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MAPS AS MARKERS OF ECOLOGICAL CHANGE : A CASE STUDY OF THE NILGIRI HILLS OF SOUTHERN INDIA

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"To do science is to search for repeated patterns, not simply to accumulate facts, and to do the science of geographical ecology is to search for patterns of plant and animal life that can be put on a map."

Robert H. MacArthur[1]

I. Introduction

Human societies have had a significant impact on the patterns of distribution of the plants and animals on the surface of the earth. Especially over the last two hundred years, human societies have expanded to every corner of the world and have transformed the landscape of the earth in significant and irreversible ways. Our area of study, the Nilgiri hills of Southern India have been colonised by people at least from the second century BC. These communities, mainly pastoral, hunting-gathering and shifting cultivating, have interacted closely with the environment. Although there have been debates on the impact of these communities on the vegetation of the Nilgiris, recent researches have shown that the Nilgiri shola-grassland vegetation complex has not changed significantly for the last thirty thousand years. Settled agriculture is supposed to have come into the hills during the fifteenth and sixteenth centuries. This was

brought up by the immigrant Badaga community[2]. With this, a wide variety of cultivars like ragi, wheat and barley were introduced into the hills. Major and significant changes in the environment and ecology of the Nilgiri hills was brought about in the colonial period, from 1800 onwards. This paper concerns itself with the ecological changes in the Nilgiri area from the colonial period to the present as discerned by maps of the area.

Maps are a graphic representation of selected natural and man-made features of geographical area at a particular point in time and at a particular scale. For ecological studies where the interest is to analyse the spatial and temporal distribution of biological communities, maps form an important data source. Even for historical studies, they provide information that have been hitherto been unused by historians of modern India. Further, maps provide quantitative location specific information on different aspects or 'layers' of landuse, topography, vegetation, communications, settlements, etc., that can be used for a formal analysis of the landscape. In addition the graphic representation of the time series of the maps yield visual impressions and inferences that provide significant clues to the process of ecological change.

II. The Nilgiri Area and its Cartographic Data Base

> "The historical value of these maps (of the Survey of India) is considerable, though uneven. Many of them make definite reference to interesting historical events, persons and dates....Generally speaking, these maps may be taken as good evidence as to the face of the country at the actual time of survey, especially as to roads, towns and villages and boundaries also where they are definitely indicated."
>
> Col. R.H. Phillimore[3]

The Nilgiri area, lying between 11°N to 12°N and 76°E to 77°15'E, forms a part of the Western Ghats chain of mountains of southern India. The Nilgiri area is constituted by an upper plateau, with an average elevation of over 1800 m, and the surrounding plains tapering off in the south to the Palghat gap. Our study area stretches about 80 km east to west and about 50 km north to south (refer map 1). Geologically, the entire area belongs to the continental block of peninsular India made up of metamorphic Archaean rocks[4]. The fault plains in the Nilgiri area suggest considerable tectonic activity causing block upliftment of the Nilgiri massif from the surrounding plains during the late Jurassic period which is about 160 - 210 million years ago.

Our cartographic data base of the area starts when it came into the possessions of the East India Company after the fall of Tipu Sultan in 1799. The first efforts of the British in the area were to consolidate their positions and to gain control over the western and northern portions of the hills. In 1802, Col. Colin Mackenzie was deputed to survey the hills. He does not seem to have ascended the Nilgiris but his report refers to an account

and a map of the hills drawn by his surveyors. These could not be found[5]. Other colonial officers from the Collectorate of Coimbatore did discover routes of access to the hills but there were no detailed maps prepared until 1822. This map and a brief report was prepared by Capt. B.S. Ward showing the early routes to the hills and the progress of the European settlements on the Nilgiris.

The next detailed map that forms an important data base for our study was a consequence of a survey done by Capt. Ouchterlony and submitted to the Madras Government in 1847. This map was drawn on a large scale of 1 inch = 1000 feet, or 1:12000, showing in detail the European and indigenous settlements, agricultural areas, forest areas, streams and swamps and the routes on the Nilgiris. This map, along with a detailed survey memoir, formed the basis of a later revenue settlement of the district.

Our next significant cartographic data base is the topographic sheets of the 'Modern Survey' initiated in 1905. From this period onwards, a uniform and reliable time-series of maps are available on the standard scale of 1 inch = 1 mile, or 1:63000. These are essentially the products of geodesic and topographic surveys done in the area from 1905 onwards. In 1950, a survey committee was appointed that decided to further rationalise the legend of the maps, and to produce the map on the metric system. These were surveyed and drawn to the scale of 1:50000. They provide accurate information on natural vegetation, plantations and agriculture; legal land categories; water resources and drainage patterns; topography; and human artifacts

like settlements, communications, power lines, reservoirs, temples and places of worship, fairs festivals and markets. Sporadically, there were other surveys conducted of selected areas, such as the forest surveys on the scale of 1:15000 and the revenue surveys on the scale of 16 inch to the mile.

On a consolidated level for the whole of the Nilgiri area, these maps represent four surveys during the seasons 1847, 1905-1908, 1950 and 1970. These provide four snapshots of the physical features in time.

In addition, there have been thematic maps of the area, representing the climate, soils, geology and land use. The current scenario of land use and vegetation is derived from the visual interpretation of a set of satellite imageries covering the period 1973 to 1989 with thematic overlays and extensive ground surveys. These are listed in Appendix 1.

For a historical analysis with maps, some of the features like topography, climate and geology are invariant over the the period in question, ie., over the 200 year period. These features then form the basis of the biophysical zones of the Nilgiris.

III. Methodology

We divide the Nilgiri area into six biophysical zones based on topography and climate that form an independent variable on which the ecological history of the area is constructed (refer Map 1).

1. The Nilgiri plateau and slopes: This is formed by the triangular mountain block rising steeply from the surrounding plains with an average elevation of 1800 m. The physiographic and orographic effects combine to give the area a cooler climate from the surrounding plains, and expose the western portions of the plateau to the monsoonal fury of the subcontinent. It thus has a rainfall ranging from 1000 mm to 5000 mm. Its natural vegetation is the shola-grassland system on the upper plateau with dense forests on the outer slopes.

2. The Sigur plateau: It stretches on the northern side of the Nilgiri hills and forms a part of the Mysore plateau. However, it is separated from the Mysore plateau by a chasm 300 m deep, known as the Moyar gorge. The Sigur plateau itself is at an elevation of 1000 m. Being on the leeward side of the monsoonal winds, it receives a very scanty annual rainfall of 500 mm to 1000 mm, but is fed by many streams originating in the Nilgiri plateau. The natural vegetation is mainly dry deciduous with pockets of scrub in drier places and riverine evergreen vegetation along the perennial streams.

3. The Coimbatore plains: It stretches on the eastern side of the Nilgiri plateau and is contiguous with the Tamilnadu plains. It has an average elevation of 300 m, and receives sporadic

rainfall of 1000 mm to 1500mm in the winter months from the 'north-east monsoons'. The area is mainly agricultural with very few patches of natural vegetation of dry deciduous forests and scrub. There are a few perennial streams and the tract is well-endowed with subsoil water.

4. The Attappadi plateau: This is a narrow plateau of undulating hills, stretching from the south of the Nilgiri hills to the Palghat gap with an average elevation of 800 m. The western portions of the plateau receive heavy monsoonal rains amounting to 2500 mm an year. The annual rainfall declines eastward towards the Coimbatore plains to 800 mm. The natural vegetation consequently ranges from dense evergreen forests in the western portions to dry deciduous and scrub jungle in the eastern parts.

5. The Nilambur plains: On the western side of the Nilgiri plateau, lies the Chaliyar valley and the Nilambur plains with an elevation of about 80 m. From here the Nilgiri massif rises steeply to over 2000 m forming deep and highly eroded escarpments. Open to the western seaboard of the Arabian Sea, it receives a very high rainfall of 2500 mm to 5000 mm. The natural vegetation is dense evergreen forests with all the altitudinal variations.

6. The Wynaad plateau: It is a flat tableland with an average elevation of 800 m. It lies to the west of the Nilgiri hills, forming the south-western extremity of the Mysore plateau. It contains low rounded hills with large swampy valley. It has a

monsoonal climate and receives an annual rainfall of 1500 mm to 2500 mm. The natural vegetation consists of swampy grasslands in the valleys with dense moist deciduous and evergreen forests on the hill slopes. The area is currently under intensive plantation cropping.

We analyse the ecological changes in these six zones with respect to each of the following parameters:

1. Land use: This is represented in the maps as a colour wash giving details of agricultural lands, natural forests, commercial plantations, forest plantations and settlement areas. In addition, the survey memoirs give information on agricultural areas and agricultural practices.
2. Legal and administrative categories of land: These are marked on the maps and represent revenue lands, under the control of the revenue department. These are used for agriculture and other purposes that are under open access to local communities. Also represented on these maps are the reserved forests, under the control of the forest department, where local communities have restricted access.
3. Communications and settlement patterns: The opening up of hinterlands by communication networks have helped the spread of commercialisation and the market economy into remote areas. These have been conduits for resource extraction leading to ecological change in many situations. The progress of communication networks, faithfully represented on the maps, thus reveal the integration of areas into the market economy.

4. Water resources: The utilisation and distribution of water resources have played a significant role in agricultural and urban communities. Further, the availability of water, whether seasonal or perennial, is significantly linked to the rainfall and land use patterns in the catchment areas. Human artefacts like dams, reservoirs, canals and wells, which have altered the water regime in significant ways, have had consequences for the ecology of many areas. These water resources have been well-represented in the historical maps of the Nilgiri area.

IV. Analysis and Results

Based upon our cartographic data base and the survey memoirs we analyse each of the biophysical zones, and draw inferences on the process of ecological change. Further we attempt a more formal quantitative analysis for the Attappadi biophysical zone.

1. The Nilgiri plateau and slopes : The Nilgiri plateau with an area of 1686.44 km^2 had been considered to be a isolated tribal enclave in peninsular India during the pre-colonial period. However evidences of routes suggest that the Nilgiri plateau had regular contact with the northern areas of Devarayapatna in Mysore and the Kongu region stretching to the Coimbatore plains. The area seems to have been administered from a place called Denaikenkotai in the northeastern tip of the plateau. The presence of many antiquities and forts on the northern prominences of the Nilgiri plateau suggest that the area was in regular contact with the surrounding country. Early surveys of 1812 record three routes to the plateau, one from the northeast,

one from the north, and the other from the southwest. None of these were suitable for wheeled traffic and thus most of the communication and trade was on foot, although it is asserted that Tipu Sultan did carry up some cannons and horses to the forts on the northern prominences overlooking Mysore territory[6]. The settled villages were confined to the eastern and northern portions of the plateau and so was agriculture[7]. The western portions of the plateau were mainly pastoral. Locally by custom, the area was divided into three territories of Porunganad to the east, Maikanad to the south, and Todanad to the west. William Keys notes that there were 41 principle and 119 subordinate villages. However reliable or unreliable the actual numbers may be, most of the agricultural villages were small consisting of about of four to six houses in a row surrounded by agricultural fields[8]. The village hamlets were often in clusters of three or four within one km of each other[9]. The only large and well-settled villages were the Kota villages distributed evenly all over the plateau. Their main activity in addition to subsistence agriculture was to provide artisanal services to the agriculturist Badagas on the plateau. Each village had forty to fifty houses arranged in neat rows[10]. On the northeastern and southeastern slopes, in the flat portions of the steep valleys there were a few Irula and Kurumba villages that were subsisting with some shifting cultivation in the fertile valleys augmented by gathering the numerous forest produce for subsistence and trade[11].

