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# LAND USE ANALYSIS OF KOTAGIRI WATER-SHED AND KOOKALTHORAI USING GOOGLE EARTH IMAGERY (2012-2018)

**FIELDWORK REPORT AT KEYSTONE FOUNDATION**
**(5/10/2018 to 16/10/2018)**
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# CHAPTER 1: INTRODUCTION

## 1.1 BACKGROUND

Nilgiris is one of the oldest mountain ranges of Tamil Nadu state of Western Ghats with many hill ranges and broad valleys slopping towards the plain. It comprises of dense Shola forests, rolling grasslands, waterfalls, streams, tea plantations, vegetable gardens, tourist spots etc. Because of its pleasant climate Britishers were mainly attracted towards this area and promoted the eucalyptus plantations on the fallow lands, whereas, tea plantation was promoted for the livelihood purposes. But with time, rapid changes in the settlement areas due to the urbanization, growth of tea estate and many tourist resorts have come up, which has contributed to the change in land use.

Our study is focused on the change in the land use. It's a term that is used to describe human uses of the land, or immediate actions modifying or converting land cover. It includes broad categories such as human settlements, protected areas, and agriculture. These broad categories are subdivided into refined categories, such as urban and rural settlements, irrigated and rainfed fields, national parks and forest reserves, and transportation and other infrastructure. Land Use portrays the utilization of the land and helps to understand its management.

Thus, Land use can be studied by Land use mapping, which helps to monitor the changes which are being observed regarding the increase and decrease in the settlements, agricultural land cover, plantations, forest cover etc. Thus, in order to understand any problem in terms of natural resources and find its solution, we need to identify the potential zones of problems for in depth understanding. All mismanagement of resources have been linked to the sudden increase in population and land use mapping helps to analyze the major land use changes. We have restricted our time frame to six years. This can further help us to understand about the water problems or any other resource problem in nature.

## 1.2 OBJECTIVES

1. To analyze the land use change of Kotagiri and Kookalthorai.
2. To study community perception towards land use change in their immediate catchment.
3. To document their traditional practices and beliefs towards the water source.

# CHAPTER 2: LITERATURE REVIEW

Nalina P. *et al.*, 2014 discussed the land use-land cover pattern of Nilgiris District. They had divided their study area into 9 categories. They mentioned about the land conversion occurring through the replacement of natural forest by settlement, or agriculture. This was primary due to the human destruction of forest and association with extensive use of land for the agricultural production for livelihood systems. They had taken the data from 1990 to 2010 using satellite remote sensing. The changes in land use and land cover of Nilgiris district were monitored using LISS I and LISS III of IRS 1A and IRS-P6 (Nalina P. *et al.*, 2014) satellites.

Mamtha R. *et. al*., 2016 studied the Kotagiri area of Nilgiri district. In their study, they emphasized on deforestation of the area. One of the primary sources of Landsat image is The United States Geological Survey (USGS), from which the imageries of Kotagiri panchayat were taken for the years 2013 and 2016. They had divided their land use pattern into twelve categories (Mamtha R. *et. al*., 2016). Through NDVI imagery they differentiated the area between 2013 and 2016. The changes are becoming more in destroying of trees and lands. In which, the satellite image shows the difference between the images for both different years.

Lakshumanan C. *et. al*., 2012 had discussed about past 36 years of data of Nilgiri district by using Remote Sensing and Geographic Information Systems (GIS) techniques. Landsat-MSS, Landsat-TM, and IRS-P6- LISS III satellite imageries were used to assess the Landuse and Land cover changes through visual interpretation techniques in their study. Land use mapping coupled with detailed ground truth verification and Landsat Enhanced Thematic Mapper (ETM) and IRS-P6-LISS III (Lakshumanan C. et. al., 2012) was used for the analysis. They had their land use map in thirteen categories for analyzing the land use map pattern. In their study Land use, change detection allows for the identification of major processes of characterization of land use dynamics. The reason for such consequence is a result of over-dependence on primary resources with a direct effect on biodiversity; land use and land cover dynamics, terrestrial ecosystem and climate. They worked on a broader perspective and analyzed the data from 1973-2009.

