Satoyama Development Mechanism

Problems and Prospects of SEPLS' Conversion for Alternate Benefits - A Research Case Study from The Western Ghats

M S SWAMINATHAN RESEARCH FOUNDATION
INDIA

Project Title	Problems and prospects of SEPLS' Conversion for Alternate Benefits- A Research Case Study from The Western Ghats.
Case Study Title	Lateritic Biotopes- A Socio Ecological Production andscape in the North Kerala of Southern Western Ghats (Biotope is an area of uniform environmental conditions providing a living space for a specific assemblage of plants and animals, almost synonymous with the term Habitat, but the subject is biological community rather than a population)
Field Area:	Lateritic Biotopes spread over the of Kannur and Kasaragode Districts of Kerala State, India (Vast stretches of laterite-capped hillocks are characteristic of this area)

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PROJECT SUMMARY

This project comes up with a research case study from the Western Ghats on the problems and 'prospects' of converting Laterite Hills, a Socially and Ecologically Productive Landscape (SEPLS) for alternate benefits. These hills are the source of water and nutrients for the valleys where people live densely and do farming extensively. The rich biodiversity in the hilltops supports endemic and unique flora across seasons. This case reveals that the Laterite Hills are the most imposing but extremely threatened topographical feature of Northern Kerala. Mining and quarrying activities and ruthless constructions are silently destroying these biotopes beyond repair. The status-co of the lateritic hills, as 'wastelands' in public concern, accelerate this process. In consultation with people, local governments and researchers, the project has developed a case with a few recommendations which can be used for further regional planning and policy formulations.

Case Study Methodology:

- Through extensive secondary data review and intense field explorations, a list of potential risk activities on SEPLS in the Southern Western Ghats was prepared.
- With further probing in the same direction, the Lateritic Biotopes of Northern Kerala was identified as the specific SEPL and studied for its diversity and environemental concerns.
- Methodology workshops included Focus Group Discussions and Key informant interviews.

Laterite hills in Indian Context

In the peninsular India, laterite deposits are the most important Pleistocene Formations. The laterite generally occurs as capping on the hills and plateaus of Madhya Pradesh and in some states of the Deccan peninsula at altitudes ranging from coastal to 2,000 MSL with thickness varying between 20 and 60 m. Laterite occurrences are reported from all over the country. Almost all Indian bauxite deposits are associated with laterite except those in Jammu & Kashmir.

Hard crust of laterite formation has been reported from a number of locations in the laterite occurring regions of the world. In India such formations are found both in the west coast, more from Dapoli in Rathnagiri, Maharashtra to Malappuram district in Kerala extending about 8000 ha and in the Deccan plateau, which is under semi arid conditions. As early as 1807 Buchnan coined the term laterite for hardened called '*ittica kallu*' (in vernacular Malayalam, mean brick stone) occurring in Engadipuramm (Malapuram district Kerala) that is used as a building material in the northern districts (Malabar) Kerala. The term has been widely used in geological and pedagogical literature in the country and elsewhere.

Laterite hills of Kerala

Geomorphologically the state of Kerala is divided into three regions, the coastal plains, the midland hills and the highland hills. The midland hills are characterised by laterite capped plateaus. The area from Malappuram district to Kasargod district is typically formed of these kinds of laterite hills, which also serve as a major ecosystem for many plants and animals besides serving as good watershed areas. Major part of Kannur district comes under midland region with numerous hills and dales. Vast stretches of laterite capped hillocks are the characteristic feature of this district.

The midland lateral hills in the northern part of the state are slowly vanishing as the soil is enormously being scrapped off to meet the demand of land developers and contractors. Trucks and Tipper Lorries, carrying hundreds of loads of soil shuttling up and down the main roads across the region is a common sight in these days. Large numbers of excavators are being engaged every day for the demolition work. Midland hills have become the attractive source of big business involving builders, land developers and contractors who purchase private midland laterite hills and coastal wetland plots at cheaper rates. The hills are then demolished and laterite soil is transported to fill water lands and paddy fields. It has been estimated that more than 50 percent of the hillocks in various Grama Panchayaths and Municipal towns had been subjected to heavy excavations and removal of earth; among them 10 to 15 percent had suffered ultimate eradication. Nearly half a dozen laterite hillocks near Thalassery are in the process of demolition. A major portion of a hill near Iritty town has been completely demolished. Demolition also took place at Chuzhali and Chiravakku near Taliparamba. Hill degradation is also taking place in Srikandapuram. The Achilamvayal hillock degradation at Vellur near Payyanur had been studied in detail by a society in Kannur district (SEEK). Hillock at Madayipara is also facing various threats.

People are often unaware of the importance of the midland laterite hills that are being demolished due to the booming construction industry, the growing commercialization of land and expanding urbanization. The geological and ecological importance of these laterite hills are to be highlighted and conveyed to the local people with appropriate propaganda and orientation. Media has a significant role in educating the mass on the ecological and environmental impacts of this activity. The demolition often goes unnoticed and unopposed because of the popular perception that these hills are waste lands and absolutely useless in the prevailing scenario of development. The uncontrolled deterioration of the laterite hills causes irreparable damage to the ecosystem, bio diversity and nature's water conservation strategies. Degradation of hills resulting in loss of vegetation, destruction of the animal fauna, land deterioration, ground water loss, dust pollution, change in wind pattern and its influence in traditional faiths, rituals and culture of localities are to be studied in detail.

Biodiversity of midland Laterite Hills

Rocky surfaces, grasslands and green patches of laterite hills are rich and diverse habitats accommodating vast varieties of flora and fauna. The age old biological activities have transformed these areas into bio-rich realms which are the nature's gifts. Degradation of midland laterite hills brings about simultaneous collapse of at least three ecosystems including hillocks, valleys and wetlands. The Sacred groves which are unique to these laterite hills are the naturally existent floral centers supporting various groups of butterflies, birds and other animals, of which some are endemic to these habitats.

