SCIENTIA

Peer Reviewed National Science Journal

Volume 15. No.1 ◆ Jan-Dec.2019 ◆ ISSN: 0976-8289

Published by

MERCY COLLEGE

PALAKKAD 678006, KERALA, INDIA

Scientia ISSN: 0976-8289
Vol. 15, No.1, Jan.-Dec., 2019, pp.117-122

Land use pattern and biodiversity value of Siruvani Watershed Area, Western Ghats

Suganthasakthivel, R., Sreekumar, V. B.* and Sreejith, K. A.
Forest Ecology and Biodiversity Conservation Division
Kerala Forest Research Institute, Peechi, Thrissur, Kerala – 680 653, India

Abstract

The landscape in the Siruvani watershed experienced large scale human disturbance in the past through various activities including dam construction and selection felling. A large-scale degradation of natural forests resulted in disruption in the rainfall patterns and subsequent changes in landscape. This paper deals with the present land use pattern and significance of biodiversity of Siruvani watershed area. The decline in forest cover and disruption of rainfall had affected the hydrological regimes in different landscape units. The land use cover changes had resulted in the deforestation in the Attapady valley where the Siruvani watershed is located. Through remote sensing satellite image analyses, this paper finds out the present land cover information and by collating the floral and faunal resources existing in the remnant forest patches, highlights the significance of biodiversity of this study area and its conservation.

Keywords: Siruvani watershed, Bhavani River Basin, Muthikkulam, biodiversity

Introduction

The Siruvani watershed is situated on the Bhavani river basin falling in the Attapady Block of Palakkad district in Kerala State. The watershed is located between 10° 56'and 11° 9' N latitudes and 76° 34' and 76° 44' E longitudes. The River Siruvani, originating from the high, rain drenched and heavily forested Muthikkulam High Value Biodiversity Area, descends rapidly and flows across Attappady and joins the River Bhavani. The total geographical area of Siruvani watershed is around 215 km^2. Muthikulam is a part of Attappady Reserve and was under private ownership and subjected to intensive cultivation in the past[1]. These areas were reserved by the British in the early 1900s. The following description, as given in the notification of 1901 and cited by Ayyar[2] gives an idea of the destruction of these forests.

"Unscientific forestry, the ravages of timber thief, the destructive *Ponam* (shifting) cultivation fatal to tree growth, the average *Jenmis*' (landlord) anxiety to turn his trees into money with the least possible delay, the *Moppila* (Muslim trader) in the guise of honest merchant removing on payment of *Kuttikanam* (stump fee) three times as many trees as he has paid for – all these contributed to the slow but steady denudation of the forests in the accessible areas, and these gradually became almost destitute of good timber". Dietrich Brandis in Madras Government Records[3] stressed the need to protect the evergreen forests which formed the water resources of the Bhavani and its tributaries.

Forests affect the hydrology of watersheds in various and complex ways. Increasing evapo-transpiration, increasing soil infiltration, intercepting cloud moisture, reducing the nutrient load of runoff are some of the services available through the forests to the watershed. Destruction to the natural forest may result in drastic environmental changes including change in hydrological regime. The relationship between the forest degradation and disruption of the rainfall regimes is a proven hypothesis[4].

* *Corresponding author, E-mail: sreekumar@kfri.res.in*

It leads to increased runoff, desertification, loss of specialized microclimates etc. The loss of biodiversity with the removal of keystone species, the change of land-use pattern such as conversion of forest land for agriculture practices, grazing, and invasion by alien plant species may all have profound effects on the functioning of watersheds. A sustainable co-existence of land, water and vegetation is a prerequisite for environmental security and livelihood dependence for local community. As a part of preparation of the management plan for the Muthikkulam High Value Biodiversity Area, we anlaysed the pattern of current land-use system and the existing flora and fauna of Siruvani watershed. The existing land-use information of the available forest area and its potential in supporting a wide range of plant and animal resources of this watershed are largely unknown. Despite the services of this watershed in supporting the irrigation and drinking water needs of the population that spreads across two states of Kerala and Tamil Nadu, a comprehensive understanding on its present landuse and biodiversity status is also not available. In this context, this paper attempts to provide insight to the current land use pattern and biodiversity value of Siruvani water shed.