The soils of the cultivated areas were very fertile and well looked after[12]. On the flat upper plateau cultivation was done by the use of the plough with two cropping seasons each year. Early estimates of the total agricultural lands on the plateau was fixed at about fourteen square miles or 3625.2 ha[13] ie. 2.25 % of the total land area.

The western portions of the plateau were largely uncultivated and used as seasonal grazing grounds by the Toda buffalo keepers during the dry months of January to March. There were no permanent habitations in the area but many seasonally-used buffalo penning sites[14]. There were many brooks and streams on the plateau but practically no irrigation.

Upon this scene, the Europeans descended in the first half of the nineteenth century. They discovered the cool environment of the hills and established many routes to the upper plateau. By 1850 they had established townships, municipalities and sanatoriums at Kotagiri, Wellington and Coonoor on the eastern side of the hills and Ootacamund towards the west[15]. These townships and municipalities became centres of immigration drawing a lot of people from the plains of Coimbatore and Mysore. By 1847 at the time of the Ouchterlony Survey, the immigrant population was 8,887, slightly higher than the indigenous population of 7,704 persons[16].

The agricultural area expanded four-fold during this period, to 12718 ha and many marginal lands were put under shifting

cultivation. All this expansion was still confined to the northern and eastern parts of the plateau. The western parts were relatively untouched by all this activity, although two routes had been established westwards, one via the Sispara pass and Silent Valley to the Nilambur plains and the other via Gudalur towards Mysore[17]. There were some experiments with tea and coffee on the hills[18].

The Europeans and the immigrants from the plains had already started seeing the many brooks and streams of water as a resource. They had plans for the utilisation of water for agricultural expansion and by 1847 had built the Ooty Lake with plans for further harnessing other streams of the Nilgiris.

By the beginning of the twentieth century, communications were well established all over the Nilgiri hills. The main route to the plains was via Coonoor and the railway route was already laid from Mettupalayam to Ootacamund. The centre of trade and commercial activity shifted from Kotagiri to Coonoor. On the western side, the route over Kundahs was abandoned and a new route to the Kerala plains opened via Gudalur. A network of roads opened out southwards from Coonoor that brought the southern fringes of the Nilgiri hills in proximity to the markets. Plantation crops like tea and coffee first experimented with on the northern slopes spread to the southern side. These areas, with an altitude of 1200 m to 1800 m, were ideally suited for the plantation crops. These occupied 18.75 km^2 as one contiguous patch[19].

The Western side of the plateau were still unpopulated. By this period the European elite concerned with the destruction of the sholas introduced many exotic plantation crops to alleviate the fuelwood requirements of the population and reserved the uninhabited areas and remnant sholas all over the plateau. Thus, by 1905 eighty percent of the lands of Ootacamund taluk and forty percent of Coonoor taluk were declared as reserved in over 400 small and large patches under the Madras Forest Act of 1882.

By 1950's the communication road networks had further increased into the western areas of the hills. Tea plantations were experimented with in these inhospitable areas. In the southern fringes of the hills many forested tracts were converted into coffee estates utilising the virgin soils of the area under the microclimate provided by the natural forest vegetation. Tea and coffee estates expanded during this period from 18.75 km^2 to 47 km^2 mainly confined to the southern portions of the hills.

It was also during this period that the water resources of the Nilgiris began to be harnessed for the generation of electricity. A series of dams and reservoirs were built which significantly altered the water regimes that was to have important consequences for the ecology of the lower hills. On the Nilgiri hills itself most of this activity was confined to the western portions. The reservoir and dam construction activity itself had major ecological consequences. These areas were relatively undisturbed and were the only remnants of the original vegetation of the Nilgiri hills. They were penetrated with a network of roads and the influx of a large labour force led to

the destruction of sholas around the reservoirs. The Pykara Reservoir built in 1932 had a waterspread of 4 km^2 and a catchment area of 185 km^2. This scheme linked up the northern streams of the Moyar catchment and these had consequences on Sigur plateau that will be discussed later.

The modern period is marked by a massive growth in communication networks; a growth of non-agricultural labour settlements; large scale conversion of reserve forest areas into forest plantations; massive manipulation of the water regime by dams and reservoirs; conversion of agricultural and degraded lands into tea plantations; and degradation of the Nilgiri slopes into scrub vegetation[20].

The Kundah range that were the last hinterland areas without communication networks were suddenly opened up by roads for the development of hydro-electric schemes. Over 90 % of the catchment of the Bhavani was bound with a network of reservoirs to generate power[21]. With it came settlements[22] to provide labour and other services for construction and maintenance of these. The series of dams built essentially did not change the landuse patterns on the hills, but made many of the streams flowing southward and eastward seasonal, which had consequences for landuse on the lower hills.

With the impetus given by the National Forest Policy of 1952, large areas under the control of the Forest Department were converted to plantations to provide raw material to industry. Attempts were made to convert over 90% of the grasslands into

wattle and eucalyptus plantations. These failed on the western fringes of the plateau due to frost and monsoonal fury. In other areas, plantations became an industry and supported a large immigrant labour force that encroached on government lands. Agriculture noted a marginal expansion due to attempts to settle the Toda graziers to agriculture. With the loss of tree cover in the southern portions, soil fertility and microclimate had changed. Consequently many of the coffee plantations were replaced by the hardier tea plantations. Other areas degraded into scrubland.

Table I summarises the ecological changes on the Nilgiri plateau.

Map 2 shows the important landscape changes during the period.

The Sigur plateau: The Sigur plateau with an area of 281.25 km^2 had been a major population centre during the pre-colonial period being at the tri-junction of the Tamil plains, the Mysore plateau and the Wynaad area. It had many settled agricultural villages along the perennial streams and was a major route of communication in the area. The many ruins of forts and indications of bridle tracks crisscrossing the area reveal that Tipu had significant control over the area which had strategic importance for his fight against the British. Thus, when it came into the possessions of the British after the fall of Tipu in 1799, the early surveyors noted great detail about this area as revealed in Ward's map of 1822[23]. The map notes the area thickly forested by teak trees in the western portions and sandal trees towards the east. It shows roads through the area leading to Wynaad in the west and Devarayapatna in the north. All the routes to the Nilgiri plateau were from this area. There were three perennial streams along which were settlements. Some of these streams had canals branching off for the irrigation of paddy-lands[24].

The map notes eight inhabited villages, seven abandoned villages and a couple of temples in the area. "It is plain that it had been more largely cultivated some years back, and had likewise some paddy fields; but the depredations of wild elephants of late and the diminution of hands have almost laid it desolate"[25].

The British considered the plateau as highly malarial and did not venture into it in the wet season. The early attempts to

expand agriculture into the area and grow commercial crops like cotton failed. But during the second half of the nineteenth century, they extracted valuable timber which was used as building material for the townships on the Nilgiris. The Sigur ghat was also opened up and formed the main route to the Nilgiris from Mysore[26].

In the beginning of the nineteenth century, agricultural area constituted 4.2 km^2, ie., 1.4 % of the total area. This was not much more than what existed in 1822. But in forest clearings, coffee plantations were tried. They constituted about 1 km^2 in the western portions. By this period, the whole area was reserved under the forest reservation laws and commercial timber removed. There were many seasonal cattle-penning sites in the reserve forests that were frequented by Badaga agriculturists of the Nilgiri plateau. Along the Mysore route, a new township had come up at Masinagudi that provided trade and services to the coffee plantations and travellers.

There were no major changes till the 1950s, when hydroelectric projects were established on the Sigur plateau. This was a part of the Pykara hydroelectric system that diverted the westward-flowing waters of the Pykara onto the Sigur plateau. Construction activity further increased the township of Masinagudi. It was during this time that malaria was eradicated and this too contributed to the immigration of people into this area.

The modern period has been marked by a decrease in agriculture, declaration of forest lands as a wildlife sanctuary, water shortage due to the seasonality of two of the earlier perennial streams and an increase in the scrubland in the area[27].

Consequent to the increased utilisation of water in the upper plateau for intensive agriculture, two of the major streams watering the Sigur plateau has become seasonal. Agricultural areas have thus shrunk to less than 200 ha[28]. Further, because of overgrazing by an increased cattle and buffalo population concentrated near water holes and milk-collection centres, areas around them have degenerated into thorny scrub[29]. The declaration of 60 km^2 of the plateau as a part of a wildlife sanctuary brought in increased tourism and the growth of the Masinagudi township. The coffee estates have deteriorated as a consequence of changes in microclimate brought about by decrease in forest cover and many of them have since been abandoned.

Table II summarises the ecological changes on the Sigur plateau.

Map 3 shows the important landscape changes during the period.

3. The Wynaad plateau: Little is known of the Wynaad plateau with an area of 1048 km^2 during the pre-colonial period. Even after the fall of Tipu, there was independent resistance in the Wynaad area. The first mention of the area is in the Ouchterlony survey memoir of 1847[30]. Detailed maps of the area are available only since the 1900s. From these, inferences are drawn that indicate that during the pre-colonial period, the area was thickly forested with evergreen and moist deciduous trees. Major portions did not have permanent settlements but were used by many tribal communities for hunting and gathering. Permanent settlements with settled agriculture were prevalent only in a few swampy lands where paddy was cultivated.

By 1847, a rough track was established from the Nilgiri hills through Gudalur to Sultan's Battery in the Wynaad. The area was surveyed in 1847 and pronounced most suitable for coffee plantations[31]. By 1905, regular communications for wheeled traffic was established and coffee estates had spread covering an area of about 25 km^2. There was a well-established European community in the plantation area with their settlements and recreation centres. The northern portions of the Wynaad, rich in teak trees, were constituted into reserved forests by 1905 under the Forest Act of 1882, with an area of 281 km^2. These forests were regularly worked and teak trees harvested for building the townships on the Nilgiri plateau.

By 1950, Gudalur had become a trade and communications centre with roads leading to Mysore, the Kerala plains and the Nilgiris. With the eradication of malaria, the area drew

immigrants from Kerala and Mysore, and Gudalur became the most important town in the Wynaad. Tea and coffee estates spread in the area occupying a total of 130 km^2 by the end of this period.

In the modern period, the area has seen an unprecedented growth of settlements. Ambiguous legal land categorisation and political reorganisation of the linguistic states brought about waves of immigrants from the Kerala side. Forested areas were cleared for agriculture and cultivation and the government took over 800 ha converting them to tea estates to settle refugees from Sri Lanka. While lands were under litigation between the government forest department and the immigrants, forested areas were being clear-felled and cultivation expanded. Thus, at the end of this period, except for the reserve forest of 281 km^2 and 1200 ha of other forest[32], all other areas were converted to intensive agriculture and plantation crops. About 260 km^2 of forest lands in the northern portion were declared a sanctuary and forest workings in them were minimised.

Table III summarises the ecological change in the Wynaad area.

4. The Nilambur plains: The first detailed map of the Nilambur area of 265 km^2 was after the 1905-1908 survey of the area. In the pre-colonial period, parts of the Nilambur plains adjacent to the Nilgiri hills were densely covered with lowland evergreen forests, inhabited by a few hunting-gathering tribal societies. The flatlands of the Nilambur plains were cultivated. By tradition, the forested areas were called temple lands and were held with the temple of the area. On the periphery of the forest, there were a few teak and other commercial timber trees.