The laterite biotopes falls under the larger category of rock outcrops, which are special habitats, of freely exposed bedrock which protrude above the soil level due to natural reasons. Abundance and dominance of endemics is an important feature of this habitat.
Lateritic biotope in north Kerala are large scale ecological units, which contains ecological units such as:

Laterite vegetation (primary and secondary)
Agro-ecological units with varying slope management systems
Ephemeral Flush Vegetations
Seasonal pools
Stream banks and shelter belts
Grasslands
Kanams
Sacred groves

Flora of Laterite Hills

The floral diversity is astounding with different species of shrubs, herbs, trees and creepers growing at the surfaces and in the slopes of the hills. Midland hills are characteristic with hundreds of varieties of grasses, some of which are medicinally important. Candhium, Figs, *Alstonia*, Indian Coral tree, Indian Iron wood, *Semicarpus*, Neem, *Pterocarpus, Holarrhena, Terminalia, Ixora* spp etc. are invariably present in midland hills. *Gnetum*, *Calycopteris*, *Vitis* and other Lianas represent some of the highly important and rare plants having commercial and economic importance. Biodiversity of midland laterite hills varies greatly. Studies of Madayipara alone has documented 38 species of grass, 280 species of other plants, 92 species of butterflies and 68 species of birds (Jaffer, 1998). *Eriocaulon madayiparense* (Eriocaulaceae). *Nymphoides krishnakesara* (menyanthaceae) *Justicia ekakusuma* (Acanthaceae), *Rotala malabarica* (Lythraceae), *Rotala tilundensis* (Lythraceae), *Lapidagathis keralensis* (Acanthaceae) are found only in laterite hills.

Fauna of Laterite Hills

Faunal diversity of the midland laterite hills is amazing. Butterflies which are the bio-indicators of nature are abundantly present in these hills. As they cannot be seen in polluted lands, their presence indicates the virginity and versatility of these hills. The water bodies found during rainy season support different species of fishes and amphibians. Out of 80 species of amphibians reported from Kerala 13 survive in midland laterite hills. Skipper frogs, Rufescent frogs, Common tree frogs, Malabar flying frogs and several varieties of toads are peculiar inhabitants of the laterite hills. Out of 100 species of snakes reported from Kerala 20 species inhabit the laterite hills. Other reptiles include Pond Terrapin, Mugger crocodiles, Mabuya, Calotes and Lizards. Out of 480 species of birds reported from Kerala, about 50% of species have been recorded in midland hills (Jaffer, 1998). It is interesting to note that the Desert Wheater was first located in Kerala in Madayippara hills of this District. Many migratory birds select water bodies in the laterite hills as their favorite breeding grounds. The Skylarks, Lapwings and Stone Crews which are intimately associated with the laterite hill habitats are on the verge of extinction as they are unable to withstand the changing situations. Out of 110 species of mammals of 15 orders reported from Kerala, 90 are terrestrial and one-third among them inhabit the midland laterite hills. Bonet monkeys, Jackals, Indian fox, Smooth coated otters, Toddy cat, Small Indian Civet, Mongoose, Jungle cat, Wild boar, Pangolins, Hares, Shrews, Squirrels, Mole rats, Porcupines, Flying fox etc are some of the mammals facing the threat. All these animals face severe threat due to their loss of habitat by the deterioration of the midland laterite hills. With regard to the fauna it should be taken into account that depletion of different groups of organ-

isms should not be treated separately as different groups associate in diverse ways forming intricate chain or web in utilizing the biological resources and in energy transfer. This chain relationship and energy dynamics will be irreparably affected when a particular group is disappearing and the ultimate sufferers will be we ourselves. The disappearance of plants and animals endemic to this peculiar habitat ultimately leads to severe damage in genetic diversity and gene pool.
These microhabitats which are interacting with each other, are unique in character, poorly documented and figure insignificantly in the conservation literature and policy documents. A number of recent botanical discoveries and rediscoveries suggest that the ecological interlinkages and limits are yet to be explored.

These are areas having long history of human habitations, unique flora and fauna, systems of sustainable extraction and usage of ground water, soil rejuvenation measures, slope management and traditional systems of conservation, for eg. Sacred groves, Kanams, etc.

At the same time a number of extractive and developmental projects and guiding policies are fast altering and threatening these landscape elements in the pretext that these are wastelands. The elements in these landscape and their cross linkages in the concurrent and socio-historical milieu that shaped them and continue to reshape them would throw crucial insights on the possible management and policy making for conservation and restoration of human impacted landscapes in the region.

Socio-cultural significance of Lateritic biotopes

There existed and still exists a symbiotic relationship between the communities and the hill top in many ways. Lateritic Biotopes has also Archeological significances. The ecological condition of this landscape acted as pivotal element in molding a heterogeneous cultural landscape here from time immemorial. The archaeological evidences especially the tradition of demarcating the spaces for the dead and constructing deliberate burials in laterite and with laterite in the Iron Age and also the early engravings found on the bed of hard lateritic surface of the region emphasis the laterite as a production landscape from time immemorial.

Rock engravings at Ettuthadukka is a protected site of Kerala State Archaeology Department.

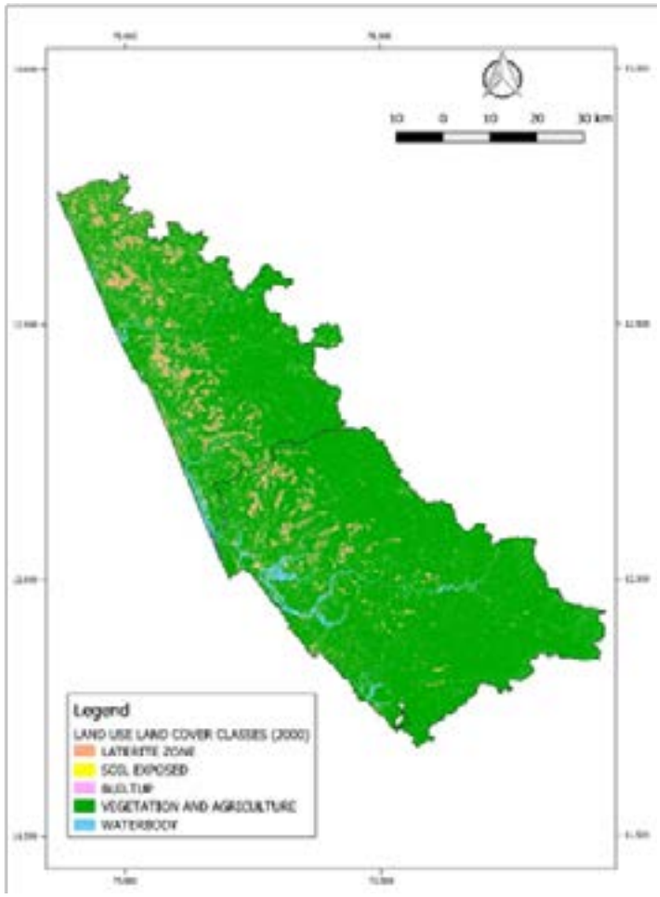
At present, Lateritic biotopes are important grazing lands for surrounding villages.

