Working Paper 435

Monsoon Diseases in Lower Kuttanad (Kerala): An Environmental Perspective

Bejo Jacob Raju
S Manasi

ISBN 978-81-7791-291-3

© 2019, Copyright Reserved
The Institute for Social and Economic Change,
Bangalore

Institute for Social and Economic Change (ISEC) is engaged in interdisciplinary research in analytical and applied areas of the social sciences, encompassing diverse aspects of development. ISEC works with central, state and local governments as well as international agencies by undertaking systematic studies of resource potential, identifying factors influencing growth and examining measures for reducing poverty. The thrust areas of research include state and local economic policies, issues relating to sociological and demographic transition, environmental issues and fiscal, administrative and political decentralization and governance. It pursues fruitful contacts with other institutions and scholars devoted to social science research through collaborative research programmes, seminars, etc.

The Working Paper Series provides an opportunity for ISEC faculty, visiting fellows and PhD scholars to discuss their ideas and research work before publication and to get feedback from their peer group. Papers selected for publication in the series present empirical analyses and generally deal with wider issues of public policy at a sectoral, regional or national level. These working papers undergo review but typically do not present final research results, and constitute works in progress.

Working Paper Series Editor: **A V Manjunatha**

MONSOON DISEASES IN LOWER KUTTANAD (KERALA): AN ENVIRONMENTAL PERSPECTIVE

Bejo Jacob Raju[1], S. Manasi[2]

Abstract

This paper attempts to trace the change in the epidemiology of monsoon diseases (communicable diseases that show high occurrence during the monsoon) in the Lower Kuttanad region of the Kuttanad Wetland Ecosystem (Kerala). Change in the epidemiology of climate sensitive diseases in an environment sensitive hotspot can be validated only if the environmental history and changes in the geography of the region are traced. The changes in the geography of the study area are traced with the help of Global Information System (GIS). The occurrences of monsoon diseases were captured by IDSP[3] data. The results were subsequently supplemented with the review of published literature and archival reports and in parallel, the perception of the local inhabitants regarding the changes in the geography of the region and its linkages to disease epidemiology are traced through oral history methods. The key informants (on the basis of traditional occupational divisions) from the villages in Lower Kuttanad were identified for the oral history. The results from the study reveal signs of ecological degradation in Kuttanad wetland. The narratives from the field visits connect changes in disease epidemiology to the changes in the geography of the study area.

Keywords: *Monsoon diseases, environmental epidemiology, Kuttanad Wetland Ecosystem*

Introduction

Climatic patterns are one of the cardinal factors that influence infectious disease trends and its transmission. It was known to human beings that climatic conditions affect epidemic infections well before the basic notion of infectious agents and infectious disease transmission was understood in the late nineteenth century. The variations in climatic conditions and erratic weather events can exert direct effects on the health outcomes of human beings.

Sachs & Malaney (2002) note that climatic features such as rainfall and humidity affect the stability of disease transmissions. Moreover, studies from all around the globe have proved that floods and other climatic factors can potentially increase the transmission of communicable and infectious diseases. For instance, floods accelerate the spread of water-borne diseases such as typhoid, fever, cholera, leptospirosis and hepatitis viral influenza. They also spread vector-borne diseases like malaria, dengue (and dengue haemorrhagic fever), yellow fever, and West Nile Fever (WHO Report, 2014).

There exists a large body of literature devoted to the impact of climate variability or seasonality on human health. It is interesting to note that the local epidemics which happen annually follow a predictable pattern. In North America, epidemics usually occur between November and March, manifested first by high rates of school and industrial absenteeism, followed by an increase in visits to health care facilities. In the tropics, disease seasonality can be associated with monsoons and the spread of epidemics during the monsoons suggest that indoor crowding caused by weather can be an

---

[1] PhD Scholar, CRUA, Institute for Social and Economic Change, Bangalore.

[2] Associate Professor, CRUA, Institute for Social and Economic Change, Bangalore.

[3] IDSP – Integrated Disease Surveillance Progamme is a disease surveillance scheme under the Ministry of Health and Family Affairs launched in November 2004 with support from the World Bank.

important factor (Nelson & Williams, 2007). Amarakoon *et al* (2004) also noted that most of the diseases (specifically communicable) do exhibit a seasonal pattern or trend.

Kerala is one of the highest monsoon rainfall regions in India and since serious association between weather seasonality and infectious diseases prevail, Kerala is highly vulnerable to communicable diseases during the monsoons every year. The paper aims to unravel the complexities involved in the understanding of monsoon epidemics in Kuttanad with an extensive field study in the Kuttanad wetland ecosystem (one of the most ecologically sensitive areas in India), where the topography and geo-climatic conditions of the region appear to intensify the risks of communicable diseases.

The territorial developments that have happened in the region over a few decades with criss-crossing roads, reclamation of wetlands and construction activities ignoring the sensitivity of the wetlands has made the region vulnerable to numerous ecological and public health problems. The developments have altered the ecological balance of the wetlands and has adversely affected the ecology and livelihoods of the people. The region has been giving potent warnings of ecological degradation like loss of flora and fauna, loss of eutrophication of water bodies, rapid spread of water hyacinth, avian flu outbreaks, increasing intensity of flooding, shortage of safe drinking water and increase in the proliferation of pathogens and parasites that spread water-borne and vector-borne diseases affecting human health.

The spread of infectious diseases during the monsoon is one of the most perennial problems in Kuttanad wetlands. The region becomes engulfed under water during the monsoons with the threats of flooding from four major rivers, namely Pampa, Achenkovil, Manimala and Meenachil. Thus incidence of infectious disease outbreaks during monsoons has become a perpetual phenomenon in the region.

The paper aims to trace the occurrences of infectious diseases (both vector and water-borne) specifically during the monsoons in the background of changes in the geography of the study area. The study also makes an investigation to understand the linkages between disease occurrences and resurgences with changes in the landscape if any.

Study Area

The study was conducted in Kuttanad wetland ecosystem in Kerala.The region lies in the south-west coast of the Indian peninsula and belongs to the largest Ramsar site[4] in India, the Vembanad-Kole wetland. The wetland is under serious threat due to environmental degradation arising from numerous anthropogenic activities and rapid urbanization. The spatial and temporal characteristics of the ecosystem have undergone a rapid change which had led to a multitude of environment and public health issues.

The total geographical area of the ecosystem is 1,157 sq. km. and it is spread across three districts in Kerala, namely Alappuzha, Kottayam and Pathanamthitta. The region is known for its vast paddy fields and is referred as the ‘rice bowl of Kerala’. The geographic characteristics of the region are unique as it lies between 0.5 to 2.5 metres below the average sea level and is water-logged almost

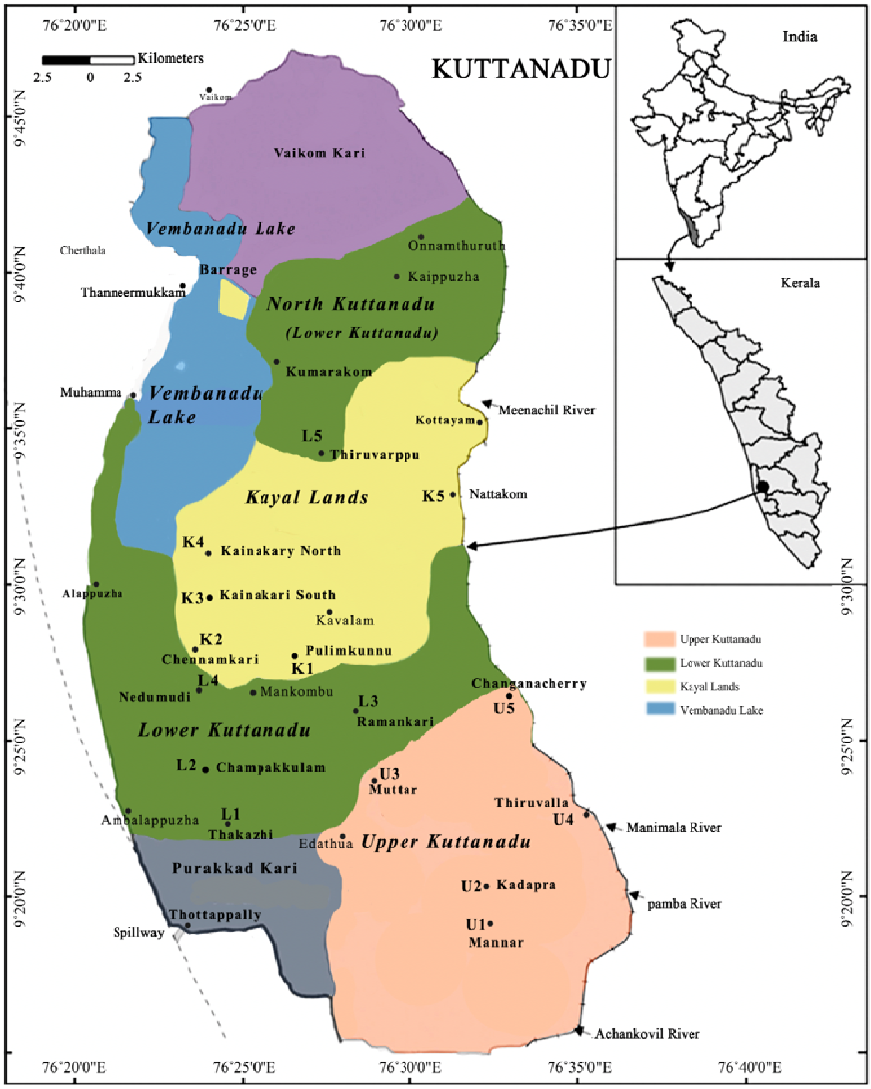
[4] Ramsar sites comprisewetlands deemed to be of “international importance” under the Ramsar Convention (1971).