By 1905, the Nilambur had become an important trade, communication and administrative settlement. It was on the main route connecting the Kerala plains with Mysore and the Nilgiris. Realising the importance of teak, attempts were made to raise plantations of this species. This was the first attempt by the British to artificially grow teak in India, which proved successful in the Nilambur plains. Rubber was also experimented with as a plantation crop during this period. The thickly-forested hill areas were reserved under the Forest Act of 1882 and many of the accessible areas worked for timber.

By 1950, the railway line was extended to Nilambur with the sole purpose of exporting sleeper timber for railway expansion from the evergreen forest around the Nilambur area and on the slopes of the Nilgiri hills. The rubber plantations had established themselves in the Nilambur plains where the climate was most appropriate. It was confined to an area of about 12 km^2 on the forest fringe at the edge of the plains.

During the modern period, large areas of the plains were converted to rubber plantations. On forest department lands, about 25 km^2 of forests were clear-felled and converted to teak and other timber plantations[33]. On the fringes of the forests, new settlements were established that provided labour for the rubber plantations and forest work.

Table IV summarises the ecological change on the Nilambur plains.

5. The Attappadi plateau: We attempt a quantitative analysis for the landscape changes in the Attappadi plateau with an area of 806.25 km^2 during the historical period. The earliest maps of the area date from 1905; and we have four data points for the landscape from that time to the present.

In the pre-colonial period, the Attappadi area was mainly inhabited by tribal communities growing a variety of crops by shifting cultivation along the perennial streams and water sources. The area was watered by two perennial streams from the south and three from the north, joining into the main Bhavani river that flows eastward through the plateau. This thickly forested area was an important source of minor forest produce in the nature of roots and herbs collected and traded for medicinal use.

The first available maps, those of 1905, show 89 km^2 of the Silent Valley designated as reserved forests, and the remaining lands under local control. Minor routes extended towards the Coimbatore plains in the east and Mannarkad in the west. Agriculture was limited to about 22.5 km^2 in 36 patches all over the northern portions of the plateau. These were mainly small patches of shifting cultivation used with an intervening fallow period.

By 1954, communications into the plateau were opened up from the Coimbatore plains, bringing in agricultural immigrants who occupied the flat valley bottoms on the banks of the Bhavani river. A large patch of about 60 km^2 thus came under annual

cultivation. The shifting cultivating tribals were displaced to the slopes of the hills. The total agricultural area of about 109 km^2, increased to about 171 km^2 by 1975. The smaller patches along the slopes were completely inadequate for rotation and much of this area degraded into scrub. A series of dams, built on the upper plateau in the 1970s, made the two perennial streams on the northern side of the plateau seasonal. This rendered these regions of the plateau also into dry scrubland and much of the agriculture now shifted southward.

During this period, communication links were established with the Kerala plains in the west. A wave of colonisers from the west occupied the south-western portions of the plateau converting the forests into a variety of garden and plantation crops. By 1989, this had come to occupy about 66 km^2 [34].

For a formal analysis of the landscape, we calculate the area of each agricultural patch for each of the years 1908, 1954, 1974, and 1989. Their patch size distribution is shown in Table V. In 1908 all the agriculture was in shifting cultivation patches of below 6 km^2 distributed along the perennial streams of the area. These patches were rotated around the favourable sites that were numerous in the Attappadi. By 1954, immigrant agriculturists from the Coimbatore plains had settled permanently in the Bhavani Valley and 55% of the the agricultural land was aggregated into one large patch of 65 km^2. By 1989, with immigration from the surrounding areas, 73.8% of the land was aggregated into one large permanently used agricultural land, marginalising the small

shifting cultivation plots to just 1% of the total agricultural area.

Table VI summarises the ecological changes on the Attappadi plains.

Map 3 shows the changes in the landscape during this period.

6. The Coimbatore plains: The Coimbatore plains with an area of 750 km^2 had been a major agricultural area during the pre-colonial period. It had typical agricultural settlements of the Tamilnadu plains, constituted by both agricultural and artisanal communities. Wells and lift irrigation was prevalent in this area. Eastward and northward were the hills of the Nilgiri and Mysore plateau, respectively. These were thickly forested and inhabited by tribal communities practising shifting cultivation and collecting forest produce for barter with the agricultural communities of the plains. Many routes passed through the area connecting Mysore, Wynaad, the Kerala plains and the Tamilnadu plains[35]. The Coimbatore plains came into the possession of the British after the fall of Tipu Sultan in 1799. The British established their administrative centre at Coimbatore and soon it became an important trade and communication centre.

By 1850, routes to Mysore and the Nilgiris passed through Coimbatore. The forested tracts adjoining the hills were thus opened up for exploitation. Agriculture had spread to the foot of these hills and the tribal communities inhabiting the area were further pushed to the hill slopes of the Nilgiris.

The 1905 map shows patches of cultivation all along the slopes of the hills and that permanent cultivation had spread along the streams and communication routes of the Coimbatore plains. The remaining forests adjoining the hills towards the west and north were reserved, limiting the further spread of the agricultural areas. The map shows some of the agricultural settlements on the hills to be abandoned, possibly as a

consequence of the famine of 1878[36]. In addition to being an important administrative and trade centre, Coimbatore became an important railway junction with tracks leading to Kerala in the west and Mettupalayam and Nilgiri hills to the north.

By the 1950s, Coimbatore town had grown in size and stature to become an industrial town, drawing in waves of immigrants. In the perennial river valleys, some plantations had spread and many dry agricultural areas were irrigated by means of wells. The Noyil river basin was one such region where lift irrigation was practiced. During this period, roads were laid into the hill slopes and into the Attappadi plateau, which opened up areas for the emigration of agriculturists from the Coimbatore plains.

During the modern period, increase in lift irrigation by deep borewells has significantly lowered the water table in the area leading to the abandoning of cultivation in large tracts. This has also led to an increase in scrub vegetation on the hillsides and the foothills of this region. With a fall in agriculture and an increase in efficient communication networks, many small industrial townships have sprung up over the entire area.

Table VII summarises the ecological changes on the Coimbatore plains.

V. Summary & Conclusions

A study of the time-series of maps for the Nilgiri yield a history of the landscape of the area which has implications for the changes in the resource use patterns. In the pre-colonial period, resource flows were localised in each of the bio-physical zones. The area supported a wide spectrum of communities from hunting-gathering and pastoral communities to subsistence agriculture and artisanal communities. These communities interacted among themselves in the exchange of goods and services. The area also had cultural links with the larger South Indian civilization. There were many trade and communication routes passing through the lower plateau, some of which led up to the northern ridges of the higher plateau. However there was no large-scale export of resources from the area, other than certain special forest products like medicines, honey, etc.

The British gained control of the area after the fall of Tippu in 1799. Their early attempts were to consolidate their control over the area. They discovered the cool climate of the Nilgiri plateau and concerted efforts were made to establish a European colony on the hills. Townships and cantonments were established; routes were laid to the hills from the surrounding plains; agricultural stations were set up to experiment and acclimatise temperate plants; and immigration of people from surrounding area was encouraged to provide the necessary services. Consequently, agriculture expanded on the Nilgiri hills. The surrounding plateau and plains were relatively undisturbed during this first phase of colonial rule. During this

period, thus infrastructure was laid and experiments such as raising of tea plantations and mining for gold were tried for the commercial integration of the area. However, major resource flows were still confined within the area, and there was an inflow of resources in the nature of immigration, infrastructure and biota from outside the area.

By 1905, coffee and tea had established itself as a significant commercial crop. Large areas on the Nilgiri plateau and the Wynaad plateau were cleared of natural vegetation and commercially exploited with tea and coffee plantations, integrating the area with the global market. The remaining natural forests on the Nilgiri plateau were legally "reserved" for their aesthetic and recreational appeal to the colonists, whereas forests with valuable timber species in the Wynaad and Sigur plateau were reserved for commercial exploitation to the exclusion of rights of the local inhabitants. The depauperisation of the surrounding areas in Coimbatore plains and Mysore provided the much needed immigrant labour force for commercialisation of the Nilgiri plateau. Thus, but for the plantation crops, and the expansion of agriculture to meet the requirements of the towns and settlements in and around the area, resource flows were still confined to the local area.

By 1950s, the favourable areas in the Nilgiri plateau were completely converted to commercial tea and coffee plantations. Along with this, communication networks and settlements expanded in these areas. In the lower plateau, a network of roads were

laid selectively into areas the had commercial timber. In other areas subsistence and commercial mixed agriculture expanded with the entry of immigrants from the surrounding areas.

In the modern period, the landscape of the Nilgiris was significantly altered. With the encouragement of the policies of the government, the natural resources of the area were exploited for the larger "national" interest. Thus, with the new forest policy of 1950, commercial forest plantations expanded to provide raw materials at highly subsidised rates to forest based industries. Plantations of wattle and eucalyptus were laid in remote areas. Under the "grow more food" campaign of the agriculture department, expansion, intensification and commercialisation of agriculture was encouraged. The water resources of the area was extensively tapped by setting up a series of dams and reservoirs for the generation of power. These activities were accompanied by a network of communication routes in hitherto inaccessible areas. Settlements had sprung up all over, and the natural vegetation was confined to limited areas where the government had established national parks and sanctuaries. The borders between such areas and the transformed areas had become very sharp, bringing conservation objectives in direct conflict with the people. Now, resources flows had reached an unprecedented scale. A wide variety of agricultural and natural products were brought into the market economy. The indigenous inhabitants, mainly the forest dwellers and hunting and gathering communities were completely marginalised, with mich reduced access to their subsistence resources. They had to mainly

depend on labour for their livelihoods. The agriculturists were at the mercy of market forces to provide inputs for their agriculture and markets for their produce, leaving small patches of subsistence agriculture in areas that were not suitable for commercial crop production and were inaccessible to markets.

The following conclusions are drawn from the study of the Nilgiri hills.

1. During the period 1800-1990, human activity has been the most significant force in transforming the landscape.
2. Each bio-physical zone has imposed its range of possibilities and constraints in determining human activity.
3. Over the period in question, there has been a differentiation of access to natural resources with an increasing role of the state and corporate sectors.
4. There has been an increasing influx of market forces mediated by the spread of communication and labour settlements all over the landscape.
5. During the period there has been a sequential exploitation of resources: from more accessible areas to less accessible areas; and, from a limited range of exploitable and marketable resources to a more diverse set of resources. These have been mediated by the development of infrastructure, communications and technologies.
6. There has been an increase in the scale of resource flows from being confined within the geographical area to expanding into larger and larger domains.

7. These have caused large scale transformations of the landscape from natural vegetation to man-made vegetation. Natural areas have been confined to state protected areas like national parks and sanctuaries.

8. Time-series maps, representing selected landscape features at the time of survey are efficient markers of ecological change. However they do not contain information on cropping patterns, forest types, or the socio-economic and cultural characteristics of the population who are the principle actors in the process of ecological change. And this information needs to be supplemented to historical maps for a comprehensive account of the ecological history of the Nilgiris.

Acknowledgements

We thank Dr. Anindya Sinha for his editorial help and the Ministry of Environment and Forests, Government of India for partial financial support.

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21. Survey of India, 58A, 1981, Survey Year 1974.