Shrines of deities worshipped by the villagers and places of ancestral worship have special socio cultural value for local communities

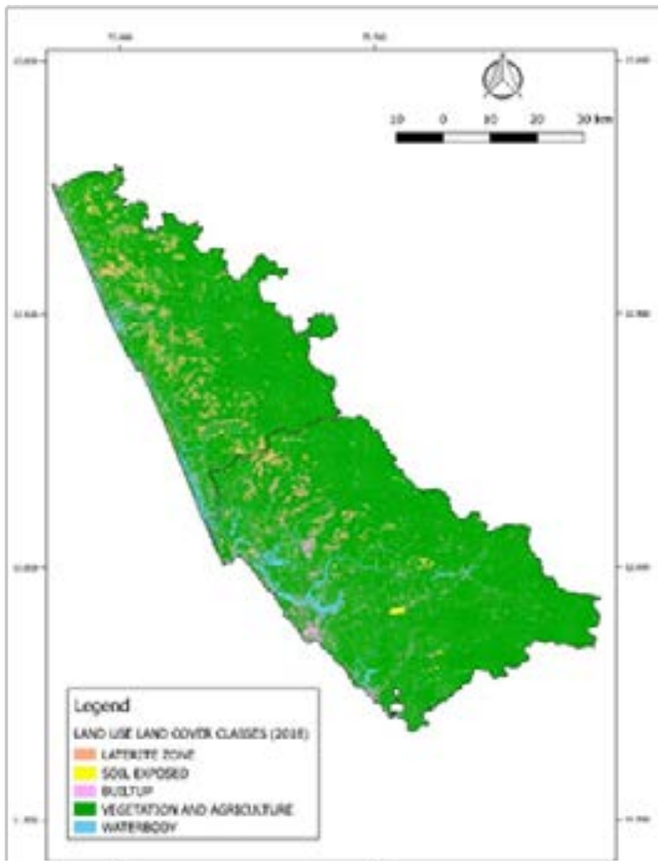
Villagers also use the hill tops for collecting grass for roofing, collecting medicinal herbs, etc for their day to day utilization.

Location Map

Laterite zone mapping and Land Use Land Cover analysis of the study area viz. Kasaragod and Kannur Districts of Kerala State, were done using Landsat 7 (Dec 20th 2000 Path 145 Row 51&52 data) and Landsat 8 (Jan 3rd 2018 Path 145 Row 51&52 data)
on ARGGIS10.1 and QGIS 2.18 environment



LULC analysis of the study area for Year 2000



LULC analysis of the study area for Year 2018

Table 1. Land use land cover change detection analysis for the study area

LULC	Year 2000		Year 2018		Change Area (km)	Change%	Percentage of Area Change comparing to yr2000(%)
	Area (km)	% of the Total	Area (km)	% of the Total			
Built_up	11.13	0.22	229.77	4.64	218.64	4.41	1964.364
Laterite Zone	477.90	9.64	209.10	4.22	-268.80	-5.42	-56.2458
Soil Exposed	51.19	1.04	91.53	1.84	40.33	0.81	78.79165
Vegetation	4301.03	86.76	4287.94	86.50	-13.08	-0.26	-0.30419
Water body	115.92	2.34	138.83	2.80	22.91	0.46	19.76187
Total	4957.17	100	4957.17	100	0.0	0.0	

The Land use land cover change analysis of 2000 and 2018 data showed that the built up area has increased from 11.3 sq. km to 229.77 sq.km over the period of 17 years. In terms of percentage it would come nearly 2000%. The laterite zone has changed from 477.90 sq. km to 209.10 sq.km during the same period. Soil exposed area increased from 51.19 sq.km to 91.53 sq.km. The vegetation cover including seasonal crops, perennial tree crops and forests areas not changed over the period. Water body including rivers, ponds and water logged areas increased from 115.92 sq.km to 138.83 sq.km. To understand the change of land use areas and its distribution of changes in all LULC classes, the 2000 and 2018 LULC data analysed further. The result of change detection matrix analysis presented in Table.

Table 2. Land use land cover change detection matrix

Year 2018LULC / Year 2000LULC	Built_up	Laterite zone	Soil Exposed	Vegetation	Water body	Yr 2000 Total
Built_up	1.68	0.44	0.47	7.76	0.78	11.13
Laterite zone	39.22	75.23	24.50	330.67	8.28	477.90
Soil Exposed	3.21	2.26	1.82	42.63	1.27	51.19
Vegetation	179.38	130.22	63.48	3847.02	80.93	4301.03
Water body	6.28	0.95	1.26	59.86	47.56	115.92
Yr 2018 Total	229.770	209.100	91.530	4287.940	138.830	4957.17

The land use land cover change matrix analysis showed that the Built up class gained area from 11.13 sq. km to229.77 sq.km, was mainly from Vegetation class, ie. 179.39 sq.km. The Built up class also gained from Laterite zone class at the tune of 39.22 sq.km.

The Laterite zone class has decreasedfom477.90 sq. km to 209.1 sq.km due conversion to other LULC classes, Built up class and Vegetation class (farming in the 'Reclamation' zones of laterite mining). The laterite zone gained 130 sq.km from Vegetation class due to the removal of tree crops and exposure of laterite. Due the mineral or ore mining and laterite stone mining, the Soil exposed class area increased from 2.26 sq.km to 24.50 sq.km during the period in the Laterite zone.

The Soil exposed class mainly gained area from Laterite zone class ie. 24.50 sq.km and the Vegetation class (63.48 sq.km) due removal of tree crops and conversion for 'development' activities.
The Vegetation class gained a major chunk of area from Laterite zone class at the tune of 330.67 sq.km due to reclamation and abandoned laterite stone mines. The Vegetation class also gained 59.86 sq.km from Water body class due to land filling.

The Water body class gained mainly from vegetation class ie. 80.93 sq.km due to cultivation abandoned water logging areas.

The diagonal cells of the matrix shows the LULC values unchanged over the period 2000 -2018

SPECIAL CASE

Madayipara, a midland Laterite Hill in Kannur

Special case

Madayipara, a midland Laterite Hill in Kannur

Madayipara is a flat topped hillock overlooking Payangadi town located in the northern bank of Kuppam river in the Madayi Grama Panchayath of Kannur district in Kerala. Madayipara is a flat topped hillock overlooking Payangadi town in the northern bank of Kuppam river located in the Madayi Grama Panchayath, lies between latitude 120 2'N and longitude 750 16'E about 21 km north of Kannur town, the district headquarters of Kannur district in Kerala. Total area of the study site is 365 Acres. The southern part of the study area is Payangadi town and Vengara village is in the north. On the west is the Ezhimala and in the east the Rampuram village.