throughout the year. The 'low-lying' nature often subjects the region to severe flooding during the monsoon and saline ingression during the summer.

Based on the geomorphology, agro-ecological and climatic characteristics like the height from the mean sea level, influence of rivers, flood risk, risk of saline water intrusion, soil type and fertility and the cropping pattern, Kuttanad is divided into six agro- ecological zones (Indo- Dutch Mission, 1989). They are Upper Kuttanad, Purakkad Kari, Lower Kuttanad, Kayal Lands, North Kuttanad and Vaikom Kari (See Figure 1).

We have attempted to trace the environmental history and geographic changes for the entire Kuttanad wetland but the field visits were restricted to Lower Kuttanad region (specifically in the villages under Kuttanad taluk) as this region faces high risk of monsoon flooding, salt water ingression and infectious diseases comparatively.

Figure 1: Map of Kuttanad Wetland Ecosystem (Showing the Agro-ecological Zones)



Source: (Vijayan & Ray, 2015)

Methods

The changes that have taken place in the geography of the Kuttanad wetland in terms of water bodies, land utilisation, agricultural practices and anthropogenic interventions were comprehended by employing GIS and remote sensing techniques. To check the land use change in Kuttanad wetland, Landsat 7 satellite image of Kuttanad wetland for the month of March has been downloaded for the year 1990 (Figure 1.2) and Landsat 8 satellite image of the same for the month of March 2017 (Figure 1.3) has also been downloaded. The satellite images for the two years have been processed and compared using ERDAS imaging software. One of the classification techniques such as supervised classification is extensively used to check the temporal changes in land use. The results were subsequently supplemented with the review of published literature and archival reports.

The occurrences of monsoon diseases were captured through IDSP data, and in parallel, the perception of the local inhabitants regarding the changes in the geography of the region and its linkages to disease epidemiology is traced through the oral history method. The key informants identified for the oral history are senior inhabitants of Lower Kuttanad who were formerly engaged (some still engaged) in the indigenous occupations of Kuttanad[5].

Land Use Changes in Kuttanad Wetland

The land use changes in Kuttanad wetland were captured using GIS and remote sensing techniques. For the analysis, the region was classified under five categories namely: water bodies, agricultural land use, current fallow, build-up land use[6] and mixed land use[7]. The area in sq. km. for each category and its share in the total land mass (in percentage) for two years 1990 and 2017 are shown in Table 1. The results from the table help in understanding the temporal changes in the land use over the span of 27 years.

The results reveal that there is considerable change in the land use over 27 years. The two key findings that have reflected in the mapping are the shrinkage of the water bodies and increase in the agriculture land use.

[5] The names of the informants given in the paper are not real to ensure confidentiality.

[6] Build-up Land comprises areas characterised by building, asphalt, concrete, suburban gardens and systematic street patterns.

[7] Mixed Land involves a range of complementary land uses that are located together in a balanced mix, including residential developments, shops, employment community and recreational facilities.

Figure 2: Land Use Classification, Kuttanad (1990)

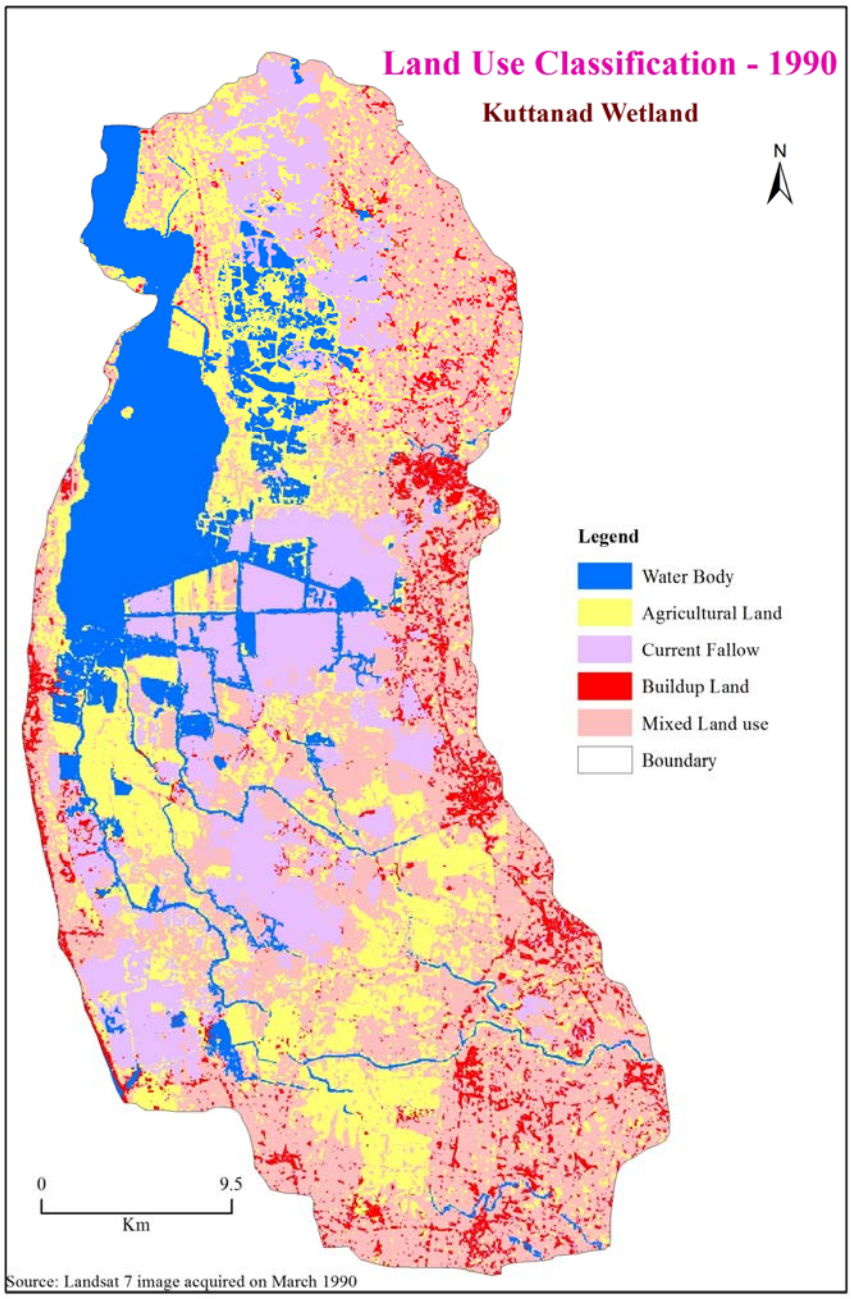


Figure 3: Land Use Classification, Kuttanad (2017)

