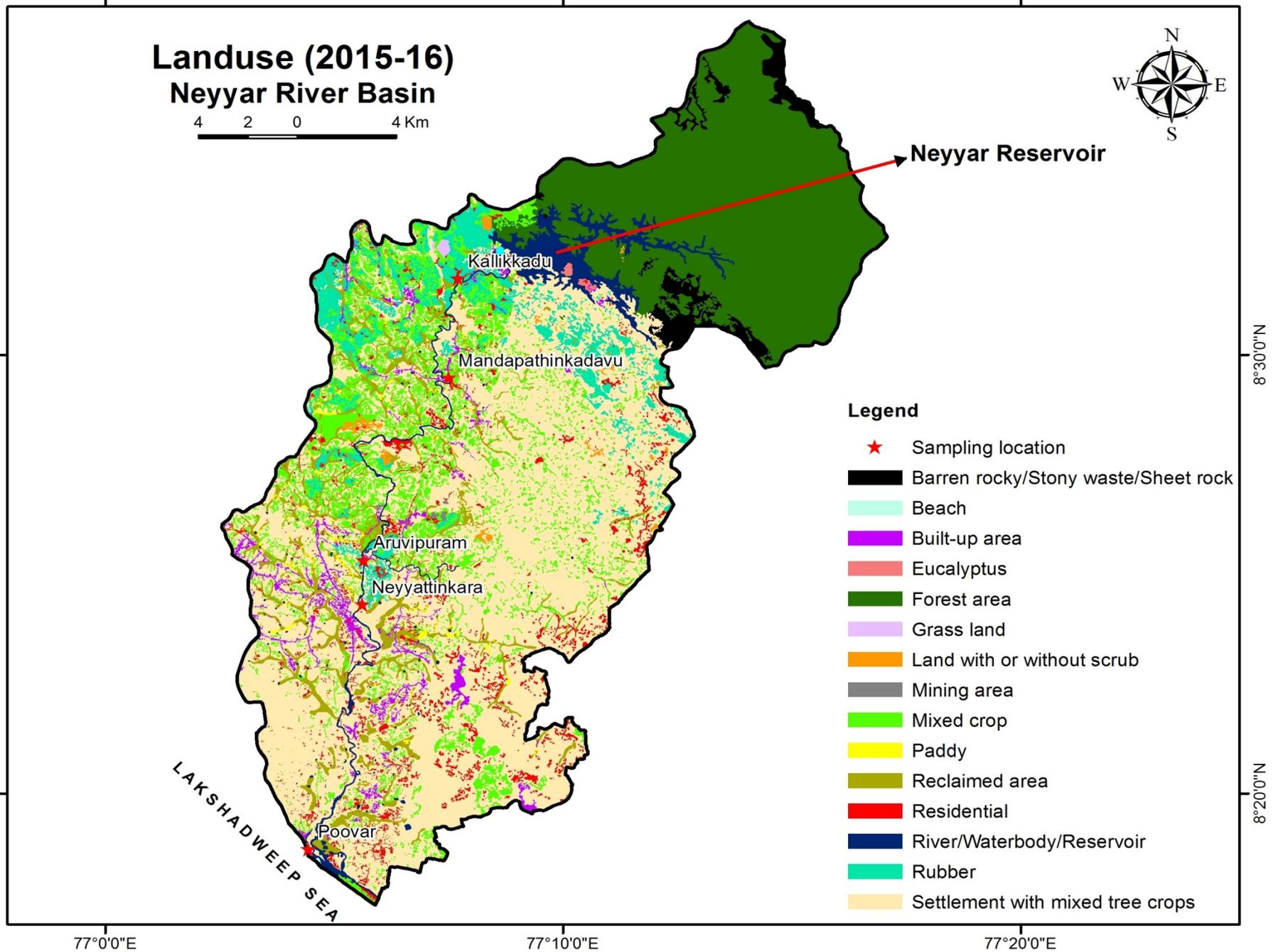


Fig 1: Landuse pattern of Neyyar River basin (2015-2016)