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Appendix 1

Thematic Maps and Satellite Images used:

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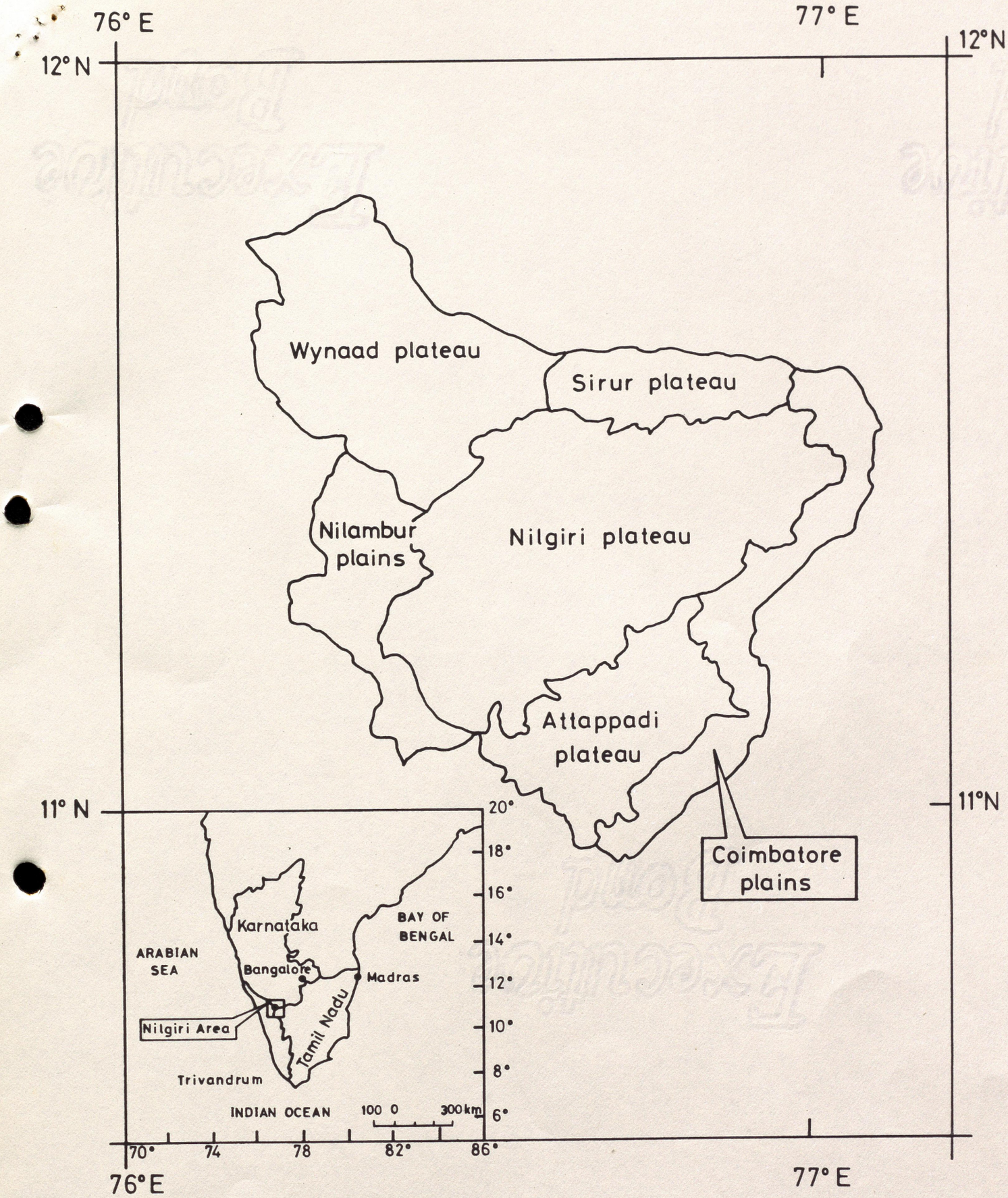
5. LANDSAT TM Satellite Image, 6th Feb, 1989.

6. LANDSAT Satellite Image, 31st Dec, 1987.

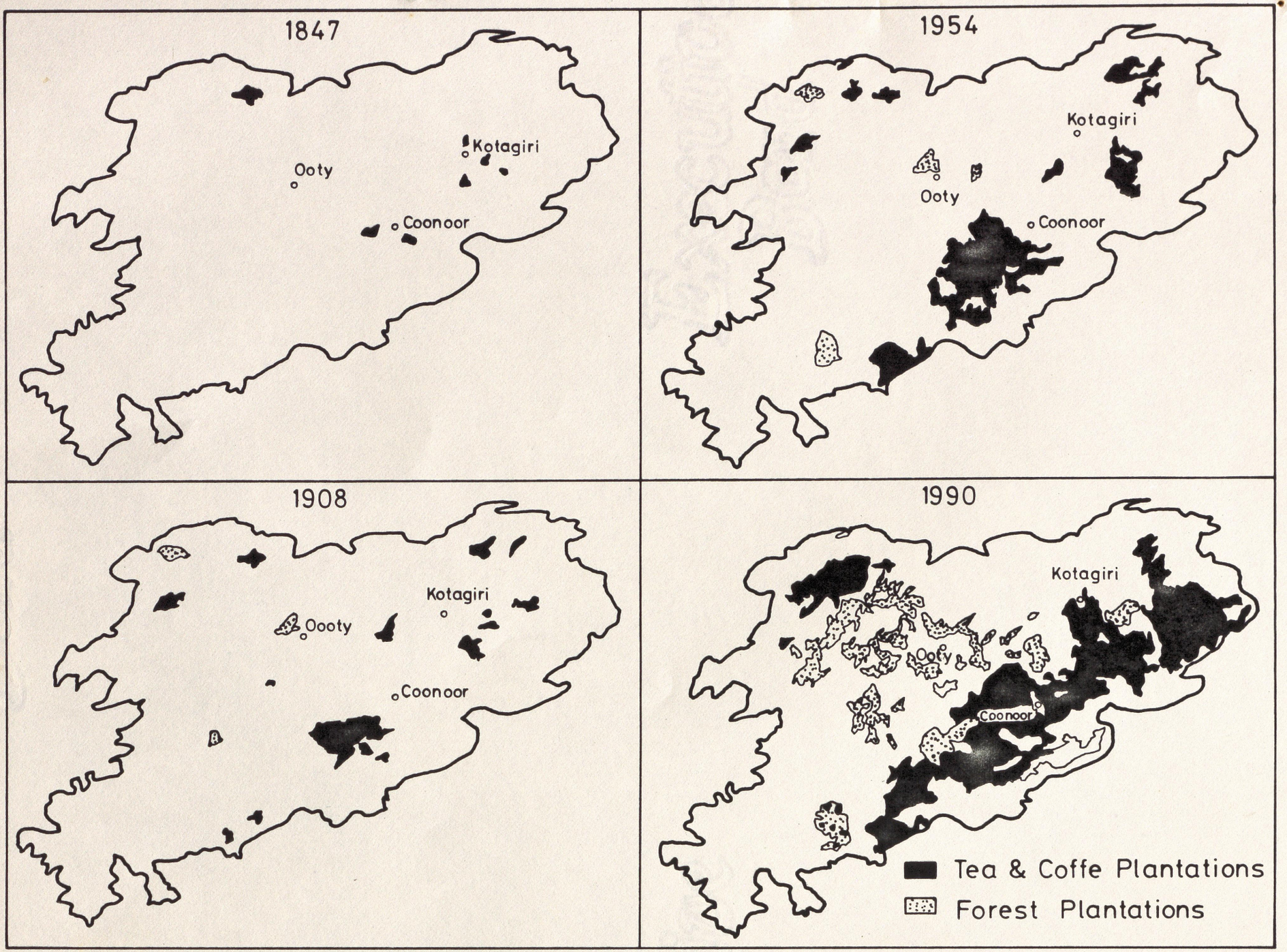
7. LANDSAT Satellite Image, 21st Jan, 1982.

8. LANDSAT Satellite Image, 27th Feb, 1973.

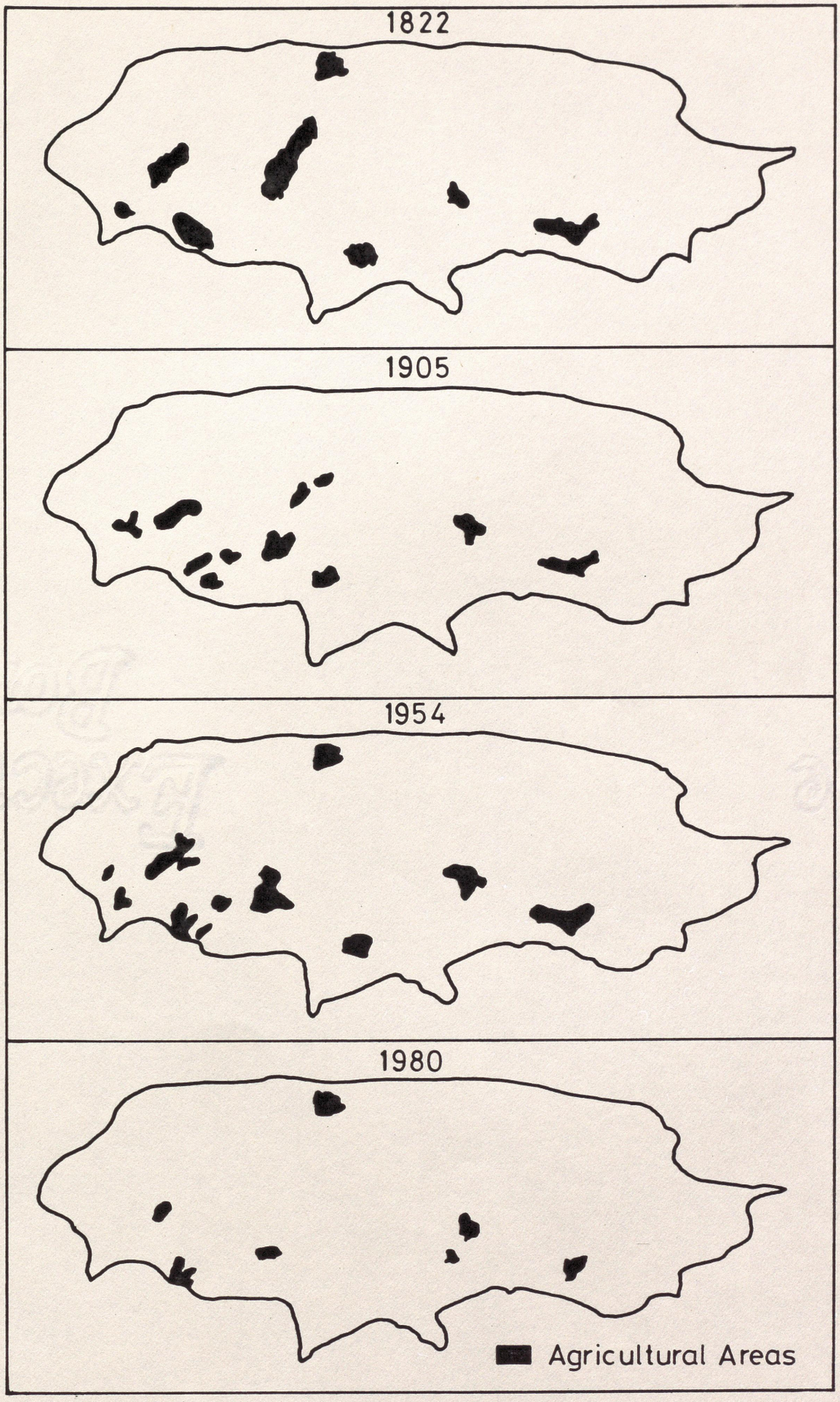
9. LANDSAT Satellite Image, 10th Feb, 1973.