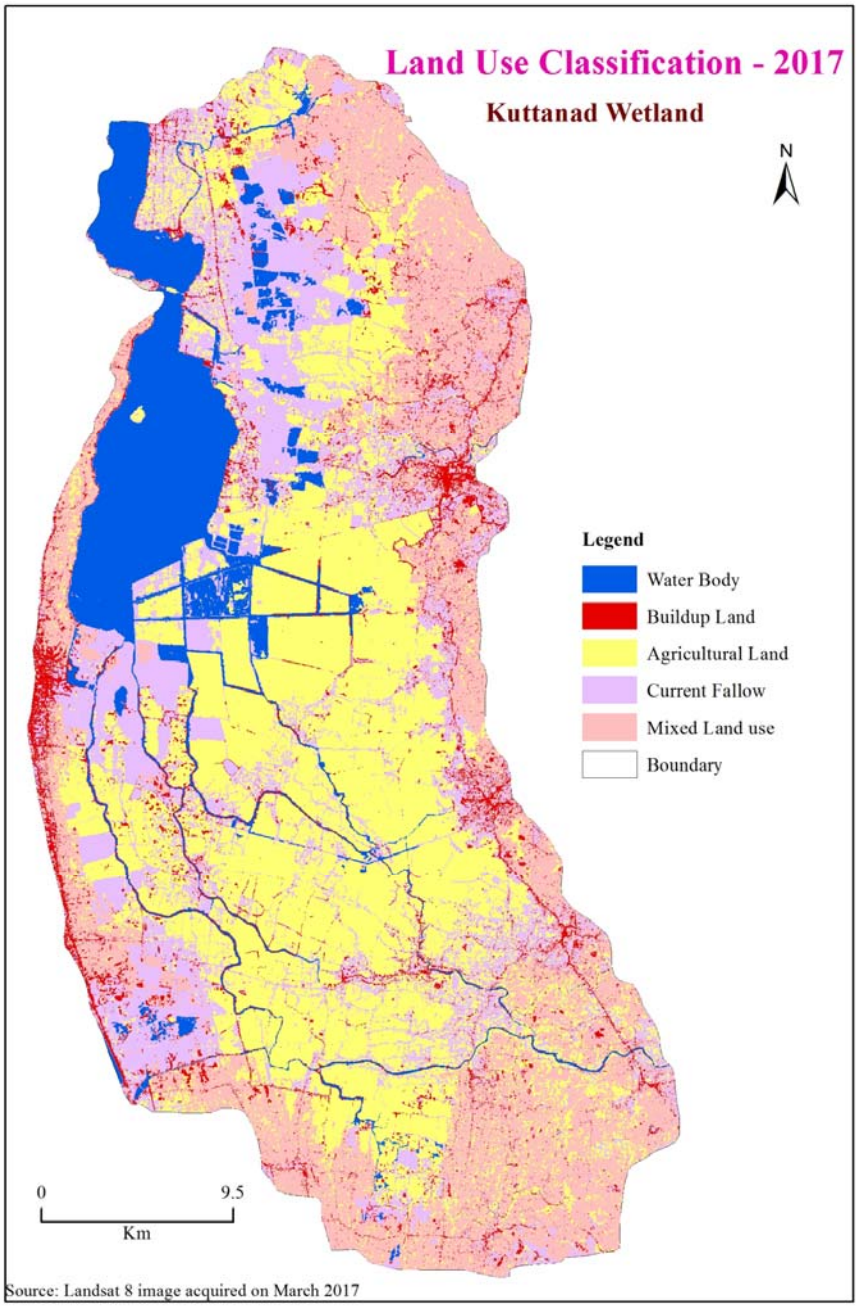


Table 1: Land Use Classification of Kuttanad (1990 and 2017)

Sl. No	Land use Classification	1990 (Area in Sq. Km.)	Percentage (%)	2017 (Area in Sq. Km.)	Percentage (%)
1	Water Body	195.95	15.85	140.84	11.39
2	Agricultural Land Use	277.29	22.42	453.52	36.67
3	Current Fallow	224.16	18.13	254.01	20.54
4	Build-up Land Use	66.02	5.34	79.83	6.46
5	Mixed Land Use	473.24	38.27	308.47	24.94

Source: Author (Extracted from Landsat satellite images 1990 & 2017)

Observations

Shrinkage of Water bodies

The reclamation of the lake area, unchecked encroachments and rising lakebed due to silting are the major reasons that led to the shrinkage of water bodies in Kuttanad over a period of years. While paddy cultivation was responsible for the reclamation of Vembanad lake until the 1980s, the growth of tourism is responsible for the current decline in the lake area (MSSRF, 2007).

The boom that happened in Kuttanad backwater tourism since the 1990s has paved the way for the mushrooming of the tourist resorts and homestays. All such establishments were built and spread targeting the water bodies in the wetland. This is one significant reason that led to the shrinkage of water bodies in Kuttanad wetland. In 1990, the water bodies in Kuttanad wetland covered up to 15.85% of the total wetland and has decreased to 11.39% in 2017.

Apart from the commercialisation of tourism in Kuttanad, other anthropogenic activities like urbanisation and rapid increase of human settlements have also put the wetland under environmental stress that accelerated the shrinkage of water bodies. From Table 1.1, a slight increase in the build-up land use also can be traced over the period of years. A study (Roopa & Vijayan, 2017) in an attempt to analyse the changes in the spatial extent of Vembanad lake, found significant depletion in the total area of the lake. The study employed spatial and statistical analysis using GIS for the years 1967, 2001 and 2014. The results reveal that the area of the Vembanad lake depleted 5% from 1967 to 2001 and from 2001 to 2014, a further depletion of 2% was marked.

Changes in Agriculture Land Use

The change in agriculture land use over this period is also substantial. The total agriculture land increased from 277.29 sq. km. (22.42%) in 1990 to 453.52 sq. km. (36.67%) in 2017. The commercialisation of agriculture and increased mechanisation post 1990s in Kuttanad are the cardinal reasons for the increase in agriculture land use.

The subsistence farming that existed before the 1990s in Kuttanad was replaced through large scale commercial operations and improved mechanisation. The re-establishment of paddy farming ensured profits to the farmers through commercialisation and mechanisation. The entry of harvesters is one significant change that happened in paddy cultivation in Kuttanad post 1980s. Though the entries of harvesters and increased mechanisation have eliminated labour in paddy cultivation, it increased the production of paddy by putting more land into cultivation.

The support and thrust from the state government since 2000s further expedited the pace of rejuvenation in paddy farming. Thus the large-scale commercialisation of agriculture, improved mechanisation and support from the state government accelerated the increase in agriculture land use in Kuttanad wetland.

Backwater Tourism and Environmental Hazards

Backwater tourism and houseboat cruise is an economic evolution that has successfully marketed the scenic beauty and natural charm of Kuttanad. Innumerable houseboats ply the waterways in Kuttanad and countless tourist resorts have clumped over the banks of the lakes with the widest possible waterfront. Considering the potential market and scope for revenue generation, the state government has extended complete support to backwater tourism.

The total revenue (both direct and indirect) generated by the state from tourism in the year 2017 is Rs. 33,383.68 crore which is 12.56% higher than the previous year. The arrival of both foreign and domestic tourists to the state in the year 2017 has also marked an increase over the previous year which is 5.15% and 11.39% respectively (Kerala Tourism Statistics, 2017).

According to the Department of Tourism (Kerala State), the districts of Alappuzha and Kottayam together account for 6.4% of the total tourist arrivals to Kerala. The influx of tourists to Alappuzha and Kottayam are mainly due to backwater tourism that is centered around Kuttanad wetland. The Kuttanad backwater tourism and the houseboat cruise are widely popular among foreign and domestic tourists visiting Alappuzha and Kottayam.

Houseboat Tourism

The birth of Houseboat Tourismin Kuttanad can be traced back to 15 November 1991 when the first houseboat in the history of Kuttanad cruised Punnamada lake. The initiative was made by the Alleppey Tourism Development Co-operative Society Ltd by redesigning and renovating a cargo boat into the shape of a house. The innovation gained popularity and lured both foreign and domestic tourists into houseboat cruising in Kuttanad backwaters.

The houseboat industry which flourished in the early 1990s changed its face with time. The industry which started with manually propelled boats (using oars) with just a single room now offers ineffable luxuries. The oars were replaced with motors which increased the speed of the cruise, making it more pleasurable to the tourists. The sizes of the houseboats too vary from single-room houseboats to luxurious air-conditioned double decker houseboats with conference halls and swimming pools.

The houseboat tourism industry is huge and has generated massive employment over a period of time. According to the estimates of the All Kerala Houseboat Owners Association, the industry has generated over 8,000 permanent jobs excluding the employment opportunities in houseboat tourism allied sectors (Michael, 2017).