Materials and Methods

The Siruvani watershed boundary was delineated using the Survey of India toposheets at the scale of 1:25,000. The topo-sheets used are 58 A 12 and 58 B9, four sub-sheets each. The toposheets were geo-rectified with the software ArcGIS and vector mask of the watershed was prepared. The general land-use/land-cover information on the maps was used as the reference with the satellite images at the preliminary stage. Then the area was visited and different land uses were recorded with the handheld Global Positioning System (Garmin Map 60 CSX). The field verification was carried out by repeated field visits and the landuse of the area was classified into five thematic classes on the basis of a comparison with the older landuse maps. The categories in the thematic classes are forested patches, scrubs, plantation/ agriculture areas, barren land and water bodies.

The Landsat 7 Enhanced Thematic Mapper along with satellite images of the March 2001 of the Nilgiris region was used and made a subset of the Siruvani Watershed in Erdas Imagine software. The bands 4, 3 and 2 was used to discriminate the forest related landuse categories in the study region and performed a supervised classification with the maximum likelihood algorithm to develop thematic classes of the landscape and estimated the classification accuracy with the transformed divergence index for seperability implemented in the software Erdas Imagine software.

Results and Discussion

The understanding the present landuse pattern and biodiversity significance of Siruvani watershed is

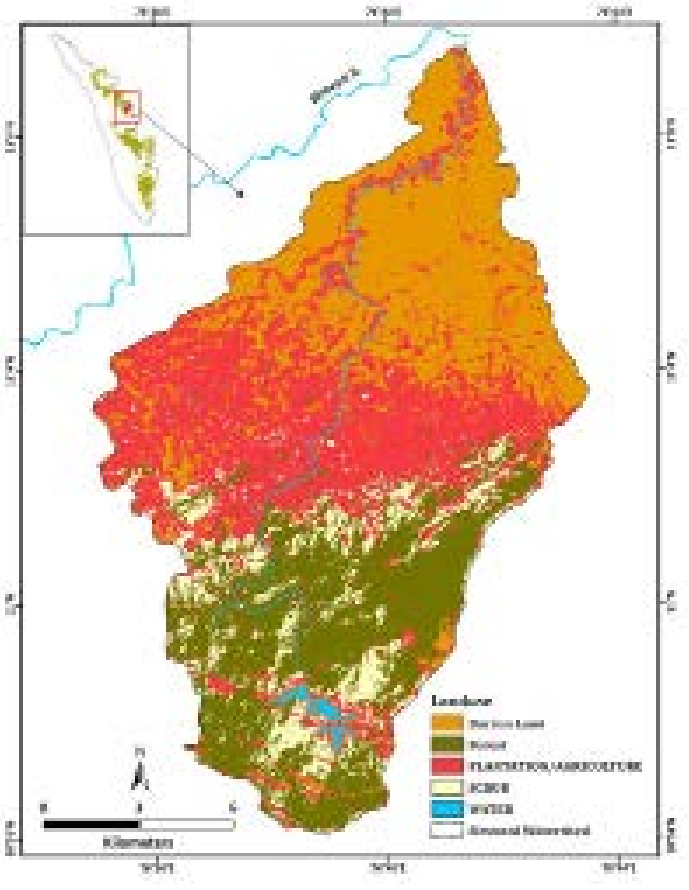

Fig. 1. Landuse Map of Siruvani Watershed, Kerala

important considering of its water scarcity, drastic climate variation, high runoff potential, slide susceptibility and land degradation. According to Sankar and Muraleedharan[5], this area has experienced high rate of deforestation, since the second quarter of the century, with large areas of mature forests being converted to agricultural lands, waste lands and pastures. Unscientific management practices, large-scale human interventions produced barren lands leading to large scale soil erosion in this area[6]. In the present study, the maximum likelihood classification accuracy is significant than expected, which is demonstrated in the Erdas Imagine as the separability index of the average and minimum transformed divergent indices are 1929 and 1358 respectively. The land uses of the Siruvani watershed are predominantly of plantation/agriculture followed by barren lands (Table 1) in the northern half of the watershed (Fig. 1). The intact forests are found in the southern half which forms the 'Muthikulam High Value Biodiversity Area' with an area of 52.5651 km^2. This forests acts as a critical component of Siruvani watershed and also forms the connectivity between forests of north of the Palakkad gap and Silent Valley forests which is the lifeline of Siruvani shed.