Compared to those studies we have mainly focused on Kotagiri and Kookalthorai areas of Nilgiri district. We have discussed five land use patterns, which are tea, built up, agriculture, tree cover and rock outcrop. In our study we are using the Google Earth images from 2012 to 2018. Google Earth Pro Software was used for mapping. Later, QGIS was used to prepare the land use maps and area for the different classes was calculated.

# CHAPTER 3: RESEARCH METHODOLOGY

## 3.1 STUDY AREA

We have two study areas. The first one is the Catchment of the Catherine Waterfalls. The catchment area of the Catherine Waterfalls lies over an area of 3510.53 acres. It encompasses villages and towns like Kotagiri, Kerben Hatti, Anayatti, Gathugul Hatti, Thanthandu. Kotagiri has the major proportion of the population in the catchment. It has population of 7952 of which 3755 are males while 4197 are females as per Population Census 2011. Land Use Mapping was carried out for the same.

The second area we focussed on was Kookalthorai. The watershed for the Kookalthorai stream was demarcated and land use mapping has been carried out for the same. The total area of the study is 6848.8 acres. Kookalthorai Shed is a small Village/hamlet in Udhagamandalam Block in the Nilgiris District of Tamil Nadu State, India. It comes under Kookal Panchayath. It is located 16 Km towards East from district head quarters Udhagamandalam and 15 Km from ooty. Kookalthorai Shed and postal head office is Kattabettu. To tide over the loss from tea plantations, a movement to encourage small farmers to take up the cultivation of silver oak trees is catching on in the Nilgiris.