Impacts of Backwater Tourism on the Environment

The growth of backwater tourism in Kerala has boosted employment opportunities and contributed to the GSDP which is great for a state like Kerala where the contribution of primary and secondary sectors to the GSDP is exiguous. But it is also important to understand the externalities associated with backwater tourism. 'Sustainable tourism' is possible only when it is sensitive to the local ecology, biodiversity and cultural traditions.

There are over 1,500 houseboats cruising the backwaters of Kerala and according to the records of the Port Office (Alappuzha) only 638 houseboats have proper licences to operate. The remaining run their boats illegally without following the state government's norms and rules. The Centre for Water Resource Development and Management (Kozhikode) made an attempt to determine the carrying capacity of Vembanad lake to contain the houseboats. According to the environment report of CWRDM, the optimum number of houseboats that can cruise in Vembanad lake is 328. Any addition to this can create serious environment hazards to the wetland ecosystem (Abdulla *et al*, 2014).

It was in November 2013 that a sewage treatment plant was installed in Kuttanad for the houseboats that operate in the backwaters. Previously, before the installation of the sewage treatment plant, the houseboats drained sewage to the water bodies directly without any treatment. Only houseboats that run with proper licence make use of the treatment plant as it is monitored by the District Tourism Promotion Council. The other houseboats continue polluting the backwaters by dumping both organic and inorganic wastes directly into the water bodies.

It is estimated that every day, a total of 4.25 tonnes of wastes are drained to the Vembanad lake by the houseboat tourism industry in Kerala. Among the total wastes dumped daily, 1.2 tonnes belong to inorganic waste category (Michael, 2017).

The sprouting of backwater tourism has also encouraged encroachments in the Vembanad lake. The lake is encroached for the construction of home stays, tourist resorts and other commercial buildings to lure tourists. The encroachments are targeted to maximise the water front for the tourist resorts as it is one of the prime attractions for the tourists visiting Kuttanad. The encroachments of the lake leads to the shrinkage of water bodies in the wetland and exacerbates the problem of solid waste discharge to the water bodies.

The umpteen houseboats operating over the capacity of the water bodies in Kuttanad and improper waste disposal are prime reasons for the water pollution in Kuttanad. The houseboats and tourist resorts add to the pollution load on water by discharging solid wastes to the water bodies. This raises growing dangers to public health, causing infectious diseases (water-borne and vector-borne) by degrading the ecology of the wetland.

Public Health in Kuttanad

The anthropogenic interventions hindering the tranquility of the local ecology of Kuttanad wetland have created precarious and outrageous public health issues. Overthe years, the wetland had fallen into the clutches of water-borne and vector-borne diseases. These infectious diseases assume epidemic proportions between the months of June and September every year when the monsoonal showers hit the region.

The wetland has been a nursery for pathogens and parasites that spread infectious diseases like Japanese encephalitis, leptospirosis, dengue and cholera. The scale, contagious nature and sometimes the fatal consequences due to these diseases has put it under the stamp of 'epidemic fevers'. The trepidation about the 'epidemic fevers' in Kuttanad sprouted in the mid-1990s when Japanese encephalitis struck in the form of an epidemic. Since the mid-1990s, in addition to Japanese encephalitis, Kuttanad has witnessed outbreaks of malaria, leptospirosis, dengue, chikungunya and what is generically described as 'viral fever'.

The occurrence of water-borne diseases, specifically Acute Diarrheal Disease (ADD) and leptospirosis, are on the higher side in Kuttanad compared to the other districts in Kerala. The flooding during the monsoons and the lack of access to safe drinking water are the main reasons for the high occurrences of water-borne diseases. The lack of access to safe drinking water in Kuttanad is a problem round the year, but it turns severe during the monsoons with the water bodies becoming completely undependable for drinking. The crisis gets accentuated with the spread of water-borne diseases. Apart from leptospirosis and ADD that are common in Kuttanad during the monsoon flooding, the resurgence of cholera was also reported in the region during the 2009 monsoons.

Communicable Diseases in Kuttanad

The Consolidated Communicable Disease Reports from the CHCs[8] and PHCs[9] in Kuttanad taluk reveal a slightly increasing trend in the occurrences of both water-borne and vector-borne diseases in the recent years. The major communicable diseases that get reported in Kuttanad are dengue, hepatitis (both A and B), leptospirosis and ADD. The trends in the occurrences of these diseases reveal seasonality, showing higher occurrences during the monsoon (June – September).

Table 2 shows the occurrences of communicable diseases in the district of Alappuzha in the recent years (2011- 2017). The data was extracted from the IDSP databank portal and is slightly under-reported as IDSP do not cover most of the cases that reach the private hospitals and alternative medicine based health care units.

The figures of the table show an increase in the occurrence of viral fever, dengue and leptospirosis in the recent years. On the contrary, the occurrence of malaria shows a declining trend. The figures for leptospirosis and dengue in the district appear appalling when compared to the state level data. In the year 2017, Alappuzha district reported the second highest cases for leptospirosis in the state. The figures of dengue occurrence were also high compared to other districts in the state. The district reported the third highest cases for dengue in 2017. Alappuzha district being the smallest (area wise) of all 14 districts in Kerala and one of the least populous districts, the figures on communicable diseases are quite shocking.

[8] CHCs – Community Health Centres

[9] PHCs – Primary Health Centres

Table 2: Communicable Diseases in Alappuzha District (2011 – 2017)

Diseases	2011	2012	2013	2014	2015	2016	2017
Fever(OP + IP)	1,13,751	1,46,480	1,66,153	1,48,928	1,32,530	1,40,823	1,84,562
Dengue	36	81	184	46	157	832	1,373
Malaria	119	123	77	81	83	40	0
Leptospirosis	86	58	70	76	71	282	199
ADD*	14,951	21,507	22,036	22,502	21,440	22,901	18,382
Hepatitis (A & B)	344	106	21	12	20	20	8

*ADD – Acute Diarrheal Disease

Source: IDSP, 2017

The water-borne and vector-borne diseases that got reported in the district in 2017 peaked during the monsoon months. The occurrences of the infectious diseases were mostly reported from the Kuttanad wetland, more precisely from Lower Kuttanad region which is most prone to monsoon flooding. During the monsoons in 2017, 70% of the total water-borne diseases that got reported in Alappuzha district were from Lower Kuttanad region (Lakshmi, 2017).

Apart from the seasonality trend (higher occurrences during monsoons), occupational patterns in the spread of water-borne diseases are also quite evident in Kuttanad. Most cases of leptospirosis in Kuttanad are reported from paddy workers, canal desilting labourers and MGNREGA volunteers who are more exposed to contaminated water and soil. Hence, most of the pre-monsoon preparatory measures of the local self-government bodies to contain the spread of leptospirosis are targeted around those people who are more exposed to dirty water at their work spaces.

People's Perception:

Changes in the Landscape Vs. Disease Epidemiology

To comprehend the environmental epidemiology of monsoon diseases in Lower Kuttanad, along with the capture of the environmental history and disease epidemiology of the region, it is also important to understand the local inhabitants' perceptions regarding the changes in the landscapes and their linkages to disease epidemiology, if any. The knowledge on people's perceptions could plug the gaps in conceiving the changes in the geography of the region to understand the changes in the occurrence of infectious diseases during the monsoons.

The perceptions of the local inhabitants on the changes in landscape and disease resurgences are captured through the oral history method. Field visits were conducted in Lower Kuttanad region, in the villages of Kuttanad taluk. The taluk comprises 14 villages wherein except three, all other villages fall in Lower Kuttanad Agro-ecological Zone. The key informants for the study were identified from these villages from whom the oral history was traced. The people identified as key informants were senior inhabitants of the region and belong to different social and occupational backgrounds. The indigenous occupational divisions of the Lower Kuttanad people were identified for the selection of the key informants. The key informants thus fall under the following occupational divisions:

- Agriculture labour (Paddy workers)
- Inland fishing

- Mussel gathering
- Toddy tapping
- Duck rearing
- Sand mining

Apart from those belonging to these occupations, the key informants also include social activists, environmental activists, and public servants. The narratives from the field helped in tracing the landscape changes and disease epidemiology. The signs of a degrading ecology could be captured from the narratives where people could link to disease resurgences.

Changes in the Agriculture Practices

The ecological settings of Kuttanad were not apt for the practice of agriculture, as the region falls below the mean sea level. The region is thus prone to frequent floods and salt water intrusion, making agriculture a risky venture. The natural settings in Kuttanad were altered in the second half of the 19th century through land reclamation from Vembanad lake. Thus the history of paddy cultivation in Kuttanad commenced with the state's support for land reclamation from Vembanad lake. Currently, Kuttanad wetland is called the 'rice bowl of Kerala' and the region's share in the total rice production of the state is over 20 percent[10].