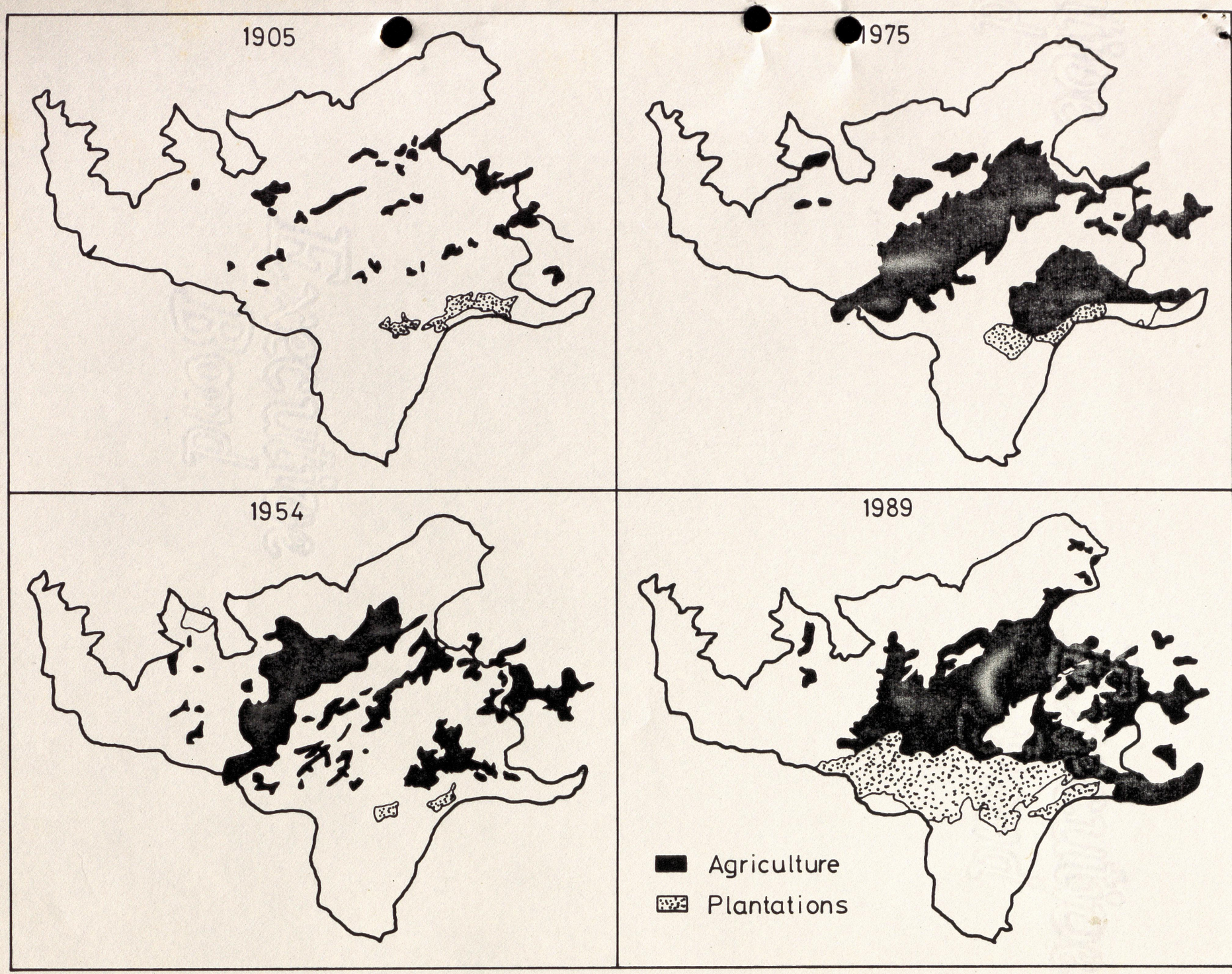
MAP 1. BIOPHYSICAL ZONES OF THE NILGIRI AREA.



MAP 2. LANDSCAPE CHANGES ON THE NILGIRI PLATEAU.



MAP 3. LANDSCAPE CHANGES ON THE SIGUR PLATEAU.



MAP 3. LANDSCAPE CHANGES ON THE ATTAPADI PLATEAU.

Table I. Ecological changes on the Nilgiri plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1847	Subsistence agriculture in north and east. Seasonal grazing in west. Tea, coffee and fuelwood plantations	Agricultural settlements in north and east. Three urban settlements. Routes to the plains through the north	Land controlled by local communities and Europeans	Many streams and springs. One water body at Ooty
1905	Tea and coffee plantations in the south (18.75 km^2) Forest plantations (6 km^2)	Urban settlements larger. Main road and railway through Coonoor. Roads into southern portions. Routes towards the west	Revenue and forest settlement. 55% of area reserved as forests	Increase in irrigated agriculture. One more water body in the east
1950	Coffee and tea plantations in south (47 km^2). Forest plantations (18 km^2)	All settlements larger. Labour settlements in interior areas. Communication networks into south-west	Forest land leased to Electricity Board	Pykara hydro-electric scheme executed with catchment of 185 km^2
1990	Commercial agriculture in north and east. Conversion of coffee and agriculture to tea. Increase in scrublands on outer slopes	Urban settlements larger. Permanent settlements on encroached lands. Routes to all parts of the hills	Encroachments on revenue and leased lands	Kundah hydro-electric scheme executed. High siltation into reservoirs

Table II. Ecological changes on the Sigur plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1812	Six patches of dryland agriculture. Teak forests in west and sandal trees in east	Few settled villages. Many abandoned villages. Routes to Wynaad, Mysore, Coimbatore and Nilgiris	Lands under local control	Perennial streams. Minor irrigation works in disuse
1905	Coffee estates towards the west	One trade and communication settlement	Most of the plateau as reserved forest	Few perennial streams
1950	Increase in grazing	Interior areas opened up by game roads. Trade and communication centre larger	No change	Hydroelectric schemes initiated scheme
1990	Decrease in agri-cultural area. Increase in scrubland	Unprecedented growth of township	Wildlife sanctuary declared (60 km^2)	Two perennial streams become seasonal

Table III. Ecological changes on the Wynaad plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Agriculture limited to few swamps. Other areas thickly forested	No major communication links	Lands held by chieftains and temple	Many perennial streams
1905	Coffee estates in forest clearings(25 km^2). Forests worked	European settlements around estates. Routes to Nilgiri, Sultan's Battery and Kerala plains	Northern portions reserved. Other areas leased from cheiftan	No change
1950	Agriculture expands. Tea and coffee plantations larger (130 km^2)	Gudalur settlement as trade and communications centre. Routes to Nilgiri, Kerala and Mysore. Game roads in forested areas	No change	No change
1990	Forests cleared for agriculture and plantations	Increased communication in south and west.	Change in land categories. Reserved forests declared sanctuary	No change

Table IV. Ecological changes on the Nilambur plains

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Densely forested hills. Flat lands under cultivation	Few permanent settlements	Forested lands under traditional temple control	Many perennial streams
1905	Teak and rubber plantations on the forest fringes	Nilambur town becomes a trade, communication and administrative centre. Routes to Kerala, Mysore and Nilgiris	Forested areas reserved	No change
1950	Rubber plantations in the plains	No change	No change	No change
1990	Timber and rubber plantations increase. Agriculture expands	Nilambur town expands. New labour settlements in forest fringes	No change	No change

Table V. Patch size distribution of agriculture on the Attappadi plateau

Patch Size * 6.25 km^2	1908		1954		1974		1989	
	No.	Area	No.	Area	No.	Area	No.	Area
< 0.1	27	1.51	15	0.8	1	0.05	4	0.24
0.1 - 1.0	9	2.09	9	2.13	7	2.65	5	0.85
1.0 - 5.0	0	0	3	4.9	1	1.45	0	0
5.0 - 10.0	0	0	1	9.59	1	8.15	1	5.25
> 10.0	0	0	0	0	1	15.12	1	17.83
Total	32	*	28	*	11	*	11	*
Total agricultural area	3.60		17.37		27.42		24.17	

Table VI. Ecological changes on the Attappadi plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Densely forested. Shifting cultivation in patches	Paths towards east: to the Coimbatore plains	Local chieftain control	Many perennial streams
1905	No change	Paths towards east and west	Small forested areas reserved	No change
1954	Settled agriculture. Forest degraded and reduced	Road linked to Coimbatore plains. New settlements along the river	Immigration and Encroachments	No change
1975	No shifting cultivation. Settled agriculture shifting southward. Forest degraded to scrub	Road linked to to Coimbatore and Kerala. New settlements in the south-west	No change	Perennial streams in northern parts become seasonal
1989	Garden and plantation agriculture in the south-west	Settlements in the south-west increase	No change	Perennial streams in southern parts become seasonal

Table VII. Ecological changes on the Coimbatore plains

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Mainly agricultural. Hill slopes thickly forested, also under shifting cultivation	Agricultural settlements. Routes to Kerala plains, Mysore, and Tamil plains	Lands under local control	Some perennial streams, well and lift irrigation
1905	Agriculture spread to foot hills. Forest workings	Coimbatore a trade, communication and administrative centre. Routes to Nilgiris, Mysore, Kerala and Tamil plains. Railway lines to Kerala and Nilgiris	Forested areas in the hills reserved	No change
1950	Hill slopes degraded into scrub	Coimbatore township larger and becomes industrial. Communications extended into hills	No change	Well and lift irrigation increased
1990	Increase in scrubland. Reduction in agri-cultural area	Coimbatore township larger. Growth of small industrial towns	No change	Depletion of subsoil water

WHAT MAPS REVEAL OF ECOLOGICAL CHANGE IN THE NILGIRIS

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"To do science is to search for repeated patterns, not simply to accumulate facts, and to do the science of geographical ecology is to search for patterns of plant and animal life that can be put on a map."

Robert H. MacArthur[1]

I. Introduction

Human societies have had a significant impact on the patterns of distribution of the plants and animals on the surface of the earth. Especially over the last two hundred years, human societies have expanded to every corner of the world and have transformed the landscape of the earth in significant and irreversible ways. Southern India and the Nilgiri hills have been colonised by people at least from the second century BC. These communities, mainly pastoral, hunting-gathering and shifting cultivating, have interacted with the environment. Although there have been debates on ~~the~~ the impact of these communities on the vegetation of the Nilgiris, recent researches have shown that the Nilgiri shola-grassland vegetation complex has not changed significantly for the last thirty thousand years. Settled agriculture is supposed to have come into the hills during the fifteenth and sixteenth centuries. This was brought up

by the immigrant Badaga community[2]. With this, a wide variety of cultivars like ragi, wheat and barley were introduced into the hills. Major and significant changes in the environment and ecology of the Nilgiri hills was brought about in the colonial period, from 1800 onwards. This paper concerns itself with the ecological changes in the Nilgiri area from the colonial period to the present as discerned by maps of the area.

Maps are a graphic representation of selected natural and man-made features of geographical area at a particular point in time and at a particular scale. For ecological studies where the interest is to analyse the spatial and temporal distribution of biological communities, maps form an important data source. They provide quantitative location specific information on different aspects or 'layers' on landuse, topography, vegetation, communications, settlements, etc., that can be used for a formal analysis of the landscape. In addition the graphic representation of the time series of the maps yield visual impressions and inferences that provide significant clues to the process of ecological change.