However, the major change on the pattern of land use, its fragmentation due to selection felling, encroachments, fire and forest degradation and various human disturbances seriously affected the continuous connectivity between Attappady Block VI and Silent Valley forests. Phyto-geographically the vegetation structure of this area shows more affinities to that of tropical Asia and Sri Lanka, thereby suggesting the existence of land connections in the past. The comparison of floristic diversity of Silent Valley, Muthikulam and Nelliampathy forests indicates[7] that the flora of these areas is of a higher Simpson's index of above 0.87. The main species associations in the study area is *Myristica-Mesua-Aglaia* and these three species constitutes 50% of the tree species community. Moreover, this forests hosts 77 species of micro and macro lichens,[8,9] 83 species of pteriodophytes and 488 species of flowering plants. Recently, new species of *Ophiorrhiza* (Rubiaceae)[10] and *Chlorophytum* (Asparagaceae)[11] and rediscovery of rare plants like *Gnidia glauca* var. *sisparensis* (Thymelaeaceae)[12] suggests the floral significance of this area. Similarly, this area is home to diverse wild aromatic and medicinal plants and the Muduga tribe of this area has a rich ethnic knowledge[13] of these plants. NTFP collection, including the medicinal plants is their main source of income. Gajathippali (*Balanophora fungosa* J. R. & G. Forst. ssp. *indica* (Arn.) Hansen), Thelli (*Canarium strictum* Roxb.), Manjakoova (*Curcuma zanthorrhiza* Roxb.) Cheenikka (*Acacia sinuata* (Lour.) Merr.), Maravettikkuru (*Hydnocarpus alpina* Wight) Oken,), Urunjikai (*Sapindus emarginatus* Vahl), Kallurvanchi (*Rotula aquatica* Lour.), Analivenga (*Pittosporum neelgherrense* Wight & Arn.) and Kattupavakka (*Momordica dioica* Roxb. ex Willd.) are collected from the forests. The other important medicinal plant resources are *Coscinium fenestratum* (Gaertn.) Colebr., *Dicliptera cuneata* Nees, *Gymnostachyum febrifugum* Benth. var. *bracteatum* V.S. Ramach., *Justicia procumbens* L., *Rungia parviflora* (Retz.) Nees, *Dioscorea pentaphylla* L., *Dioscorea oppositifolia* L., *Elettaria cardamomum* (L.) Maton, *Amomum pterocarpum* Thw., *Curcuma neilgherrensis* Wight, *Artocarpus hirsutus* Lam., *Phyllanthus amarus* Schum. & Thonn., *Cinnamomum sulphuratum* Nees, *Piper hymenophyllum* Miq., *Piper trioicum* Roxb., *Piper nigrum* L. var *nigrum* Hook. f., *Piper galeatum* Cas., *Myristica malabarica* Lam., *Bacopa monnieri* (L.) Pennell, *Sida cordifolia* L., *Sida acuta* Burm. f. and *Naravelia zeylanica* (L.) DC.

The study area is also rich with high faunal diversity which includes rare species such as Nilgiri Tahr and Lion-tailed macaque. The presence of extensive patches of almost undisturbed medium elevation evergreen forests (*Cullenia-Mesua-Palaquium* type)[14, 15] provides an ideal habitat for the Lion-tailed macaque. Similarly the mountain goat endemic to the Nilgiri Hills and the southern portion of the Western Ghats, the Nilgiri Tahr (*Nilgiritragus hylocrius*) is also found from higher reaches of Elivalmala with around 60 individuals. Populations of these animals are