The wetland had undergone changes in the pattern and practices in paddy cultivation with technological advancements and with changes in regulatory framework. The application of scientific knowledge, chemical and biotechnological interventions made paddy cultivation an attractive business in Kuttanad. The traditional single paddy cropping patterns got shifted to multiple paddy cropping patterns with the effective use of harvesters, fertilisers and with the advancements in technology. The changes in the agriculture practices had their impact on the ecology as well.

Gopalan (80 years old), an erstwhile paddy worker from Champakulam, narrates the practices used earlier for the removal of pests:

> *"We had traditional ways to remove pests that infect our crops. We would pump water into the fields to float the pests/worms and taking turns, remove them with big 'kottas'[11] and rags. This process was done twice in a day (morning and evening). It was very tiring and difficult, but we didn't have any other options back then. Now removal of pests is very easy using pesticides and agrochemicals."*

Kumaran (78 years old), a former paddy worker from Pulincunnoo village, observes the excess use of pesticides in Kuttanad:

> *"During our times, the diseases that affected our crops were 'chazhi' and 'munja'. We practiced simple ways to protect our crops like the use of ashes, cowdung and leaves of 'cheema konna'[12]. Now with the availability of pesticides, it's very easy to remove the pests. But the farmer should*

[10] Kerala Agriculture Statistics, 2015 – 2016.

[11] 'Kottas' are traditional wicker baskets.

[12] Gliricidia sepium (or 'cheema konna' in Malayalam) are mid-sized trees found in the tropics.

know how much he should use or proper supervision should be given to him. That's not happening. If the agriculture officer says one litre, our farmers now use two litres."

Apart from the application of pesticides and inorganic fertilisers, the advancements in technology have also increased the paddy production in Kuttanad. The construction of the Thanneermukkom Salt Water Barrier (TSWB) in the 1970s to contain the tidal activity and salt water ingression into the low-lands of Kuttanad from the Arabian Sea through Vembanad lake enhanced double cropping of paddy in Kuttanad. The salt water barrier, thus regulating the natural inflow of salinity, facilitated double cropping of paddy in Kuttanad. The completion of TSWB in 1976 converted a good percentage of paddy fields which previously practiced the traditional single annual cropping to double cropping (Thomas, 1996). The shift from the annual single cropping pattern of paddy cultivation to double cropping had its impacts on the ecology of the Kuttanad region.

Thomas (67 years old), a former paddy worker, observes the impact of double-cropping in Kuttanad:

"I believe the double cropping practices in Kuttanad have adverse effects on our land. We may have increased the production, but it's at the cost of our ecology. The double-cropping has decreased the intervals between the seasons. Now with the variety of seeds we get, a season will take up to five and a half months, hardly leaving any interval between the seasons. It is not good for the fields. The fields should be left fallow for some more time. The additional use of pesticides and chemicals due to double-cropping is again a threat. The use of pesticides doubled and so is its drain to the water bodies. This shift to double cropping is one important reason for the scarcity of safe drinking water in Kuttanad."

The excess use of inorganic fertilisers, pesticides and agrochemicals for paddy cultivation polluted the natural water bodies in Kuttanad. Previous studies have found residues of different pesticides in odious concentrations in Vembanad lake and in other water-channels in Kuttanad originating from the paddy fields (Padmakumar, *et al.*, 2006). The commercialization of agriculture post 1990s and the changes in the cropping patterns have increased the use of inorganic fertilisers and agrochemicals in Kuttanad. The negative effects of the excessive use of pesticides and agrochemicals have already been reflected in Kuttanad with the persistent problem of a drinking water crisis.

Change in Modes of Transport: From Water Dependent to Land Dependent

Decades ago, the prime mode of transportation of the people in Kuttanad was solely water dependent. The immense network of water bodies and man-made canals made water transport the most feasible and convenient mode of transportation. The poor road connectivity and absence of bridges made the local inhabitants of Kuttanad dependent on water transport. There were boats of different shapes and sizes, facilitating various purposes. Almost every house had '*kadav*'[13] which acted as easy access to

[13] Kadav is a ghat built along the embankments of water bodies.

waterways. The Kerala Water Transport Corporation facilitated the public water transport system in Kuttanad, which functioned across boat jetties where people could alight and board.

Compared to the other parts of Alappuzha district, the lack of road networks and the dependence on waterways as the only means of transportation had made the lives of the people in Kuttanad isolated. The arrival of monsoons would add to the agony of the people as they would be completely secluded.

Gopalan (80 years old), a former paddy worker in Champakulam village, narrates the isolation faced by him and his family decades back during the monsoon showers when the road connectivity was very poor:

> *"We didn't have roads like this through 'padashekarams'[14] before. We had only small bunds to walk through which also acted as boundaries between the paddy fields. During the monsoons, the bunds would collapse and we would be isolated in our huts for many days. The flooding would completely seclude our huts and there were times when we used to starve."*

The dependency of watertransport loosened with the development of the territorial complex in Kuttanad. A slow shift happened from water-dependent mode of transport to land-dependent mode of transport. The construction of the 24.2 km long Alappuzha-Changanacherry road (State Highway11) in 1957 and the construction of 27.2 km long Ambalapuzha-Thiruvalla road (State Highway12) accelerated the switch to land-dependent transport from water-dependent. The two roads cut across Kuttanad to join the Main Central Road (State Highway1). The construction of these two roads increased demand for many village roads to get connected to them.

Jacob (70 years old), who is elected as the president of a Panchayat in Lower Kuttanad, observes the demand for village roads in Panchayat meetings:

> *"The construction of new roads is the most discussed topic in Panchayat meetings these days. There will be pressure on the local self-government bodies to initiate proposals for new roads. Though however much we try to construct the roads scientifically, there will be definite damage done to the wetland through the construction as it will disrupt the water flows in paddy fields."*

Lately, many roads, bridges, and bunds got constructed across Kuttanad to improve the road connectivity. Initially, narrow bunds through the *padashekarams* were transformed to broad tarred roads. This disrupted the water flow through the fields which terribly increased the problem of water-logging. The unscientific construction of most roads and bridges had impacts on the environment sensitive ecosystem. The blockages of water bodies due to improper construction of roads and bridges subsequently increased the threat of flooding during the monsoons. Added to this crisis, the improvement in road connectivity and the switch from water transport to land dependent modes of transport made people neglect the natural water bodies and man-made water channels. This led to the growth of water hyacinth in water bodies which acts as breeding sites for pathogens and parasites that spread infectious diseases. The sites of abandoned 'kadavs' are now common in Kuttanad (Figure 5).

[14] Padashekarams mean 'collection of paddy fields' contiguously situated and owned by one person or a group of people.

Udayanandan (72 years old), a former paddy worker in Nedumudi, narrates the switch in the modes of transport in Kuttanad:

> *"Back then, our only means of transportation was through boats. We used to travel to Alappuzha, Changanacherry, Kottayam, Ambalapuzha, and Thiruvalla in boats only. Hourly boat services were there from boat jetties. It used to take two and a half hours to reach Alappuzha from Nedumudi in a boat. Now the situation has changed completely. We can reach Alappuzha in just 20 minutes from Nedumudi through road. We are happy that village roads are coming. But it is also sad to see boats becoming aliens to our grandchildren and kadavs getting abandoned."*

The urge for swift transportation and the sprout of backwater tourism in Kuttanad led to planned efforts to expand the road connectivity in the wetland. The changes in the terrain of the wetland had impacts on the lives of the local inhabitants. The unscientifically constructed roads and bridges have compromised the functions of the river system in Kuttanad. The deliberate interventions for a better road transport have blocked the free flow of water that led to persistent water-logging, increased growth of water hyacinth, decline in water quality, and accelerated the proliferation of pathogens and vectors that spread infectious diseases.

Figure 4: A Road through Paddy Fields Connecting Chempumpuram (Kuttanad Taluk) to Alappuzha – Changanacherry Road (State Highway 11)



Figure 5: Site of an Abandoned *'kadav'* in Front of a House in Champakulam Village



Neglect of water bodies

The introduction of piped water and improvements in road connectivity are the major reasons that led to the neglect of waterbodies in Kuttanad. The neglect led to the polluting of waterbodies through rampant waste disposal. The growth of tourism exacerbated the problem of unchecked waste dumping into the waterbodies.