II. The Nilgiri Area and its Cartographic Data Base

> "The historical value of these maps (of the Survey of India) is considerable, though uneven. Many of them make definite reference to interesting historical events, persons and dates....Generally speaking, these maps may be taken as good evidence as to the face of the country at the actual time of survey, especially as to roads, towns and villages and boundaries also where they are definitely indicated."
>
> Col. R.H. Phillimore[3]

The Nilgiri area, lying between 11°N to 12°N and 76°E to 77°15'E, forms a part of the Western Ghats chain of mountains of southern India. The Nilgiri area is constituted by an upper plateau, with an average elevation of over 1800 m, and the surrounding plains tapering off in the south to the Palghat gap. Our study area stretches about 80 km east to west and about 50 km north to south. Geologically, the entire area belongs to the continental block of peninsular India made up of metamorphic Archaean rocks[4]. The fault plains in the Nilgiri area suggest considerable tectonic activity causing block upliftment of the Nilgiri massif from the surrounding plains during the late Jurassic period.

Our cartographic data base of the area starts when it came into the possessions of the East India Company after the fall of Tipu Sultan in 1799. The first efforts of the British in the area was to consolidate their positions and to gain control over the western and northern portions of the hills. In 1802, Col. Colin Mackenzie was deputed to survey the hills. He does not seem to have ascended the Nilgiris but his report refers to an account and a map of the hills drawn by his surveyors. These could not be

found[5]. Other colonial officers from the Collectorate of Coimbatore did discover routes of access to the hills but there were no detailed maps prepared until 1822. This map and a brief report was prepared by Capt. B.S. Ward showing the early routes to the hills and the progress of the European settlements on the Nilgiris.

The next detailed map that forms an important data base for our study was a consequence of a survey done by Capt. Ouchterlony and submitted to the Madras Government in 1847. This map was drawn on a large scale of 1 inch = 1000 feet, or 1:12000, showing in detail the European and indigenous settlements, agricultural areas, forest areas, streams and swamps and the routes on the Nilgiris. This map, along with a detailed survey memoir, formed the basis of a later revenue settlement of the district.

Our next significant cartographic data base is the topographic sheets of the 'Modern Survey' initiated in 1905. From this period onwards, a uniform and reliable time-series of maps are available on the standard scale of 1 inch = 1 mile, or 1:63000. These are essentially the products of geodesic and topographic surveys done in the area from 1905 onwards. In 1950, a survey committee was appointed that decided to further rationalise the legend of the maps, and to produce the map on the metric system. These were surveyed and drawn to the scale of 1:50000. They provide accurate information on natural vegetation, plantations and agriculture; legal land categories; water resources and drainage patterns; topography; and human artifacts like settlements, communications, power lines, reservoirs,

temples and places of worship, fairs festivals and markets. Sporadically, there were other surveys conducted of selected areas as the forest surveys on the scale of 1:15000 and the revenue surveys on the scale of 16 inch to the mile. These are represented on a map in Appendix 1.

On a consolidated level for the whole of the Nilgiri area, these maps represent four surveys during the seasons 1847, 1905-1908, 1950 and 1970. These provide four snapshots of the physical features in time.

In addition, there have been thematic maps of the area, representing the climate, soils, geology and land use. The current scenario of land use and vegetation is derived from the visual interpretation of a set of satellite imageries covering the period 1973 to 1989 with thematic overlays and extensive ground surveys. These are listed in Appendix 2.

For a historical analysis with maps, some of the features like topography, climate and geology are invariant over the the period in question, ie., over the 200 year period. These features then form the basis of the biophysical zones of the Nilgiris.

Methodology

The Nilgiri area is divided into six biophysical zones based on topography and climate that form an independent variable on which the ecological history of the area is constructed.

1. The Nilgiri plateau and slopes: This is formed by the triangular mountain block rising steeply from the surrounding plains with an average elevation of 1800 m. The physiographic and orographic effects combine to give the area a cooler climate from the surrounding plains, and expose the western portions of the plateau to the monsoonal fury of the subcontinent. It thus has a rainfall ranging from 1000 mm to 5000 mm. Its natural vegetation is the shola-grassland system on the upper plateau with dense forests on the outer slopes.

2. The Sigur plateau: It stretches on the northern side of the Nilgiri hills and forms a part of the Mysore plateau. However, it is separated from the Mysore plateau by a chasm 300 m deep, known as the Moyar gorge. The Sigur plateau itself is at an elevation of 1000 m. Being on the leeward side of the monsoonal winds, it receives a very scanty annual rainfall of 500 mm to 1000 mm, but is fed by many streams originating in the Nilgiri plateau. The natural vegetation is mainly dry deciduous with pockets of scrub in drier places and riverine evergreen vegetation along the perennial streams.

3. The Coimbatore plains: It stretches on the eastern side of the Nilgiri plateau and is contiguous with the Tamilnadu plains. It has an average elevation of 300 m, and receives sporadic

rainfall of 1000 mm to 1500mm in the winter months from the 'north-east monsoons'. The area is mainly agricultural with very few patches of natural vegetation of dry deciduous forests and scrub. There are a few perennial streams and the tract is well-endowed with subsoil water.

4. The Attappadi plateau: This is a narrow plateau of undulating hills, stretching from the south of the Nilgiri hills to the Palghat gap with an average elevation of 800 m. The western portions of the plateau receive heavy monsoonal rains amounting to 2500 mm an year. The annual rainfall declines eastward towards the Coimbatore plains to 800 mm. The natural vegetation consequently ranges from dense evergreen forests in the western portions to the dry deciduous and scrub jungle in the eastern parts.

5. The Nilambur plains: On the western side of the Nilgiri plateau, lies the Chaliyar valley and the Nilambur plains with an elevation of about 80 m. From here the Nilgiri massif rises steeply to over 2000 m forming deep and highly eroded escarpments. Open to the western seaboard of the Arabian Sea, it receives a very high rainfall of 2500 mm to 5000 mm. The natural vegetation is dense evergreen forests with all the altitudinal variations.

6. The Wynaad plateau: It is a flat tableland with an average elevation of 800 m. It lies to the west of the Nilgiri hills, forming the south-western extremity of the Mysore plateau. It contains low rounded hills with large swampy valley bottoms. It

has a monsoonal climate and receives an annual rainfall of 1500 mm to 2500 mm. The natural vegetation consists of swampy grasslands in the valleys with dense moist deciduous and evergreen forests on the hill slopes. The area is currently under intensive plantation cropping.

We analyse the ecological changes in these six zones with respect to each of the following parameters:

1. Land use: This is represented in the maps as a colour wash giving details of agricultural lands, natural forests, commercial plantations, forest plantations and settlement areas. In addition, the survey memoirs give information on agricultural areas and agricultural practices.

2. Legal and administrative categories of land: These are marked on the maps and represent revenue lands, under the control of the revenue department. These are used for agriculture and other purposes that are under open access to local communities. Also represented on these maps are the reserved forests, under the control of the forest department, where local communities have restricted access.

3. Communications and settlement patterns: The opening up of hinterlands by communication networks have helped the spread of commercialisation and the market economy into remote areas. These have been conduits for resource extraction leading to ecological change in many situations. The progress of communication networks, faithfully represented on the maps, thus reveal the integration of areas into the market economy.

4. Water resources: The utilisation and distribution of water resources have played a significant role in agricultural and urban communities. Further, the availability of water, whether seasonal or perennial, is significantly linked to the rainfall and land use patterns in the catchment areas. Human artefacts like dams, reservoirs, canals and wells, which have altered the water regime in significant ways, have had consequences for the ecology of many areas. These water resources have been well-represented in the historical maps of the Nilgiri area.

Analysis and Results

Based upon our cartographic data base and the survey memoirs we analyse each of the biophysical zones, and draw inferences on the process of ecological change. Further we attempt a more formal quantitative analysis for the Attappadi biophysical zone.

1. The Nilgiri plateau and slopes : The Nilgiri plateau with an area of 1686.44 km^2 had been considered to be a isolated tribal enclave in peninsular India during the pre-colonial period. However evidences of routes suggest that the Nilgiri plateau had regular contact with the northern areas of Devarayapatna in Mysore and the Kongu region stretching to the Coimbatore plains. The area seems to have been administered from a place called Denaikenkotai in the northeastern tip of the plateau. The presence of many antiquities and forts on the northern prominences of the Nilgiri plateau suggest that the area was in regular contact with the surrounding country. Early surveys of 1812 record three routes to the plateau, one from the northeast,

one from the north, and the other from the southwest. None of these were suitable for wheeled traffic and thus most of the communication and trade was on foot, although it is asserted that Tipu Sultan did carry up some cannons and horses to the forts on the northern prominences overlooking Mysore territory[6]. The settled villages were confined to the eastern and northern portions of the plateau and so was agriculture[7]. Locally by custom, the area was divided into three territories of Porunganad to the east, Maikanad to the south, and Todanad to the west. William Keys notes that there were 41 principle and 119 subordinate villages. However reliable or unreliable the actual numbers may be, most of the agricultural villages were small consisting of about of four to six houses in a row surrounded by agricultural fields[8]. The village hamlets were often in clusters of three or four within one km of each other[9]. The only large and well-settled villages were the Kota villages distributed evenly all over the plateau. Their main activity in addition to subsistence agriculture was to provide artisanal services to the agriculturist Badagas on the plateau. Each village had forty to fifty houses arranged in neat rows[10]. On the northeastern and southeastern slopes, in the flat portions of the steep valleys there were a few Irula and Kurumba villages that were subsisting with some shifting cultivation in the fertile valleys augmented by gathering the numerous forest produce for subsistence and trade[11].

The soils of the cultivated areas were very fertile and well looked after[12]. On the flat upper plateau cultivation was done by

the use of the plough with two cropping seasons each year. Early estimates of the total agricultural lands on the plateau was fixed at about fourteen square miles or 3625.2 ha[13] ie. 2.25 % of the total land area.

The western portions of the plateau were largely uncultivated and used as seasonal grazing grounds by the Toda buffalo keepers during the dry months of January to March. There were no permanent habitations in the area but many seasonally-used buffalo penning site[14]. There were many brooks and streams on the plateau but there was practically no irrigation.

Upon this scene, the Europeans descended in the first half of the nineteenth century. They discovered the cool environment of the hills and established many routes to the upper plateau. By 1850 they had established townships, municipalities and sanatoriums at Kotagiri, Wellington and Coonoor on the eastern side of the hills and Ootacamund towards the west[15]. These townships and municipalities became centres of immigration drawing a lot of people from the plains of Coimbatore and Mysore. By 1847 at the time of the Ouchterlony Survey, the immigrant population was 8,887, slightly higher than the indigenous population of 7,704 persons[16].

The agricultural area expanded four-fold during this period to 12718 ha and many marginal lands were put under indifferent shifting cultivation. All this expansion was still confined to the northern and eastern parts of the plateau. The western parts were relatively untouched by all these activity, although two

routes had been established westwards, one via the Sispara pass and Silent Valley to the Nilambur plains and the other via Gudalur towards Mysore[17]. There were some experiments with tea and coffee on the hills[18].

The Europeans and the immigrants from the plains had already started seeing the many brooks and streams of water as a resource. They had plans for the utilisation of water for agricultural expansion and by 1847 had built the Ooty Lake with plans for further harnessing other streams of the Nilgiris.

By the beginning of the twentieth century, communications were well established all over the Nilgiri hills. The main route to the plains was via Coonoor and the railway route was already laid from Mettupalayam to Ootacamund. The centre of activity shifted from Kotagiri to Coonoor. On the western side, the route over Kundahs was abandoned and a new route to the Kerala plains opened via Gudalur. A network of roads opened out southwards from Coonoor that brought the southern fringes of the Nilgiri hills in proximity to the markets. Plantation crops like tea and coffee first experimented with on the northern slopes spread to the southern side. These areas, with an altitude of 1200 m to 1800 m, were ideally suited for the plantation crops. These occupied 18.75 km^2 as one contiguous patch[19].