small and isolated, making them vulnerable to local extinction. The studies on bird diversity of Siruvani and Muthikulam hills and reported a total 158 species of which 14 species are endemic to the Western Ghats[16]. The discovery of Nilgiri Laughingthrush (*Garrulax cachinnans*) an endangered species, with 200–250 individuals in these hills is significant in establishing the importance bird communities of these habitats. The Western Ghats endemic and Vulnerable Nilgiri marten (*Martes gwatkinsii*)[17] is sighted from South Reserve forests of Muthikkulam along with Attapady Reserve forests and Silent Valley National park[18]. The studies on butterflies diversity in Muthikulam, Mukkali and Chindakki areas reported around 84 species of butterflies with the maximum diversity was found in Muthikulam Reserve Forest (3.48) followed by Mukkali (3.41) and Chindakki areas (3.13)[19]. The surveys conducted in 1998[20] and 2007[21] recorded 52 reptile species with 17 Western Ghats endemic species from Muthikkulam hills. This includes one species of fresh water turtle, 21 species of lizards, and 30 species of snakes. Lion-tailed macaque (*Macaca silenus*) is a flagship species of Western Ghats classified as Schedule-I (highly protected) species in the W (P) A, 1972 and declared as an endangered species by IUCN[22]. The distribution of this species is restricted to the tropical evergreen forests of Kerala, Karnataka and Tamil Nadu. The population in the Muthikulam HVBA is reported to be severely fragmented[23] and isolated due to conversion of medium elevation evergreen forests into reservoirs and forestry and commercial plantations. The presence of extensive patches of almost undisturbed medium elevation evergreen forests (*Cullenia-Mesua-Palaquium* type) provides an ideal habitat for the species, since they mostly feed on fruits and young leaves of *Cullenia exarillata*[24]. Other common higher animals include, Bonnet macaque, Nilgiri langur, Elephant, Gaur, Sambar deer, Spotted deer, Barking deer, Mouse deer, Wild pig, Malabar giant squirrel, Ruddy mongoose, Indian civet, Sloth bear, Jungle cat and Wild dog etc.

Various anthropogenic disturbances in the past caused fragmentation of landscape and further reduction and isolation of primary forests and population of many species. The populations of endangered and endemic species like *Vateria macrocarpa, Dipterocarpus bourdilonii* and *Dysoxylum malabaricum* become isolated to small patches confined to limited localities. In addition to the alteration of habitats by dam construction, selection felling and other human interventions caused serious damage to the ecosystem by removing species key to the function of ecosystem. Still, the natural patches in Karimala, Vellingirimala and Elival mala provide more or less continuous forest cover with different types of forests including dense primary evergreen forests with *Cullenia exarillata – Mesua ferrea – Palaqium ellipticum* type vegetation which is relatively undisturbed and require high conservation value as a unique biodiversity repository in Western Ghats. There are six eucalypts plantations raised between 1962 and 1987 within Muthikulam HVBA, covering an area of 92.5 ha in grasslands. These plantations are under stocked and belong to the failed category which can be either restored by indigenous species or the natural grassland conditions can be maintained as such. Similarly the invasive weeds like Mikania *micrantha*, Lantana *camara*, *Mimosa diplotricha* var. diplotricha and Chromolaena *odorata* , which are a major threat to the native flora which should be removed by uprooting during monsoon in phased manner but continuously for three years, then alternate year, wherever needed.

Table 1. Land-use of Siruvani Watershed

Sl. No	Land use type	Area (km^2)	Per centage
1	Forest	52.5651	24.42
2	Scrub jungle	19.5684	9.09
3	Plantation/Agriculture	71.6265	33.28
4	Barren land	61.3683	28.51
5	Water	10.0891	4.69
	Total	215.2174	100

Acknowledgements

We thank Director, Kerala Forest Research Institute, Peechi for support and encouragement and officials of Kerala Forest Department for their support during field work.