As noted by W. Logan, the river Kuppam bending slightly on the south east edge of Madayipara suddenly turns south at Payangadi and take a curse parallel to the sea to meet the larger Valapattanam river in Matakkara.. As the name suggest, the top of this hillock is a laterite plain more than 365 ha in area. On the western side of the plateau, there is an ancient temple named Vadukundha shiva temple; a few yards away from the temple is a perennial fresh water pond, which is about 1.5 acres in extend. On the north eastern slope of the hill, is situated the Thiruvarkkad Bhagavathi temple (Madayikavu) and its sacred grove, drawing thousands of devotees every year. It is the temple of the mother Godess Kali and belongs to the royal family of Chirakkal. The entire plateau once belongs to this temple and even now the temple festival is being celebrated on the vast exposé of the hill near the Vadukunda pond and Kottakkunnu especially during the ten day long festival of Pooram in the month of March. There are remnants of a fort believed to have been occupied by the dynasty of Kolathiris and later by Tippu sulthan. The Madayipalli, one of the oldest mosques in India and believed to have been built in AD 1124 by Malik Ibn Dinar of Arabia, is situated on the eastern slope of the hill. Another monument of importance is 'Jew's pond' which indicates the historical testimony of the occupation of the area by Jews between BC 605 and AD 490. The British rulers had also built a travelers bungalow in 1753 on the eastern side of the Madayipara endowed with a rich scenic beauty of landscapes.

Due to the peculiar climatic factors and geological features, this area supports plenty of plant and animal species. Proper efforts have not been done for the documentation and conservation of flora of this peculiar laterite area. The butterflies and their plant relations in these biotypes were not properly studied yet. The present study was an attempt to document the plant and butterfly diversity of Madayipara laterite hillocks with special reference to butterfly host plants.

Geological features

The area has an altitude of 40 to 47 meters from the sea level. The land had emerged from sea and the plateau is rich in deposits of China clay, lignite and probably other minerals

Hydrological features

There is a perennial pond in the plateau near the Vadukundha temple. The Jew's pond is another water body present in the area. There are a number of wells, pits and cracks on the rocks which holds water during the monsoon season. These features have a great role in sustaining the biodiversity of the area.

Climate

The area enjoys a wet climate and is blessed with annual rainfall of more than 3000 m contributed both by the south-west Monsoon during June to September and North-east Monsoon during October to November

Madayipara in ancient literature

Madayipara was also known in these names viz., Pazhi kunnu, Marahi, Madayeli and Hilimarahi. There is a mentioning in Mushika Rajavamsam by Athulan that Madayi town was built by the King Vallabha II of Mushika Dynasty. According to Akannannuru 152th Kurinchipattu Pazhikunnu was the capital of the King Nannan of Mushika Dynasty. King Gambhiran who defeated the King of Marupuram which is adjacent to Madayipara had burned the entire town once and thus came the name Eripuram (burned place). Noted historian Chirakkal T Balakrishnan had recorded the description about the town Eripuram in a Portuguese manuscript. William Logan had described about the presence of an old ruined fort on the south eastern edge of Payangadi. The travelogues of Fahiyan, Ibnu bathutha (AD 1342) and Dorathe Barbosa are also giving some ideas about the presence of a town in Madayipara. The ancient literatures like Puranannuru, Noottinai and Theyyam thotam songs and some other folk songs also mentions about Madayipara.

History of Madayipara

The Mushika dynasty (BC 300-AD 500) was founded by Ramaghata Mushikan with Ezhimala as the capital. Later the kingdom was split and Kolathiri dynasty one of the parts settled in Madayipara and built forts and temples there. King Eliperumal built Madayi fort and King Vallabha II built Madayi town. In the period of King Vallabha II, Valapattanam became the important town of the Kingdom and was ruled based at Chirakkal. Later King Manikarna renovated all the temples there. Jew's settlement at Madayipara was around BC 605 – AD 490. The mosque at Madayipara was built by Malik Ibn Dinar of Arabia (AD 1124). The Kolathiri King Udayavarma Built Madayikavu in AD 1446. The British built a travelers bungalow on the eastern side of Madayipara in AD 1793.

Archeological Significance

Madayipara is one of the ancient Jew settlements in India. The collected remnants include an ancient boat and a stone pillar used to tie the boats. A stone edict of AD 1124 was discovered by Dr. M.G.S Narayanan from Madayipalli. 40 Roman coins were also found from Madayipalli during the renovation acitivities performed in 1948.

Landmarks at Madayipara

- Thiruvarkkat Bhagavathi temple ***(Madayikavu)*** is the main worship centre here with *Bhadra Kali* as the deity and was constructed in AD 1446 by *Kolathiri* King *Udaya Varma*. The temple is noted for its rare and unique rituals. The temple was belonging to *Chirakkal* Kings *(Chirakkal Devaswom)* and later came under the control of Malabar Dewaswom Board. The series of *Theyyam* festivals in Malabar starts from *Madayikavu* on *Thulaam* 10th
- Built by *Malik Ibn Dinar* of Arabia with the help of *Kolathiri* King, ***Madayipalli*** is the first mosque in north Kerala and the third such in India.
- ***Vadukundha Temple*** is one of the ancient Shiva temples of Kerala which was completely destructed during 18thcentury and renovated later in1978, after 180 years. ***Vadukundha lake*** is a naturally formed perennial water source in the compound of vadukundha temple. This water body is considered as sacred and many rituals of both the temples are performed here like the *Pooram Kuli*. The remnants of temple architecture found during the renovation indicate the connections of Jaina culture.
- The pond known as ***Juthakulam*** was believed to be the remnants of the Jewish settlement (BC 605 - AD 490).
- There is also a ground which is known as ***Palayam ground*** and seems to be an ancient battle ground on which *Chirakkal* Kings, Mysore Sulthans and The British Soldiers fought each other. William Logan reported that in 1776, Hydarali had signed an agreement with the British government to stop the battle against landlords who was supporting the East India Company.

Vegetation of Madayipara

The vegetation mainly consists of grass land which is varies from season to season, scrub jungles and a sacred grove. Vegetation is characterized by hydrophytes and insectivorous plants in the monsoon and xerophytes in the summer. A total of 534 plant species have been recorded from Madayipara. Among these about 110 plant species are known larval food plants of butterflies. A total of 70 species of grasses are recorded from Madayipara laterite. The common grass species are the *Eragrostis uniloides*, I*schaemum indicum, Hetropogon controtus, pennisetum polystachyon, Cynodon dactylon* and species belonging to the genera *Arundinella, Dimeria, Panicum, Themeda* etc. Species of *Arundinella* form the commonest grasses during the months of October and November. According to Agarwal (1961) Arundinella form a higher stage in the succession. So it can be safely stated that Arundinella grasses represent a higher stage in grassland development in the area where they occur.