Jacob (70 years old), the elected president of a Lower Kuttanad Panchayat, narrates the neglect of waterbodies in Kuttanad:

> *"In our childhood, we used to fetch water directly from streams and canals. The same water would be used for drinking and for household activities. Now we don't have to put that much effort as we have access to water at our house itself. The coming of piped water in Kuttanad has put us away from the waterbodies. Now I am not even seeing streams and lakes every day. People have become insensitive seeing the waterbodies getting polluted every day as it is not their worry anymore."*

The aftermath hit Kuttanad in the form of a severe drinking water crisis. Kainakary village is the worst-hit village in Kuttanad due to the scarcity of drinking water. Studies reveal that 80 percent of the people in Kainakary rely on contaminated canal water for their household purposes because of the scarcity of piped water (Sudheesh, 2017).

Apart from drinking water scarcity, the contamination of water sources increased the rates of spread of communicable diseases, specifically water-borne diseases. There has been an increase in the occurrence of water-borne diseases in Kuttanad in recent years[15]. Along with the higher occurrence of

[15] Consolidated reports of communicable diseases from CHCs and PHCs in Kuttanad Taluk

water-borne diseases, there have been reports of frequent skin diseases due to decline in the quality of water in the water sources in Kuttanad.

Kumaran (72 years old), former agriculture labourer from Pulincunoo village, narrates:

"Till 20 years ago, water from ponds was used for drinking and for other household activities in our house. It was the only source of drinking water and was pure and dependable back then. Now the water in our ponds is polluted due to the excessive use of pesticides and chemicals for agriculture. We use piped water now for our daily use, but it is not reliable. We have to travel some distance to fetch water in pots when the piped water fails."

Figure 6: Site of a Neglected Water Channel in Champakulam Covered with Water Hyacinth



The water quality in the waterbodies of Kuttanad has declined terribly. Water quality tests conducted in 2013 and 2017 to understand the extent of the decline in the quality of water found considerable decline in the quality over the four years. The test concluded that the consumption of water from the natural water channels in Kuttanad can cause serious gastrointestinal infections (Jayan, 2017). Several other geochemical studies in the Kuttanad waterbodies have found huge loads of nitrite, Total Dissolved Solids (TDS), suspended matter, low Dissolved Oxygen (DO), coliform count much higher than permissible limits and high amounts of other pesticide compounds indicating a severe decline in the quality of water in the natural waterbodies (MSSRF, 2007).

The increased drain of organic wastes and fertiliser residues from paddy fields into the waterbodies promoted the proliferation of water hyacinth and algal growth leading to the process of eutrophication. Eutrophication is accelerated with the low levels of salinity in the Vembanad lake. The dense growth of water hyacinth affects the water quality, deprives the waters of oxygen, prevents the entry of sunlight into water columns and affects the breeding of fish species. Eutrophication also builds up breeding sites for pathogens and vectors that affect human health.

The prolonged stagnation of waterbodies due to man-made hindrances and the existence of dense water hyacinth due to the neglect of waterbodies has promoted the accumulation of sewage and agricultural wastes in fresh water, causing threats to fish, human health and tourism.

Signs of degrading ecology in Kuttanad

The anthropogenic interventions and rapid urbanisation in Kuttanad wetland have created serious environmental issues. The impacts of the man-made interventions like land fillings, unscientific constructions and improper waste disposal have caused serious havoc to the local ecology.

The development agenda in the region massively hits the ecological balance of the wetland and has pushed the ecosystem into a state of 'ecological fatigue'. This has led to a multitude of environmental challenges that have short-term and long-term impacts like the loss of biodiversity, pollution of waterbodies, proliferation of aggressive water weeds, drinking water crisis, sanitation and human health problems etc. (MSSRF, 2007).

The erstwhile healthy and genetically diverse ecosystem of Kuttanad has been giving signs of degradation for many years. Some of the issues are highlighted below:

Avian Influenza Outbreaks

Avian influenza outbreaks in Kuttanad are one of the most serious signs the ecology has been giving against the degradation. The outbreaks of avian flu on ducks in Kuttanad have become a serious threat to the duck-rearing farmers in the wetland. In 2014, five spots in Kuttanad confirmed the spread of avian flu which ended up in the death of 17,000 ducks (Philip, 2014). After 2014, a second outbreak of avian flu sprouted in Kuttanad in 2016 which led to the culling of over 4,000 ducks. The avian influenza outbreaks are confirmed by the National Institute of High Security Animal Diseases (NIHSAD), Bhopal and have posed severe threats to backwater tourism in the region.

The avian flu outbreak has severely affected both the large-scale farmers who pursue duck farming throughout the year and the seasonal farmers who engage in duck farming targeting the Easter and Christmas festivity markets.

Job (65 years old), who is a large-scale duck farmer who had been into duck rearing for over 45 years in Kainakary, observes the reasons for the outbreaks of avian flu in Kuttanad. He had lost 3,000 ducks in the 2015 avian flu outbreak.

> *"I only blame the changes in the ecology, specifically the changes in the quality of water in our waterbodies. The faulty agriculture practices have ruined our water sources that have made duck farming a risk in Kuttanad. The excess use of pesticides that get drained into the waterbodies have contaminated the water, making it look like oil."*

The farmer also narrates the neighbourhood worries and the feelings people harbour against the duck-rearing folks:

> *"I have got blame from people for the spread of the flu. They think that their chicken and other domesticated animals will also get flu from my ducks. Though the veterinary doctors and other officials have made it clear that humans won't be affected, still people find my way of livelihood a threat to their lives and livestock. The profit we earn out of duck farming is not enough when*

compared to the efforts and mental tension we put up with in engaging in the business. Previously, there were 2,000 duck farmers in Kuttanad and now you won't find more than 300."

Dwindling Fish Stocks and Varieties in Inland Water Bodies

Kuttanad wetland which was home to great varieties of fish species is now facing a severe threat of rapid depletion of fish habitats. The decline in the fish varieties and stocks in inland water bodies has turned out to be an alarming ecological issue in Kuttanad. A study conducted by Ashoka Trust for Research in Ecology and Environment (ATREE) in 2017 in the inland water bodies have found significant decline in the total fish stocks and varieties. Several other reports have recorded that 23 fish species have become extinct in Kuttanad due to the shrinkage of natural water bodies and anthropogenic interventions (Michael, 2017).

The loss of natural habitats of fish species in inland water bodies in Kuttanad are caused by anthropogenic disturbances like frequent dredging in the lakes for lime shells, sand mining, creation of physical obstructions to water bodies disrupting the natural flow of water, construction of embankments, improper waste dumping by tourist resorts and houseboats into the lakes, faulty agriculture practices, erroneous methods of fishing, destruction of mangroves etc.

The studies show that the operation of Thanneermukkom Salt Water Barrier (TSWB) also contributed to the decline of fish species and stocks as it prevented the migration of several migratory fish species into Vembanad lake. A total of 13 species have vanished from the lake after the commissioning of TSWB (Kumar & Rajan, 2012). The backwater requires a small amount of salt water for the breeding of several fish species. The TSWB regulated the salt water influx to the lake which led to the decline in the catch of fishes in the inland water bodies in Kuttanad.

Apart from the impact of TSWB, the depletion of the mangroves through regular dredging and developmental interventions in the lakes have created a cascading effect on the breeding of prawns and shrimps. Thus the loss fish fauna in Kuttanad backwaters have threatened the livelihoods of the traditional inland fishermen community in Kuttanad, pushing them into agony.

Yeshodaran (75 years old), an inland water fisherman who had been into fishing in Champakulam since age 15, narrates the decline in the fish varieties in Kuttanad water bodies:

"There is no doubt that fish varieties have declined in Kuttanad inland water bodies. Fishes like 'naadan mushi', 'arakan' and 'kanambu' are rarely seen these days. The decline happened not just in these varieties, but in total stocks too. Two decades back, we used to get around 5 kilogrammes of fishes every day. Now we hardly get 2 kilogrammes in a day. The destruction of ponds and the 'kallu kettu' in water bodies (construction of embankments) have ruined the fish habitats in water bodies. The water quality has also come down and that can be understood from the colour itself. It has turned dark and look like oil silt. No wonder fishes are not able to survive."

Apart from the depletion in the fish stocks, a decline in the mussel and clam stocks is also an alarming issue in the wetland. The reports of decline in the mussel stocks and clam stocks in Kuttanad as a result of developmental interventions around the water bodies have put the mussel gatherers and clam harvesters in peril.