References

1. Madras District Gazette, 1915. Vol. I. Madras: Govt. Press.
2. Ayyar, T.V.V., 1935. *A working plan for Ghat Forests of the Palghat Division*. 1933-34 to 1942-43. Government press. Madras. 203p.
3. Madras Government Records. 1882. Government Order No. 470. Revenue dated 6th May 1882.
4. Meher-Homji, V.N. 1991. Probable impact of deforestation on hydrological processes. Climate Change. 16, 163-173.
5. Sankar, S., Muraleedharan, P. K., 1990. Human ecology in Attappady reserve. In: *Tropical forest ecosystem conservation and development in South and South-east Asia*. K. K. N. Nair, K. V. Bhat, J. K.Sharma and K. Swarupanandan (Eds). Kerala Forest Research Institute, Peechi, pp 127 – 131.
6. Prasannakumar, V., Shiny, R., Geetha, N., Vijith. H., 2011. Spatial prediction of soil erosion risk by remote sensing, GIS and RUSLE approach: a case study of Siruvani river watershed in Attapady valley, Kerala, India. *Environ. Earth Sci*. 64, 965–972.
7. Basha, C., 1987. *Studies on the ecology of evergreen forests of Kerala with special references to Silent Valley and Attappady*. PhD Thesis. University of Kerala.
8. Kumar, M., 2000. *Lichen (Macrolichen) flora of Kerala part of Western Ghats*. KFRI Research Report No.194. Kerala Forest Research Institute, Peechi, Thrissur, Kerala.
9. Kumar, M., Sequiera, S., Remesh. M., 2008. Macrolichens from Kerala Forests. *Evergreen*. 60/61, 1-7
10. Hareesh, V.S., Sreekumar, V.B., Prabhu Kumar, K.M., Nirmesh, T.K., Sreejith, K.A., 2015. *Ophiorrhiza sahyadriensis* (Rubiaceae), a new species from southern Western Ghats, Kerala, India. *Phytotaxa*. 202 (3), 219-224.
11. Prabhu Kumar, K.M., Hareesh, V.S., Vimal, K.P., Balachandran, I., Yadav, S.R., 2014. A new species of Chlorophytum (Asparagaceae) from southern Western Ghats of India. *Phytotaxa*. 188 (5), 282-286.
12. Prabhu Kumar, K.M., Hareesh, V.S., Nirmesh, T.K. Anilkumar, K.A., Sreekumar, V.B., Balachandran, I., 2014. On the identity and occurrence of *Gnidia* glauca (Fresen.) Gilg var. *sisparensis* (Gardner) Kumari (Thymelaeaceae) in India. *Webbia*. 69 (1), 131-135.
13. Sreekumar, V. B., Hareesh, V.S., Nirmesh, T. K., Sreejith, K. A., 2013. Ethnobotanical Studies of Mudugars in Muthikkulam High Value Biodiversity Area with Special Reference to Trees. *Proceedings of 26th Kerala Science Congress* Pookode, Wayanad: 28-31 Jan. 2014. Pp, 2558- 2566.
14. Pascal, J.P. 1988. Wet Evergreen Forests of the Western Ghats of India. Inst. fr. Pondichéry, trav. sec. sci. tech. Tome 20.
15. Pascal, J.P., Ramesh, B.R., Franceshi, D.D., 2004. Wet evergreen forest types of southern Western Ghats. *Tropical Ecology*. 45(2), 281-292.
16. Praveen, J., Nameer, P. O., 2007. Bird diversity of Siruvani and Muthikulam Hills, Western Ghats, Kerala. *Indian Birds*. 3, 201-217.
17. Choudhury, A., Wozencraft, C., Muddapa, D., Yonzon, P., 2008. *Martes gwatkinsii*. The IUCN Red List of Threatened Species. Version 2015.1. <www.iucnredlist.org>. Downloaded on 19 June 2015.
18. Balakrishnan, P., 2005. Recent sightings and habitat characteristics of the endemic Nilgiri Marten, Martes gwatkinsii in Western Ghats, India. *Small Carnivore Conservation*. 33, 14-16.
19. Lalitha, V., Prasad, S.N., Rathakrishnan, P., 2007. Inventory of the Biodiversity of Attappady with GIS Aid. Report. SACON, Coimbatore.
20. Easa, P.S., 1998. Survey of amphibians and Reptiles in Kerala part of Nilgiri Biosphere Reserve. KFRI Research Report 148. Kerala Forest Research Institute, Peechi.
21. Balakrishnan, P., 2007. Reptiles of Muthikkulam Reserved Forests, Kerala. *Cobra*. 1 (4),

22-29.

22. IUCN, 2007. IUCN Red List of Threatened species. www.iucnredlist.org.

23. Ramachandran, K. K., Sreekumar, V.B., Suganthasakthivel, R., Nair, P.V., 2015. Population ecology of lion-tailed macaque in Silent Valley National park, its buffer areas and Muthikulam High Value Biodiversity Area. KFRI Research Report (in press). Kerala Forest Research Institute, Peechi.

24. Ramachandran, K.K., Joseph, G.K., 2000. Habitat utilization of lion-tailed macaque (*Macaca silenus*) in Silent Valley National Park, Kerala, India. Primate Report 58, 17-25.

Scientia (Annual)

Volume 15. No.1 ◆ Jan-Dec.2019 ◆ ISSN: 0976-8289

ISSN 0976-8289
9 770976 828007