The Monsoon phase

The first fall of southwest Monsoon during late May or early June stimulates the germination of seeds and the growth of annual plants. The first group of plants seen is species of *Neonotis Eriocaulon* ssp., and grasses and followed by insectivorous plants such as *Utricularia* ssp., and *Drosera* indica that dominate the land. The deep blue flowers of *Utricularia* sp. and white flower heads of *Eriocaulon* and *Ramphicarpa* literally paints the whole plateau in shades of blue, violet and white, amidst herbaceous plants such as *Sopubia trifida*, *Lindernia, Polygala elongata, Justicia japonica, Leucas* sp. and several others. The shallow depressions filled with water accommodate plants such as *Blyxa, Nymphoides krishnakesara, Marsilea minuta, Cryptocoryne spiralis, Rotala malampuzhensis, Rotala malabarica*, and *Isoetes coromandelina*. The sparsely distributed south Indian endemic *Chamaesyce katrajensis* can also be observed during this phase on the wet laterite rocks.

Following the retreat of south west monsoon, during September, most of the early appearing plants give way to others such as *Celosia argentea, Sesamum orientale* and grasses such as A*rundinella* ssp., D*imeria* ssp., *Ischaemum indicum, Panicum* ssp., etc which dominate subsequently. The abundance of grasses can be noticed during this period. The wet phase lasts up to the end of November

The Post monsoon phase

Stronger winds during the month of January and the direct incidence of sunlight enhance the drying up process of the flora of Madayipara. The majority of the herbaceous plants dry up except for some grass species and the thorny Lepidagathis keralensis, which may remain spread all over the rocky regions

of the hill. The silver coloured, *Polycarpea corymbosa* can also be seen against the black surfaces of the rocks.

Scrub Jungles

The evergreen forest species like *Hydnocarpus pentandra, Holigrana arnottiana, Cinnamomum* ssp. are seen along the southern, western and northern boundaries of the study site. *Ficus arnottiana*, one of the characteristic fig tree of this kind of ecosystem is seen in the southwestern part of the plateau. The tree is locally called 'Kallarayal'. Other fig species such as *Ficus benghalensis, Ficus religiosa, Ficus recemosa, Ficus tinctoria, Ficus exasperate*, and *Ficus hispida* are also support large number of frugivorous birds and bats during their fruiting season.

The small patches of *Ixora coccinea, Ziziphus oenopleae, Zizipus rugosa* and thick clumps of *Calycopteris floribunda* give refuge to large number of small animals and birds in addition to providing nectar to butterflies and other insects during their flowering season. The semi evergreen forest species like *Sterospermum colais* is one of the major wonders of this woody area, with its large white flowers blooming during November and December. A large tree of *Careya arborea* situated in the compound of tourist bungalow also support a large number animals such as bats, birds and butterflies.

These are unconsolidated sediments such as boulders, cobbles, pebbles, gravels, sand and all sediments deposited by streams/rivers normally in a narrow fluvial valley and these valleys are mostly fracture controlled and elongated primarily in the east-west direction. Valleys which are seen in the dissected laterite plateaus on either side of the rivers are broad and have good thickness of alluvium and transported laterite, whereas, in the foothill regions, valleys are narrow and thickness of alluvium is less. These units have been identified in the images and aerial photographs by their white/lime light/ light tone, medium to coarse texture and locations/associations. Paddy is the chief crop grown in this area. In agricultural plantations like coconut trees and areca nut trees are also grown in plenty.

Flowering Plants

The floristic exploration in Madayipara resulted in the collection, identification of 534 taxa of flowering plants, in a total area of 365 acres. Poaceae with 57 species is the largest family followed by Fabaceae with 38 species. Euphorbiaceae is the third largest family with 30 species. The present study also resulted in the identification and description of a new species *Lindernia madayiparense* from the temporary ponds (Ratheesh, Sunil & Nandakumar, 2012).

Rare and Endangered plants

Out of 534 species collected from the Madayipara 118 species are coming under endemic and threatened category forming 22% of the total species.

It is the home of some unique and sparsely distributed endemic plants such as *Nymphoides krishnakesara, Rotala malabarica, Justicia ekakusuma, Eriocaulon madayiparensis, Lepidagathis keralensis* and *Lindernia madayiparense. Nymphoides krishnakesara* is a small water lilly appear during the wet phase in the small pools and ponds on the plateau. *Rotala malbarica* is a semi-aquatic plant seen largely in the temporary pools. Justicia ekakusuma is seen rocky edges of the plateau. *Lepidagathis keralensis* is a newly described species remain uniformly distributed. *Euphorbia katrajensis* var. *kasaaragodensis* is an endemic species of the study area, which was originally described from the similar habitats of Katraja hills of Maharashtra. The beautiful small yellowish to pinkish flowers of this species is seen during the wet phase. This plant is poorly distributed here and individuals of species can be seen on the elevated portions of rocks. *Curcuma oligantha* is another characteristic plant seen in the laterite habitats during the wet phase.

Besides, the abundance of insectivorous plants such as *Drosera indica* and *Utricularia* ssp are worth mentioning.