Anil Kumar (46 years old), a mussel gatherer from Kainakary, observes the decline in the mussel stocks in Kuttanad:

> *"I reckon the decline in mussel stock in Kuttanad is due to the stoppage of natural water flow in water bodies. Construction throughout the lake banks has affected the reproduction of the mussels. Moreover, the drain of chemicals from paddy fields has also done the damage. Now mussel gathering in Kuttanad is like gambling. There is no certainty regarding the catch."*

Decline in Toddy Production

Toddy tapping is one of the indigenous occupational divisions in Kuttanad. The region which was once famous for toddy tapping and toddy production has witnessed a setback due to a sharp decline in coconut cultivation in the recent years. The prime reason for the decline in coconut production is the land owners' neglect towards coconut palms. The neglect towards the coconut palms is primarily due to lack of profit from coconut productions as the coconut trees in Kuttanad have become unhealthy and thus more prone to several diseases. This slowly marked a decline in the traditional toddy tapping occupation in Kuttanad as the toddy tappers were not able to procure a sufficient amount of toddy, thereby not finding it profitable anymore.

The shift has happened towards Palakkad district which holds 60 percent of the trees licensed for toddy tapping (Martin, 2013). Decline in coconut plantations, drop in the number of toddy tapping labourers and lack of profitability have led to the shift from Kuttanad to Palakkad in toddy production.

Babu (63 years old), a former toddy tapper from Nedumudi village (who had taken up toddy tapping as occupation since age 14), recalls his experience then and observes the situation now:

> *"Earlier, when I was into toddy tapping, we used to get 5 to 6 litres of toddy every day. Now, it has dropped down drastically between half litre to one litre. The trees in Kuttanad have become unhealthy and are prone to many diseases which is one reason for the decline in toddy production."*

'Fever fear' and Infectious Diseases

The spread of infectious diseases and fevers in Kuttanad have undergone a change. The resurgenceof diseases which were once eliminated and the occurrences of new types of fevers have put the people in trepidation. The fear is at its peak during the monsoons when the numbers of occurrences of communicable diseases escalate.

Apart from the communicable diseases, skin-related diseases are also on the high side in Kuttanad. The contamination of the water bodies is the major reason for the increase in skin diseases.

Rajappan (61 years old), who has been running a local medical store in Nedumudi village for over 25 years, observes the transition fever has undergone in Kuttanad and change in mindset of the people:

> *"People are really cautious these days, especially during the monsoons. Their mindset has totally changed and it could be reflected from the change in the practice of over-the-counter purchase of medicines without doctors' prescription. The trend has completely gone. Now people are coming mostly with doctor's prescription which implies that the habit of self-diagnosis and self-treatment has reduced."*

He also observes the change in the symptoms of fevers during the monsoons in recent years:

"Earlier people could tell the symptoms of fevers precisely. Now they are not able to say. Most of the patients fail to convey their fever symptoms; instead they say they are suffering from some sort of "irritation" which they cannot explain. The symptoms are uncertain and have changed completely."

The perceptions on monsoon fevers have changed in the minds of the people. The fear they have developed over time has made them take all kinds of ailments during the monsoon seriously. They can figure out the changes now from the fevers that occurred in the region over a period of time.

Gopalan (80 years old), a former agriculture labourer, recalls the ailments during the monsoons in the past and compares it with ailments in recent years:

"During our young days, common cold and dysentery were the only ailments we got during the monsoon months. We mostly relied on home remedies for the treatment and rarely approached 'naattu vaidyans' (local healers). Now it's not the case. Different types of fevers with different symptoms we get during the monsoons. If fever was very 'casual' then, it's scary today. We cannot just rely on home remedies."

Varghese (74 years old), a senior inhabitant in Pulincunnoo, blames the negligence of natural water bodies as the reason for the spread of infectious diseases in Kuttanad.

"Mosquito menace has increased a lot in Kuttanad. I reckon the negligence of water bodies is the prime reason behind the spread of mosquito-borne diseases. The dysenteries are also not the same like the past. It has turned severe. The lack of safe drinking water in Kuttanad is the cause of most dysenteries in our region."

Baby (66 years old), an inhabitant in Moncompu village, observes the fever transition in Kuttanad:

"I seriously think the fever has undergone some sort of transition in our region. Earlier, fevers used to get over in 2-3 days. Now, whatever the type of fever it may be, it persists for months. The home remedies are also not effective these days."

Conclusion

Kuttanad wetland has undergone spatial changes over a period of years. The total area of the water bodies has declined and there is an increase in the total built-up area. The region has witnessed many signs of ecological degradation. Similarly, there have been perceptible changes in the epidemiology of communicable diseases. The nature and symptoms of feversand infections during the monsoons have changed. High occurrence of infectious diseases and resurgence of eliminated diseases during the monsoons have put light on the depletion of local ecology. The oral histories and narratives from the field reveal the local inhabitants' perception on the changes in landscape and its linkages to the epidemiology of monsoon diseases.

References

Abdulla, P K, D Sony, P Jayakumar, S Hameed and B A A (2014). *Assessment of Impactof Inland Vessels on the Water Quality in Vembanad Lake.* CWRDM.

Amarakoon, A M D, A A Chen, S C Rawlins and M A Taylor (2004). Dengue Epidemics - Its Association with Precipitation and Temperature, and Its Seasonality in Some Caribbean Countries. *West Indian Medical Journal*, 53 (2): 60.

Indo- Dutch Mission (1989c). *Kuttanad Water Balance Study: Updating Mission Report*. Ministry of Foreign Affairs, Netherlands and Government of Kerala, Trivandrum, Kerala. Pp 25.

Jayan, C (2017). *Nedumudi Gram Panchayat Development Report.*

Kerala Tourism Statistics (2017). *https://www.keralatourism.org/tourismstatistics/tourist_statistics_20172018031412261 4.pdf*

Kumar, K K and P D Rajan (2012). *Fish and Fisheries in Vembanad Lake.* ATREE, Community Environment Resource Centre.

Lakshmi, N (2017). After Dengue and H1N1, Now Rat Fever Threatens Kerala. Retrieved from Asianet *News: https://newsable.asianetnews.com/kerala/after-dengue-and-h1ni-now-rat-fever-threatens-kerala*

Martin, K A (2013). In Toddy, Numbers Don't Match. Retrieved from *The Hindu: http://www.thehindu.com/news/cities/Kochi/in-toddy-numbers-dont-match/article4928785.ece*

Michael, J C (2017). Kayalinu Thaangaan Aavunnilla Ee Vanchikale. *Mathrubhumi*, July 5. P 8.

MSSRF (2007). *Measures to Mitigate Agrarian Distress in Alappuzha and Kuttanad Wetland Ecosystem*. M. S. Swaminathan Research Foundation.

Nelson, K E and C Williams (2007). *Infectious Disease Epidemiology: Theory and Practice* (Second ed.). Jones & Bartlett Learning.

Padmakumar, K G, L Bindu, N Joseph, B Sreekumar, G Sunil, N Unnikrishnan and S Kurien (2006). River Fish Inventory under Participatory Approaches: Meenachil Fish Count 2004. *Environment and Ecology,* 24 (3): 584-90.

Philip, S (2014). Kerala government orders Massive Culling of Ducks after Tests Confirm Avian Influenza. Retrieved from *The New Indian Express*: *http://indianexpress.com/article/india/india-others/tests-confirm-kerala-duck-deaths-caused-by-avian-influenza/*

Roopa, V and N Vijayan (2017). Detection of Land Use Land Cover Changes in the Wetlands of Kuttanad, Kerala. *International Journal of Innovative Research in Science, Engineering and Technology,* 6 (6): 10487-91.

Sachs, J and P Malaney (2002). The Economic and Social Burden of Malaria. *Nature,* 415: 680-85.

Sudheesh, T (2017). Polluted Kuttanad in Deep Waters. Retrieved from *Deccan Chronicle*, 7 February: *https://www.deccanchronicle.com/nation/in-other-news/070217/polluted-kuttanad-in-deep-waters.html*

Sunny, Y (2016). Social Relations, Environmental Discourses and Region Formation: The Case of Kuttanad in Kerala (PhD Dissertation). May.

Thomas, P M (1996). Decline of Paddy Cultivation in Kerala: A Study of Economic Causes. Dr. John Matthai Centre, Thrissur, Department of Economics, University of Calicut.