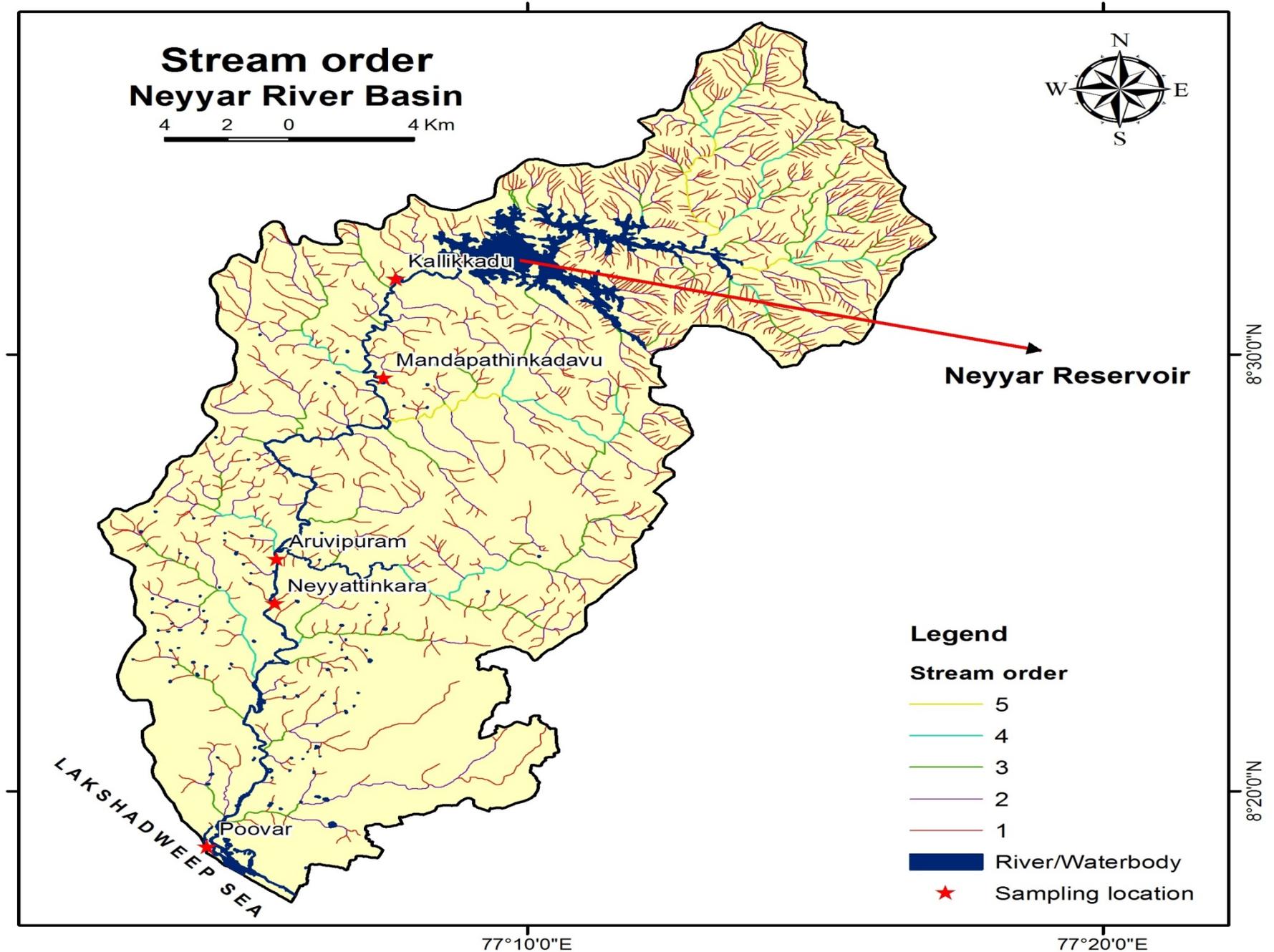


Fig 2: Stream order of Neyyar River basin



Plate 1 (a) Neyyar Reservoir



Plate 2 (b): Kallikadu



Plate 1 (b): Neyyar Reservoir



Plate 3 (a): Mandapathinkadavu



Plate 2 (a): Kallikadu



Plate 3 (b): Mandapathinkadavu



Plate 4 (a): Aruvipuram



Plate 5 (b): Neyyattinkara



Plate 4 (b): Aruvipuram



Plate 6 (a): Poovar



Plate 5 (a): Neyyattinkara



Plate 6 (b): Poovar