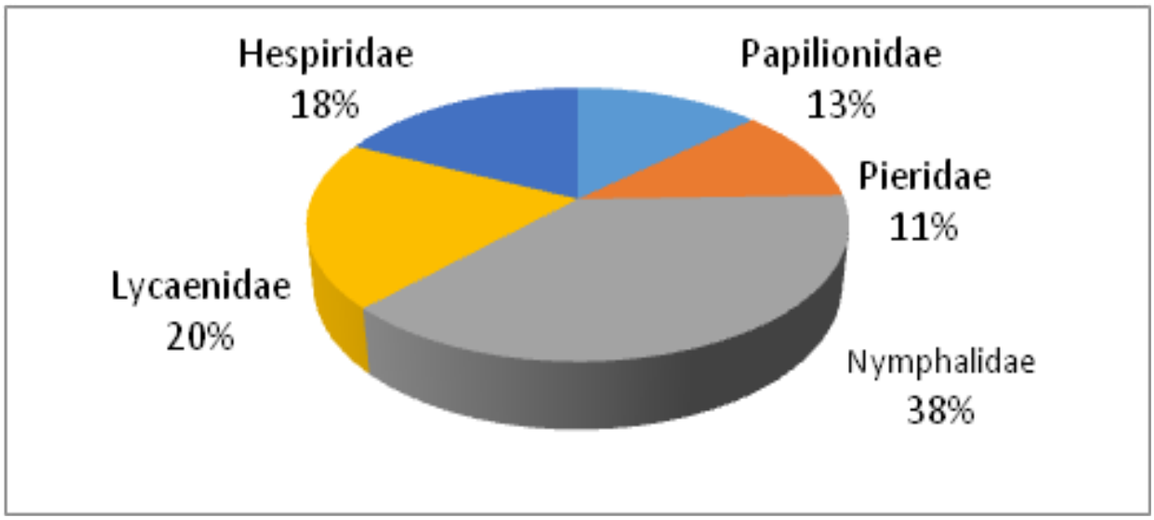
Ten species are listed in the IUCN Red list category. *Eriocaulon cuspidatum, Nymphoides krishnakesara* and *Neanotis rheedei* are coming under endangered category. Seven species included in the vulnerable category. They are I*schaemum burmanicum* var. *burmanicum, Santalum album, Capparis rheedei, Cyanotis burmanniana, Murdannia lanuginose, Hopea ponga* and *Hopea parviflora.*

Butterflies and host plant diversity

Field observations carried out in the study area during different seasons result in the identification of a total of 110 butterflies in 5 families. Among this Nymphalidae is the most dominant family including 40 species followed by Lycaenidae with 21 and Hespiridae with 19 species.

Rare and endangered butterflies:

Among the 110 species of butterflies recorded from the study area 10 are endemic. It includes India's largest butterfly, Southern Bird wing (*Triodes minos*). Endangered butterflies like Malabar banded swallow tail (*Papilio liomedon*), Crimson rose (*Pachilopta hector*) and Buddha peacock (*Papilio Buddha*) are some of the important butterflies observed in the area.



Family wise representation of butterflies

Among these butterflies India's largest butterfly Southern Bird Wing and world's smallest butterfly, Grass Jewel are included. Butterflies like Great Orange Tip, Chocolate pansy, Common crow etc. are the most common species. Among the 534 plant species recorded during the study, 110 plant species are depending by the butterflies as a larval host plant for egg laying. It was observed that many other plant species in the study area are also used by these butterflies for the nectar. These larval host plants are coming under 33 families of the total 100 families reported. Among these Poaceae is the largest family contains most number of host plants (16) followed by Fabaceae (11) and Caesalpiniaceae (7).

Environmental Issues Identified

Madayipara was facing severe environmental threats during these days. The major problem in the area is china clay mining and associated problems. The continuous mining from about last ten years leads to the changes in topography of the area. The water sources in the area are contaminated and the area suffers severe drought during summer. The uncontrolled tourism activities are another important factor which causes environmental problems. The area becomes a solid waste dumping yard during these days. The vehicle which washes from the ponds contaminates the water in the area. Fire is another major problem facing during the summer times. Majority of the fire burning the grass lands are intentional or due negligence by the people. The core factors behind these problems are the lack of awareness among the people and the authority. This study reveals the importance of the area as a potential butterfly habitat. There is more studies related with ecological and socio economic aspects in the area are needed for adopting efficient protection strategies in the area.

Protection of Madayipara – The History of protest

It was in 1952 that Mr Samuel Aaron opened a mining company named Hindusthan Clay Works at Madayipara and started China clay mining from 11 acres of land leased from Chirkkal Kovilakam. In 1964, the Chirakkal King handed over the administrative powers of the temple and properties to Madayikavu Dewaswam. In 1967 Samuel's company was closed due to labour issues. 1982 there was a case between Madayi Co-operative College and Dewaswam. A public limited company called Kerala Clays and Ceramic Products Ltd. was established in 1983 and continued the mining there In 1997, Kerala Mineral Development Corporation was launched to explore the Lignite deposition in Madayipara in collaboration with an Australian company. During these years, the place has witnessed a series of protests viz.,

- The plan for starting a flying club in the area and rise of public protest (1984)
- Environmental Conservation Group (ECG) was formed by the people and started protest aginst the Environmental issues (1992)
- Formation of Madayipara Samrakshana Samithi (1992)
- Madayipara Samrakshana Samithi picketed District Collectorate protesting against China clay mining and as a result, an evaluation committee was formed as per the instruction of Collector (1992)
- The Environmental subcommittee of Kerala Legislative Assembly paid a visit to the place and submitted a report in favor of Madayipara Samrakshana Samithi (1993)
- During the years 1996-1999, noted environmental activists Medha Patkar, Sugatha Kumarai, and Prof A. Achuthan had extended support for these protests
- A Second panel of Environmental subcommittee of Kerala Legislative Assembly paid their visit (1997)
- In 1997, The Pollution Control Board issueed an order to stop mining from Madayipara and they had specified the reasons of proximity of two temples and higher environmental impacts. (this order did not turn out positively).
- Madayipara Samrakshana Samithi extended the protests by forming a Human Chain in 1998
- Massive public protest against the company's (Kerala Clays and Ceramic Products Ltd) proposal to acquire an additional land of 33.18 acres for mining. Later a high power committee was formed chaired by Mr Gopalakrishna Pillai, Additional Chief Secretary of Kerala Govt. and the committee had produced a report in favor of the public (2000)
- Madayipara Samrakshana Samithi filed a writ petition at the High court against the company's (Kerala Clays and Ceramic Products Ltd) second effort for land acquisition (2001)

- Proposal for Kannur University Campus at Madayipara was withheld due to public protest (2005)
- 2009 July 10- an accident happened in the mining site due to unscientific mining. Huge blocks of soil collapsed and the flood caused by the accident submerged four houses in the nearby area.
- The protesters arranged a march to Kavilethodu, a polluted stream near Madayipara (2010)
  2010- Proposal for constructing water treatment plant in the area by the mining company with the help of Madayi Grama Panchayath
- In the Environmental Day of 2011, Madayipara Samrakshana Samithi arranged a symbolic guarding at Madayipara with the support of a number of local people
- 2011 March- Proposal for pilgrimage tourism in Madayipara by the government and received mixed responses from the public.