Vijayan, D and J G Ray (2015). Ecology and Diversity of Cyanobacteria in Kuttanadu Paddy Wetlands, Kerala, India. *American Journal of Plant Sciences,* 6: 2924-38.

WHO (2014). *A Global Brief on Vector-Borne Diseases*.

Recent Working Papers

371 Migration from North-Eastern Region to Bangalore: Level and Trend Analysis
Marchang Reimeingam

372 Analysis of Revealed Comparative Advantage in Export of India's Agricultural Products
Subhash Jagdambe

373 Marital Disharmony among Working Couples in Urban India – A Sociological Inquity
Shiju Joseph and Anand Inbanathan

374 MGNREGA Job Sustainability and Poverty in Sikkim
Marchang Reimeingam

375 Quantifying the Effect of Non-Tariff Measures and Food Safety Standards on India's Fish and Fishery Products' Exports
Veena Renjini K K

376 PPP Infrastructure Finance: An Empirical Evidence from India
Nagesha G and K Gayithri

377 Contributory Pension Schemes for the Poor: Issues and Ways Forward
D Rajasekhar, Santosh Kesavan and R Manjula

378 Federalism and the Formation of States in India
Susant Kumar Naik and V Anil Kumar

379 Ill-Health Experience of Women: A Gender Perspective
Annapuranam Karuppannan

380 The Political Historiography of Modern Gujarat
Tannen Neil Lincoln

381 Growth Effects of Economic Globalization: A Cross-Country Analysis
Sovna Mohanty

382 Trade Potential of the Fishery Sector: Evidence from India
Veena Renjini K K

383 Toilet Access among the Urban Poor – Challenges and Concerns in Bengaluru City Slums
S Manasi and N Latha

384 Usage of Land and Labour under Shifting Cultivation in Manipur
Marchang Reimeingam

385 State Intervention: A Gift or Threat to India's Sugarcane Sector?
Abnave Vikas B and M Devendra Babu

386 Structural Change and Labour Productivity Growth in India: Role of Informal Workers
Rosa Abraham

387 Electricity Consumption and Economic Growth in Karnataka
Laxmi Rajkumari and K Gayithri

388 Augmenting Small Farmers' Income through Rural Non-farm Sector: Role of Information and Institutions
Meenakshi Rajeev and Manojit Bhattacharjee

389 Livelihoods, Conservation and Forest Rights Act in a National Park: An Oxymoron?
Subhashree Banerjee and Syed Ajmal Pasha

390 Womanhood Beyond Motherhood: Exploring Experiences of Voluntary Childless Women
Chandni Bhambhani and Anand Inbanathan

391 Economic Globalization and Income Inequality: Cross-country Empirical Evidence
Sovna Mohanty

392 Cultural Dimension of Women's Health across Social Groups in Chennai
Annapuranam K and Anand Inbanathan

393 Earnings and Investment Differentials between Migrants and Natives: A Study of Street Vendors in Bengaluru City
Channamma Kambara and Indrajit Bairagya

394 'Caste' Among Muslims: Ethnographic Account from a Karnataka Village
Sobin George and Shrinidhi Adiga

395 Is Decentralisation Promoting or Hindering the Effective Implementation of MGNREGS? The Evidence from Karnataka
D Rajasekhar, Salim Lakha and R Manjula

396 Efficiency of Indian Fertilizer Firms: A Stochastic Frontier Approach
Soumita Khan

397 Politics in the State of Telangana: Identity, Representation and Democracy
Anil Kumar Vaddiraju

398 India's Plantation Labour Act - A Critique
Malini L Tantri

399 Federalism and the Formation of States in India: Some Evidence from Hyderabad-Karnataka Region and Telangana State
Susant Kumar Naik

400 Locating Armed Forces (Special Powers) Act, 1958 in the Federal Structure: An Analysis of Its Application in Manipur and Tripura
Rajiv Tewari

401 Performance of Power Sector in Karnataka in the Context of Power Sector Reforms
Laxmi Rajkumari and K Gayithri

402 Are Elections to Grama Panchayats Party-less? The Evidence from Karnataka
D Rajasekhar, M Devendra Babu and R Manjula

403 Hannah Arendt and Modernity: Revisiting the Work *The Human Condition*
Anil Kumar Vaddiraju

404 From E-Governance to Digitisation: Some Reflections and Concerns
Anil Kumar Vaddiraju and S Manasi

405 Understanding the Disparity in Financial Inclusion across Indian States: A Comprehensive Index for the Period 1984 – 2016
Shika Saravanabhavan

406 Gender Relations in the Context of Women's Health in Chennai
Annapuranam K and Anand Inbanathan

407 Value of Statistical Life in India: A Hedonic Wage Approach
Agamoni Majumder and S Madheswaran

408 World Bank's Reformed Model of Development in Karnataka
Amitabha Sarkar

409 Environmental Fiscal Instruments: A Few International Experiences
Rajat Verma and K Gayithri

410 An Evaluation of Input-specific Technical Efficiency of Indian Fertilizer Firms
Soumita Khan

411 Mapping Institutions for Assessing Groundwater Scenario in West Bengal, India
Madhavi Marwah

412 Participation of Rural Households in Farm, Non-Farm and Pluri-Activity: Evidence from India
S Subramanian

413 Inequalities in Health Outcomes: Evidence from NSS Data
Anushree K N and S Madheswaran

414 Urban Household Enterprises and Lack of Access to Production Loans
Shika Saravanabhavan and Meenakshi Rajeev

415 Economic and Social Benefits of SHG-Bank Linkage Programme in Karnataka
Meenakshi Rajeev, B P Vani and Veerashekharappa

416 Two Decades of Fiscal Decentralization Reforms In Karnataka: Opportunities, Issues and Challenges
M Devendra Babu, Farah Zahir, Rajesh Khanna and Prakash M Philip

417 Karnataka State Budgets - How Far Have They Promoted Inclusiveness?
K Gayithri and Vijeth Acharya

418 Caste Discrimination Practices in Rural Karnataka
I Maruthi and Pesala Peter

419 Food Security in Brics - Current Status and Issues
Malini L Tantri and Kumar Shaurav

420 Impact of Age Structure Transition on Current Account Balance for India: An Empirical Analysis
Aneesha Chitgupi

421 Market Value and Capital Structure: A Study of Indian Manufacturing Firms
Dhananjaya K and Krishna Raj

422 Inequity in Outpatient Healthcare Use and Utilization of Public Healthcare Facilities: Empirical Evidence from NSS Data
Anushree K N and S Madheswaran

423 Role of Worker's Compensation Benefit in Estimating Value of Statistical Life
Agamoni Majumder and S Madheswaran

424 Making Every Drop Count – Micro-Level Water Demand Accounting Challenges and Way Forward
Chaya Ravishankar, Sunil Nautiyal and S Manasi

425 Conceptualizing Peri-Urban-Rural Landscape Change for Sustainable Management
Mrinalini Goswami

426 Social Entrepreneurship: A Business Model for Sustainable Development
Neeti Singh and Anand Inbanathan

427 Revenue-Based Business Model to Growth-Based Business Model: A Critical Review of Indian Pharmaceutical Industry
P Omkar Nadh

428 Role of Social Entrepreneurship in the Quality of Life of Its Beneficiaries
Neeti Singh and Anand Inbanathan

429 Land Alienation in Tripura: A Socio-Historical Analysis
Rajiv Tewari

430 The Indian Mining Industry: Present Status, Challenges and the Way Forward
Meenakshi Parida and S Madheswaran

431 Impact of Irrigating with Arsenic Contaminated Water on Farmers' Incomes in West Bengal
Madhavi Marwah Malhotra

432 Macroeconomic Determinants of Software Services Exports and Impact on External Stabilisation for India: An Empirical Analysis
Aneesha Chitgupi

433 Fiscal Dependency of States in India
Darshini J S and K Gayithri

434 Determinants of Farm-Level Adoption of System of Rice and Wheat ntensification in Gaya, Bihar
Shikha Pandey and Parmod Kumar

Price: ₹ 30.00 ISBN 978-81-7791-291-3

INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE
(ISEC is an ICSSR Research Institute, Government of India
and the Grant-in-Aid Institute, Government of Karnataka)
Dr V K R V Rao Road, Nagarabhavi P.O., Bangalore - 560 072, India
Phone: 0091-80-23215468, 23215519, 23215592; Fax: 0091-80-23217008
E-mail: manjunath@isec.ac.in; Web: www.isec.ac.in