The Western side of the plateau were still unpopulated. By this period the European elite concerned with the destruction of the sholas introduced many exotic plantation crops to alleviate the fuelwood requirements of the population and reserved the

uninhabited areas and remnant sholas all over the plateau. Thus, by 1905 eighty percent of the lands of Ootacamund taluk and forty percent of Coonoor taluk were declared as reserved in over 400 small and large patches under the Forest Preservation Act of 1882.

By 1950's the communication road networks had further increased into the western areas of the hills. Tea plantations were experimented with in these inhospitable areas. In the southern fringes of the hills many forested tracts were converted into coffee estates utilising the virgin soils of the area under the microclimate provided by the natural forest vegetation. Tea and coffee estates expanded during this period from 18.75 km^2 to 47 km^2 mainly confined to the southern portions of the hills.

It was also during this period that the water resources of the Nilgiris began to be harnessed for the generation of electricity. A series of dams and reservoirs were built which significantly altered the water regimes that was to have important consequences for the ecology of the lower hills. On the Nilgiri hills itself most of this activity was confined to the western portions. The reservoir and dam construction had major ecological consequences. These areas were relatively undisturbed and were the only remnants of the original vegetation of the Nilgiri hills. They were penetrated with a network of roads and the influx of a large labour force led to the destruction of sholas around the reservoirs. The Pykara Reservoir built in 1932 had a waterspread of 4 km^2 and had a catchment area

of 185 km^2. This scheme linked up the northern streams of the Moyar catchment and these had consequences on Sigur plateau that will be discussed later.

The modern period is marked by a massive growth in communication networks; a growth of non-agricultural labour settlements; large scale conversion of reserve forest areas into forest plantations; massive manipulation of the water regime by dams and reservoirs; conversion of agricultural and degraded lands into tea plantations; and degradation of the Nilgiri slopes into scrub vegetation[20].

The Kundah range that were the last hinterland areas without communication networks were suddenly opened up by roads for the development of hydro-electric schemes. Over 90 % of the catchment of the Bhavani was bound with a network of reservoirs to generate power[21]. With it came settlements[22] to provide labour and other services for construction and maintenance of these. The series of dams built essentially did not change the landuse patterns on the hills, but made many of the streams flowing southward and westward seasonal, which had consequences for landuse on the lower hills.

With the impetus given by the National Forest Policy of 1950, large areas under the control of the Forest Department were converted to plantations to provide raw material to industry. Attempts were made to covert over 90% of the grasslands into wattle and eucalyptus plantations. These failed on the western fringes of the plateau due to frost and monsoonal fury. In other

areas, plantations became an industry and supported a large immigrant labour force that encroached on government lands. Agriculture noted a marginal expansion due to attempts to settle the Toda graziers to agriculture. With the loss of tree cover in the southern portions, soil fertility and microclimate had changed. Consequently many of the coffee plantations were replaced by the hardier tea plantations. Other areas degraded into scrubland.

Table I summarises the ecological changes on the Nilgiri plateau.

The Sigur plateau: The Sigur plateau with an area of 281.25 km^2 had been a major population centre during the pre-colonial period being at the tri-junction of the Tamil plains, the Mysore plateau and the Wynaad area. It had many settled agricultural villages along the perennial streams and was a major route of communication in the area. The many ruins of forts and indications of bridle tracks crisscrossing the area reveal that Tipu had significant control over it and it had strategic importance for his fight against the British. Thus, when it came into the possessions of the British after the fall of Tipu in 1799, the early surveyors noted great detail about this area as revealed in Ward's map of 1822[23]. The map notes the area thickly forested by teak trees in the western portions and sandal trees towards the east. It shows roads through the area leading to Wynaad in the west and Devarayapatna in the north. All the routes to the Nilgiri plateau were from this area. There were three perennial streams along which were settlements. Some of these streams had canals branching off for the irrigation of paddy-lands[24].

The map notes eight inhabited villages, seven abandoned villages and a couple of temples in the area. "It is plain that it had been more largely cultivated some years back, and had likewise some paddy fields; but the depredations of wild elephants of late and the diminution of hands have almost laid it desolate"[25].

The British considered the plateau as highly malarial and did not venture into it in the wet season. The early attempts to

expand agriculture into the area and grow commercial crops like cotton failed. But during the second half of the nineteenth century, they extracted valuable timber which was used as building material for the townships on the Nilgiris. The Sigur ghat was also opened up and formed the main route to the Nilgiris from Mysore[26].

In the beginning of the nineteenth century, agricultural area constituted 4.2 km^2, ie., 1.4 % of the total area. This was not much more than what existed in 1822. But in forest clearings, coffee plantations were tried. They constituted about 1 km^2 in the western portions. By this period, the whole area was reserved under the forest reservation laws and the commercial timber removed. There were many seasonal cattle-penning sites in the reserve forest that were frequented by the Badaga agriculturists of the Nilgiri plateau. Along the Mysore route, a new township had come up at Masinagudi that provided trade and services to the coffee plantations and travellers.

There were no major changes till the 1950s, when hydroelectric projects ~~had~~ were established on the Sigur plateau. This was a part of the Pykara hydroelectric system that diverted the westward-flowing waters of the Pykara onto the Sigur plateau. Construction activity further increased the township of Masinagudi. It was during this time that malaria was eradicated and this too contributed to the immigration of people into this area.

The modern period has been marked by a decrease in agriculture, declaration of forest lands as a wildlife sanctuary, water shortage due to the seasonality of two of the earlier perennial streams and an increase in the scrubland in the area[27].

Consequent to the increased utilisation of water in the upper plateau for intensive agriculture, two of the major streams watering the Sigur plateau has become seasonal. Agricultural areas have thus shrunk to less than 200 ha[28]. Further, because of overgrazing by an increased cattle and buffalo population concentrated near water holes and milk-collection centres, areas around them have degenerated into thorny scrub[29]. The declaration of 60 km^2 of the plateau as a part of a wildlife sanctuary brought in increased tourism and the growth of the Masinagudi township. The coffee estates have deteriorated as a consequence of changes in microclimate brought about by decrease in forest cover and many of them have since been abandoned.

Table II summarises the ecological changes on the Sigur plateau.

3. The Wynaad plateau: Little is known of the Wynaad plateau with an area of 1048 km^2 during the pre-colonial period. Even after the fall of Tipu, there was independent resistance in the Wynaad area. Th first mention of the area is in the Ouchterlony survey memoir of 1847[30]. Detailed maps of the area are available only since the 1900s. From these, inferences are drawn that indicate that during the pre-colonial period, the area was thickly forested with evergreen and moist deciduous trees. Major portions did not have permanent settlements but were used by many tribal communities for hunting and gathering. Permanent settlements with settled agriculture were prevalent only in a few swamps.

By 1847, a rough track was established from the Nilgiri hills through Gudalur to Sultan's Battery in the Wynaad. The area was surveyed in 1847 and was pronounced most suitable for coffee plantations[31]. By 1905, regular communications for wheeled traffic was established and coffee estates had spread covering an area of about 25 km^2. There was a well-established European community in the plantation area with their settlements and recreation centres. The northern portions of the Wynaad, rich in teak trees, were constituted into reserved forests with an area of 281 km^2 by 1905, under the Forest Act of 1882. These forests were regularly worked and teak trees harvested for building the townships on the Nilgiri plateau.

By 1950, Gudalur had become a trade and communications centre with roads leading to Mysore, the Kerala plains and the Nilgiris. With the eradication of malaria, the area drew immigrants from Kerala and Mysore, and Gudalur became the most

important town in the Wynaad. Tea and coffee estates spread in the area occupying a total of 130 km^2 by the end of this period.

In the modern period, the area has seen an unprecedented growth of settlements. Ambiguous legal land categorisation and political reorganisation of the linguistic states brought about waves of immigrants from the Kerala side. Forested areas were cleared for agriculture and cultivation and the government took over 800 ha converting them to tea estates to settle refugees from Sri Lanka. While lands were under litigation between the government forest department and the immigrants, forested areas were being clear-felled and cultivation expanded. Thus, at the end of this period, except for the reserve forest of 281 km^2 and 1200 ha of other forest[32], all other areas were converted to intensive agriculture and plantation crops. About 260 km^2 of forest lands in the northern portion were declared a sanctuary and forest workings in them were minimised.

Table III summarises the ecological change in the Wynaad area.

4. The Nilambur plains: The first detailed map of the Nilambur area of 265 km^2 was after the 1905-1908 survey of the area. In the pre-colonial period, parts of the Nilambur plains adjacent to the Nilgiri hills were densely covered with lowland evergreen forests, inhabited by a few hunting-gathering tribal societies. The flatlands of the Nilambur plains were cultivated. By tradition, the forested areas were called temple lands and were held with the temple of the area. On the periphery of the forest, there were a few teak and other commercial timber trees.

By 1905, the Nilambur had become an important trade, communication and administrative settlement. It was on the main route connecting the Kerala plains with Mysore and the Nilgiris. Realising the importance of teak, attempts were made to raise plantations of this species. This was the first attempt by the British to artificially grow teak, which proved successful in the Nilambur plains. Rubber was also experimented with as a plantation crop during this period. The thickly-forested hill areas were reserved under the Forest Act of 1882 and many of the accessible areas worked for timber.

By 1950, the railway line was extended to Nilambur with the sole purpose of exporting sleeper timber for railway expansion from the evergreen forest around the Nilambur area and on the slopes of the Nilgiri hills. The rubber plantations had established themselves in the Nilambur plains where the climate was most appropriate. It was confined to an area of about 12 km^2 on the forest fringe at the edge of the plains.

During the modern period, large areas of the plains were converted to rubber plantations. On forest department lands, about 25 km^2 of forests were clear-felled and converted to teak and other timber plantations[33]. On the fringes of the forests, new settlements were established that provided labour for the rubber plantations and forest work.

Table IV summarises the ecological change on the Nilambur plains.

5. The Attappadi plateau: We attempt a quantitative analysis for the landscape changes in the Attappadi plateau with an area of 806.25 km^2 during the historical period. The earliest maps of the area date from 1905; and we have four data points for the landscape from that time to the present. Table V gives the details of agricultural lands and its patch size distribution during the four time periods.

In the pre-colonial period, the Attappadi area was mainly tribal with a variety of crops grown by shifting cultivation along the perennial streams and water sources. The area was watered by two perennial streams from the south and three from the north, joining into the main Bhavani river that flows eastward through the plateau. This thickly forested area was an important source of minor forest produce in the nature of roots and herbs collected for medicinal use.

The first available maps, those of 1905, show 89 km^2 of the Silent Valley designated as reserved forests, and the remaining lands under local control. Minor routes extended towards the Coimbatore plains in the east. Agriculture was limited to about 22.5 km^2 in 36 patches all over the northern portions of the plateau. These were mainly small patches of shifting cultivation used with an intervening fallow period.

By 1954, communications into the plateau were opened up from the Coimbatore plains, bringing in agricultural immigrants who occupied the flat valley bottoms on the banks of the Bhavani river. A large patch of about 60 km^2 thus came under annual

cultivation. The shifting cultivating tribals were displaced to the slopes of the hills. The total agricultural area of about 109 km^2, increased to about 171 km^2 by 1975. The smaller patches along the slopes were completely inadequate for rotation and much of this area degraded into scrub. A series of dams, built on the upper plateau in the 1970s, made the two perennial streams on the northern side of the plateau seasonal. This rendered these regions of the plateau also into dry scrubland and much of the agriculture now shifted southward.