Conservation of Madayippara Laterite Hills

Suggestions and Recommendations (Draft as discussed in a Policy Dialogue):

1. Fragmentaion of the land must be minimized by way of taking appropriate actions at legal and educational levels.
2. Care must be taken to avoid natural or artificial fire during the dry phase.
3. Constructions must be restricted.
4. Dumping waste on the hills and washing of vehicles in the water bodies may be banned.
5. Culturally important spots need to be protected with proper fencing.
6. Visitors may be restricted. The responsibility of visitors' management may be given to paid or community guides. Allowing the visitors a guided walk with nominal fee can be arranged and this income may be allocated for the proper management of the area and to pay for the guides.
7. Proper sign/descriptive boards may be placed at appropriate places.
8. Biodiversity Management Committee of the local Panchayath shall be strengthened to look after the area.
9. Publications in local language need to be produced for the better understanding of the area on an environmental perspective.
10. There is an urgent need of a detailed scientific study on the issues and impacts of clay mining at the area. This area may be protected as a Heritage Site under the provisions of Biological Diversity Act, 2002 of Govt of India.

SPECIAL CASE

Lateritic Biotopes and Water Resources Kasaragod District

Water resources are being fast depleted and deteriorated globally, while the demands are increasing manifold. The state of Kerala is rich in water resources but it experiences serious seasonal water shortages because of inefficient water conservation and management practices. In Kasaragod district, where Laterite is the most wide spread and extensively developed aquifer, the case is not different. CGB (2007) observed that the numbers of groundwater abstraction structures especially private borewells are on increasing trend. Also the groundwater development in the central and western parts of the districts is found to be more. The water level in these areas are showing falling trend in both pre monsoon and post monsoon periods.

The laterite is generally underlain by thick lithomargic clay which is the preliminary lateritisation front. The thickness of lithomargic clay varies from about 0.5 m to 5.0 m at places. Laterite is more ferrogenous, porous and hard in northern parts of the district compared to those in the southern parts of the district. Due to its porous nature the dug wells tapping laterite get recharged fast and also the water escapes as sub-surface flow and water level falls quite fast especially in wells located on topographic highs and hill slopes (CGB, 2007). Lateritic Biotopes serve as watershed areas and support large ponds, or have perennial water sources along the edges which are extremely important for local people as well as livestock. The spongy nature of the laterite facilitates storage of rain water which is let out in the form of springs to the valleys throughout all seasons.

Of the 19 rivers in the Kannur and Kasargode districts, fourteen rivers find their origin from the

lateritic hills of the mid land and only the remaining five originate from the Western Ghat high lands. The health of the hills becomes the prosperity of the valley.

Surangam

The groundwater extraction structures depend on the nature of geological formation. In the coastal belt of the State open dug wells and tube wells are the predominant groundwater extraction structures. In the lateritic midlands, unlined open dug wells and bore wells constitute important extraction structure. In the highlands, the groundwater extraction is done either through bore wells or rectangular shaped open dug wells. In the northern Kerala, especially in the Kasaragod district, a non- conventional type of groundwater extraction structure exists and is locally known as "*Surangams*" or "*Thurangams*". It is basically a horizontal tunnel, dug in the hillocks for the purpose of harvesting freshwater, which seeps through the overlying mounds. These structures cut across the prevalent groundwater table in the area. The Surangams are usually rectangular in cross section, 50 to 80 cm wide and 0.90 to 1.5 m high and length varies between 3 to 300 m. There are two types of Surangams, viz. one dug in the hillocks for the purpose of harvesting freshwater which seeps through the lateritic mounds and the weathered residual materials; the second category are those dug horizontally at the bottom of the wells / ponds. There exist a variety of surangams having branched or pinnate types. There are also surangams, which starts from a well and conveys water to the desired points. In a few, water from the surangams is collected in a pond or well, which in turn supplies water through horizontal tunnels to the lower reaches. In some of the surangams, overlying weathered portions are completely stripped down and exposed as narrow valleys or gorges. (CWRDM, 2002).

These horizontal tunnels made on the slopes of laterite hillocks are in abundance in Kasaragod district and considerable area is irrigated by the water from these structures. The sustainable existence of Surangams depends on the healthy existence of the Lateritic biotopes. Hence, elaborate study of Surangams is important in the context of conservation of laterite hillocks.

Conservation Concerns

Serious lack of awareness in the society regarding the biological, social, cultural and economical importance of lateritic biotopes is a matter of grave concern. The uncontrolled deterioration of the laterite hills causes irreparable damage to the ecosystem, bio diversity and nature's water conservation strategies. Degradation of hills resulting in loss of vegetation, destruction of the animal fauna, land deterioration, ground water loss, dust pollution, change in wind pattern and its influence in traditional faiths, rituals and culture of localities are to be studied in detail. Rocky surfaces, grass lands and green patches of laterite hills are rich and diverse habitats accommodating vast varieties of flora and fauna. The age old biological activities have transformed these areas into bio-rich realms which are the nature's gifts. Degradation of midland laterite hills brings about simultaneous collapse of at least three ecosystems including hillocks, valleys and wet lands.

Conclusion

This project comes up with a research case study from the Western Ghats on the problems and 'prospects' of converting Laterite Hills, a Socially and Ecologically Productive Landscape (SEPLS) for alternate benefits. These hills are the source of water and nutrients for the valleys where people live densely and do farming extensively. The rich biodiversity in the hilltops supports endemic and unique flora across seasons. This case reveals that the Laterite Hills are the most imposing but extremely threatened topographical feature of Northern Kerala. Mining and quarrying activities and ruthless constructions are silently destroying these biotopes beyond repair. The status quo of the lateritic hills, as 'wastelands' in public concern, accelerate this process. In consultation with people, local governments and researchers, the project has developed a case with a few recommendations which can be used for further regional planning and policy formulation. Biodiversity Management Committees (BMCs) at the Local Self Governments, constituted under The Biological Diversity Act (2002) becomes all the more relevant in this context. The BMC's need to be strengthened and made aware of the importance of conserving the laterite hillocks.

Reference:

Aparna Watve, "Rocky Outcrops as special habitats in North Western Ghats, Maharashtra", ENVIS Bulletin, Wildlife and Protected Areas, Vol 11(1), 2008.

Chandrangadhan KP. 2010. Madayipara- charithram bhoomisasthram, Jaivavaividhyam. Cresent B.Ed college magazine , pp: 45-49.

CGB, Central Ground water Board (2007) Ground water information Booklet of Kasargod District, Kerala State, Ministry of water resources, Government of India.

CWRDM, Centre for Water Resources Development and Management (2002); Studies on Development of Surangams as a Non Conventional Water Resource in the Kanhangad Block panchayat, Kasaragod District, Kerala; Report submitted to Kerala Research Programme on Local level Department, Centre for Development Studies, GW/R-367/02, March 2002.

Eric Chivian and Aaron Bernstein, Sustaining Life- How Human Health depends on Biodiversity, 2008, Centre for Health and the Global Environment, Oxford University Press.

Integrated watershed development master plan, Madayi Grama pachayath.2011. Pp: 4-8.

Jaffer Palot.M, 1998. Inventorying, Monitoring and Conservation of Madayi Para Hill-A case study. Study Report, SEEK, Edat, Payyanur.

Jayarajan. M.2003. Scared Groves in North Malabar: the Extent of Human Intervention and Social sustainability. Study Report, KRPLLD, Thiruvananthapuram.

Lekhak, M.M. and S.R. Yadav. 2012. Herbaceous vegetation of threatened high altitude lateritic plateau ecosystems of Western Ghats,southwestern Maharashtra, India, Rheedea Vol 22(1), 31-61.

Logan, W. 1887. Malabar Manual. Chaithram publications (Reprint) Pp:768.

Nandakumar MK (2012). Butterfly and host plant diversity of Madayippara. M.Sc. Dissertation submitted to Kannur Universty.

Ollier C D and Rajaguru S N 1989 Laterite of Kerala (India); Geogr. Fis. Din. Quat. 12 27–33.
Pavithran, T. 2009. Ezhuthidangal, Kairali books, Pp: 60-63.

Rostock, Porembski Stefan and Aparna Watve, 2005. Remarks on the species composition of ephemeral flush communities on paleotropical rock outcrops, Phytocoenologia, 35 (2-3). 389-401.

Sathyan Edakkat. 2010.Kannur kanan-Ariyan, Kairali books, Pp: 27-40.

Sreedhara menon, A. 1957. Cannanore Gazatter. Gazatter Department Government of Kerala, Trivandrum. Pp:746.

Varghese Thomas and Byju.G. 1993. Laterite Soils – their Distribution, Characteristic, classification and Management. STEC, Govt. of Kerala, Thiruvananthapuram.

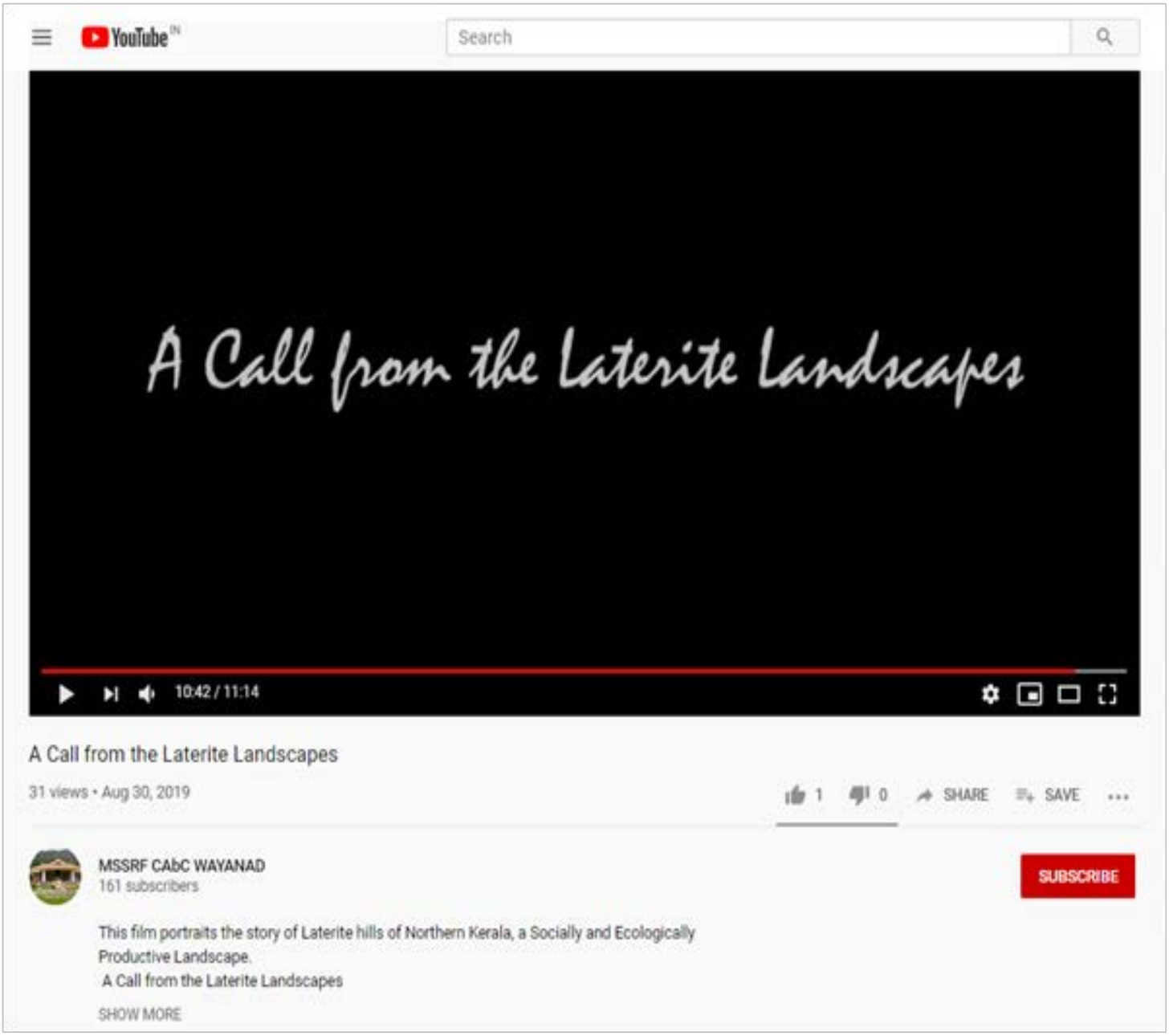
https://www.boloji.com/articles/8956/origins-of-surangam.

https://s3.ap-southeast-1.amazonaws.com/cdn.deccanchronicle.com/sites/default/files/SURANGA.jpg

https://upload.wikimedia.org/wikipedia/commons/f/f0/%E0%B4%B8%E0%B5%81%E0%B4%B0%E0%B4%82%E0%B4%97%E0%B4%82-4.jpg

Project team interacting with villagers

Villagers in protest for the conservation of Laterite areas



Video Documentation

A Call from the Laterite Landscapes

This film portrait the story of Laterite hills of Northern Kerala, a Socially and Ecologically Productive Landscape. A Call from the Laterite Landscapes Produced with the support of Satoyama Development Mechanism.

https://www.youtube.com/watch?v=xWMo2DAYzZw