During this period, communication links were established with the Kerala plains in the west. A wave of colonisers from the west occupied the south-western portions of the plateau converting the forests into a variety of garden and plantation crops. By 1989, this had come to occupy about 66 km^2 [34].

Table VI summarises the ecological changes on the Attappadi plains.

Table V. Patch size distribution of agriculture on the Attappadi plateau

Patch Size * 6.25 km^2	1908		1954		1974		1989	
	No.	%	No.	%	No.	%	No.	%
< 0.1	27	75	15	54	1	9	4	36
0.1 - 1.0	9	25	9	32	7	64	5	45
1.0 - 5.0	0	0	3	11	1	9	0	0
5.0 - 10.0	0	0	1	3	1	9	1	9
> 10.0	0	0	0	0	1	9	1	9
Total	32	100	28	100	11	100	11	100
Total agricultural area	3.60		17.37		27.42		24.17	

6. The Coimbatore plains: The Coimbatore plains with an area of 750 km^2 had been a major agricultural area during the pre-colonial period. It had typical agricultural settlements of the Tamilnadu plains, constituted by both agricultural and artisanal communities. Wells and lift irrigation was prevalent in this area. Eastward and northward were the hills of the Nilgiri and Mysore plateau, respectively. These were thickly forested and inhabited by tribal communities practising shifting cultivation and collecting forest produce for barter with the agricultural communities of the plains. Many routes passed through the area connecting Mysore, Wynaad, the Kerala plains and the Tamilnadu plains[35]. The Coimbatore plains came into the possession of the British after the fall of Tipu Sultan in 1799. The British established their administrative centre at Coimbatore and soon it became an important trade and communication centre.

By 1850, routes to Mysore and the Nilgiris passed through Coimbatore. The forested tracts adjoining the hills were thus opened up for exploitation. Agriculture had spread to the foot of these hills and the tribal communities inhabiting the area were further pushed to the hill slopes of the Nilgiris.

The 1905 map shows patches of cultivation all along the slopes of the hills and that permanent cultivation had spread along the streams and communication routes of the Coimbatore plains. The remaining forests adjoining the hills towards the west and north were reserved, limiting the further spread of the agricultural areas. The map shows some of the agricultural settlements on the hills to be abandoned, possibly as a

consequence of the famine of 1878[36]. In addition to being an important administrative and trade centre, Coimbatore became an important railway junction with tracks leading to Kerala in the west and Mettupalayam and Nilgiri hills to the north.

By the 1950s, Coimbatore town had grown in size and stature to become an industrial town, drawing in waves of immigrants. In the perennial river valleys, some plantations had spread and many dry agricultural areas were irrigated by means of wells. The Noyil river basin was one such region where lift irrigation was practiced. During this period, roads were laid into the hill slopes and into the Attappadi plateau, which opened up areas for the emigration of agriculturists from the Coimbatore plains.

During the modern period, increase in lift irrigation by deep borewells has significantly lowered the water table in the area leading to the abandoning of cultivation in large tracts. This has also led to an increase in scrub vegetation on the hillsides and the foothills of this region. With a fall in agriculture and an increase in efficient communication networks, many small industrial townships have sprung up over the entire area.

Table VII summarises the ecological changes on the Coimbatore plains.

Conclusions

Historical maps, representing features of the landscape at the time of survey, yield quantitative location-specific information on various aspects of ecological importance. At the first level, they help delineate zones for the study of ecological history. In the Nilgiri area, the time-series of maps indicate changes in administrative control over the land, the relationship between the development of communication networks and exploitation of areas, changes in the patterns of land-use and vegetation, changes in water regimes, etc. Especially for large area studies, these maps reveal the gross patterns of ecological change. Historical maps of the Nilgiri area, however, are patchy and represent the state of the physical features of the region only at discrete times. They thus fail to throw any light on the actual process of ecological change, as well as the motivation and causes for such change.

Certain other factors that are significant for tracing ecological history like types of crops grown, cropping patterns, density and diversity of forest types, limits of irrigated agriculture etc. are never revealed in the usual maps. Furthermore, such maps give no information on the sociological, economic and cultural characteristics of the population, which constitutes the settlements on the landscape and who are the principal actors in the process of ecological change.

Finally, maps contain the biases of the map-makers. Thus, the historical maps of the Survey of India, an arm of the

government, represent legal and administrative boundaries, plantation limits etc. as detailed in the official records and do not reflect changes in them brought about by illegal activities and encroachments.

Footnotes and References

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17. Ouchterlony, 1847, *ibid.*

18. Ouchterlony's map of 1847 and Survey Memoir 1848, *ibid.*

19. Survey of India, 58A, 1922, Survey Year 1905 - 1908.

20. Satellite Image Interpretation of LANDSAT TM, 6th Feb 1989.

21. Survey of India, 58A, 1981, Survey Year 1974.

22. Survey of India, 58A, 1981, *ibid.*

23. B.S. Ward, 1822. Map of the Neelgherry Mountains.

24. Keys, *ibid.*

25. Keys, *ibid.*

26. Survey of India, 58A, 1922, *ibid.*

27. LANDSAT TM, 1989 and Survey of India, 58A, 1981, *ibid.*

28. Survey of India, 58A, 1981, *ibid.*

29. LANDSAT TM, 1989.

30. Ouchterlony, 1848, *ibid.*

31. Ouchterlony, 1848, *ibid.*

32. Survey of India, 58A, 1974, Survey Year 1954 - 1955.

33. Survey of India, 58A, 1981, *ibid.*

34. LANDSAT TM, 1989, *ibid.*

35. Ward, *ibid.*

36. Survey of India, 58E/3, 1927, Survey Year 1905 - 1908.

APPENDIX 1.



CARTOGRAPHIC DATA BASE OF SURVEY OF INDIA MAPS

Appendix 2

Thematic Maps and Satellite Images used:

1. J.P. Pascal, Bioclimates of the Western Ghats, French Institute, Pondicherry, 1974.

2. M.F. Bellan, Nilgiri Hills (India), Map of the Main Vegetation Types from LANDSAT Imagery, Institut de la Catre Internationale du Tapis Vegetal, Toulouse, 1985.

3. SPOT Satellite Image, 4th Feb, 1989.

4. SPOT Satellite Image, 23rd Nov, 1989.

5. LANDSAT TM Satellite Image, 6th Feb, 1989.

6. LANDSAT Satellite Image, 31st Dec, 1987.

7. LANDSAT Satellite Image, 21st Jan, 1982.

8. LANDSAT Satellite Image, 27th Feb, 1973.

9. LANDSAT Satellite Image, 10th Feb, 1973.

Table I. Ecological changes on the Nilgiri plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1847	Subsistence agriculture in north and east. Seasonal grazing in west. Tea, coffee and fuelwood plantations	Agricultural settlements in north and east. Three urban settlements. Routes to the plains through the north	Land controlled by local communities and Europeans	Many streams and springs. One water body at Ooty
1905	Tea and coffee plantations in the south (18.75 km^2) Forest plantations (6 km^2)	Urban settlements larger. Main road and railway through Coonoor. Roads into southern portions. Routes towards the west	Revenue and forest settlement. 55% of area reserved as forests	Increase in irrigated agriculture. One more water body in the east
1950	Coffee and tea plantations in south (47 km^2). Forest plantations (18 km^2)	All settlements larger. Labour settlements in interior areas. Communication networks into south-west	Forest land leased to Electricity Board	Pykara hydro-electric scheme executed with catchment of 185 km^2
1990	Commercial agriculture in north and east. Conversion of coffee and agriculture to tea. Increase in scrublands on outer slopes	Urban settlements larger. Permanent settlements on encroached lands. Routes to all parts of the hills	Encroachments on revenue and leased lands	Kundah hydro-electric scheme executed. High siltation into reservoirs

Table II. Ecological changes on the Sigur plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1812	Six patches of dryland agriculture. Teak forests in west and sandal trees in east	Few settled villages. Many abandoned villages. Routes to Wynaad, Mysore, Coimbatore and Nilgiris	Lands under local control	Perennial streams. Minor irrigation works in disuse
1905	Coffee estates towards the west	One trade and communication settlement	Most of the plateau as reserved forest	
1950	Increase in grazing	Interior areas opened up by game roads. Trade and communication centre larger		Increase in water flow due to hydroelectric scheme
1990	Decrease in agri-cultural area. Increase in scrubland	Unprecedented growth of township	Wildlife sanctuary declared (60 km^2)	Two perennial streams become seasonal

Table IV. Ecological changes on the Nilambur plains

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Densely forested hills. Flat lands under cultivation	Few permanent settlements	Forested lands under traditional temple control	Many perennial streams
1905	Teak and rubber plantations on the forest fringes	Nilambur town becomes a trade, communication and administrative centre. Routes to Kerala, Mysore and Nilgiris	Forested areas reserved	
1950	Rubber plantations in the plains			
1990	Timber and rubber plantations increase. Agriculture expands	Nilambur town expands. New labour settlements in forest fringes		

Table VI. Ecological changes on the Attappadi plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Densely forested. Shifting cultivation in patches	Paths towards east: to the Coimbatore plains	Local chieftain control	Many perennial streams
1905			Forested areas reserved	
1954	Settled agriculture. Forest degraded and reduced	Road linked to Coimbatore plains. New settlements along the river	Encroachments	
1975	No shifting cultivation. Settled agriculture shifting southward. Forest degraded to scrub	Road linked to to Coimbatore and Kerala. New settlements in the south-west		Perennial streams in northern parts become seasonal
1989	Garden and plantation agriculture in the south-west	Settlements in the south-west increase		Perennial streams in southern parts become seasonal

Table VII. Ecological changes on the Coimbatore plains

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Mainly agricultural. Hill slopes thickly forested, also under shifting cultivation	Agricultural settlements. Routes to Kerala plains, Mysore, and Tamil plains	Lands under local control	Some perennial streams, well and lift irrigation
1905	Agriculture spread to foot hills. Forest workings	Coimbatore a trade, communication and administrative centre. Routes to Nilgiris, Mysore, Kerala and Tamil plains. Railway lines to Kerala and Nilgiris	Forested areas in the hills reserved	
1950	Hill slopes degraded into scrub	Coimbatore township larger and becomes industrial. Communications extended into hills		Well and lift irrigation increased
1990	Increase in scrubland. Reduction in agri-cultural area	Coimbatore township larger. Growth of small industrial towns		Depletion of subsoil water

Table III. Ecological changes on the Wynaad plateau

Year	Land use	Communications and Settlements	Legal Categories	Water Resources
1800	Agriculture limited to few swamps. Other areas thickly forested		Lands held by cheiftains and temple	Many perennial streams
1905	Coffee estates in forest clearings(25 km^2). Forests worked	European settlements around estates. Routes to Nilgiri, Sultan's Battery and Kerala plains	Northern portions reserved. Other areas leased from cheiftan	
1950	Agriculture expands. Tea and coffee plantations larger (130 km^2)	Gudalur settlement as trade and communications centre. Routes to Nilgiri, Kerala and Mysore. Game roads in forested areas		
1990	Forests cleared for agriculture and plantations	Increased communication in suth and west.	Change in land categories. Reserved forests declared sanctuary	