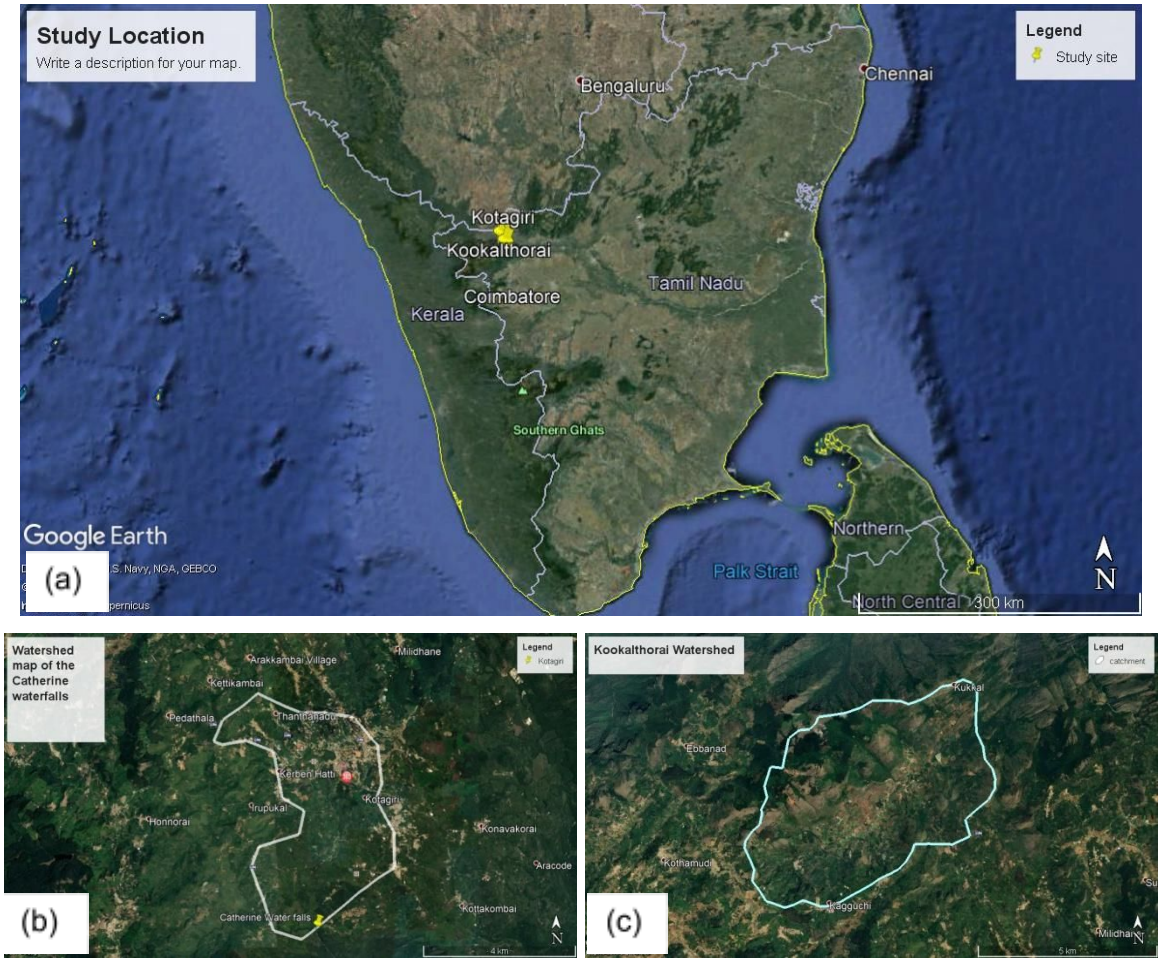


*Fig. 3.1: (a)Both the study sites; (b) Catherine waterfalls Catchment; (c) Kookalthorai watershed*

## 3.2 QUESTIONNAIRE DESIGN

Based on the demographics of the two study area, separate questionnaires were prepared for each area because Kotagiri is more of semi-urban land use type and Kookalthorai more of village area most of the area covering agricultural practices.

We used simple random sampling technique and door to door survey method for recording the human perception about the land use in the Kookalthorai.

However, we used stratified sampling technique for the Catchment of the Catherine Waterfalls. As most of the population is in and around Kotagiri, we took surveys in the Happy Valley and Main Market area of Kotagiri. Due to the time constraint and weather issues, the total sample size was 60. The questionnaire was designed in general to get a detailed outcome about the people's perception on the different aspects and their experiences regarding land use and water availability, change in built up or tea estate in past six years and how this has affected their livelihood. Also, along with it, we asked about the traditional practices people followed in regard to land and water.

We used ODK build to design our questionnaire and data was collected using the ODK collect app. This helped to record the perception of the respondents and the data could be directly transferred to the excel sheet and analysis could be performed.

### 3.2.1 FIELD SURVEY

Day 1: We went to Kookalthurai and recorded around 20 perceptions of the people regarding water and land use changes. We also enquired about their traditional beliefs and practices regarding land use and water.

Day2: We took the perception of the people from the Happy valley region of the Kotagiri

Day3: We recorded 35 perceptions of the local people from the Kotagiri main town area which included local people, shop and the households etc.

*Fig. 3.2: (a)Images from field survey*

*Fig. 3.2: (b)Images from field survey*

### 3.2.2 DATA COLLECTION

After the survey we transferred the answers recorded in ODK collect to the excel sheet and overall analysis regarding the outcome of the human perception was done.

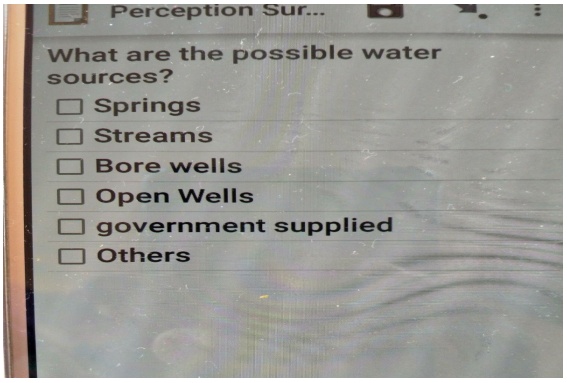


*Fig. 3.3: Snapshot of ODK form*

## 3.3 MAPPING

Google Earth pro software to map the land use classes for the two study areas. We took the 2012 and 2018 Google Earth images to analyze the land use change pattern in these areas. 2012 was chosen as the base year because of the absence of data which led to blank strips on the images or the images were not clear due to the presence of clouds. We have divided the land use in five classes, which are built up, tea estate, tree cover, agricultural field, and rock outcrop. The land use for the catchment of the Catherine Waterfalls for 2018 was mapped by the Keystone foundation. QGIS was used to create the land use maps later and perform further analysis.

# CHAPTER 4: OBSERVATIONS AND FINDINGS

## A. CATCHMENT OF CATHERINE WATERFALLS

The catchment area of the Catherine Waterfalls lies over an area of 3510.53 acres. It encompasses villages and towns like Kotagiri, Kerben Hatti, Anayatti, Gathugul Hatti, Thanthandu (*Fig 4.1)*.

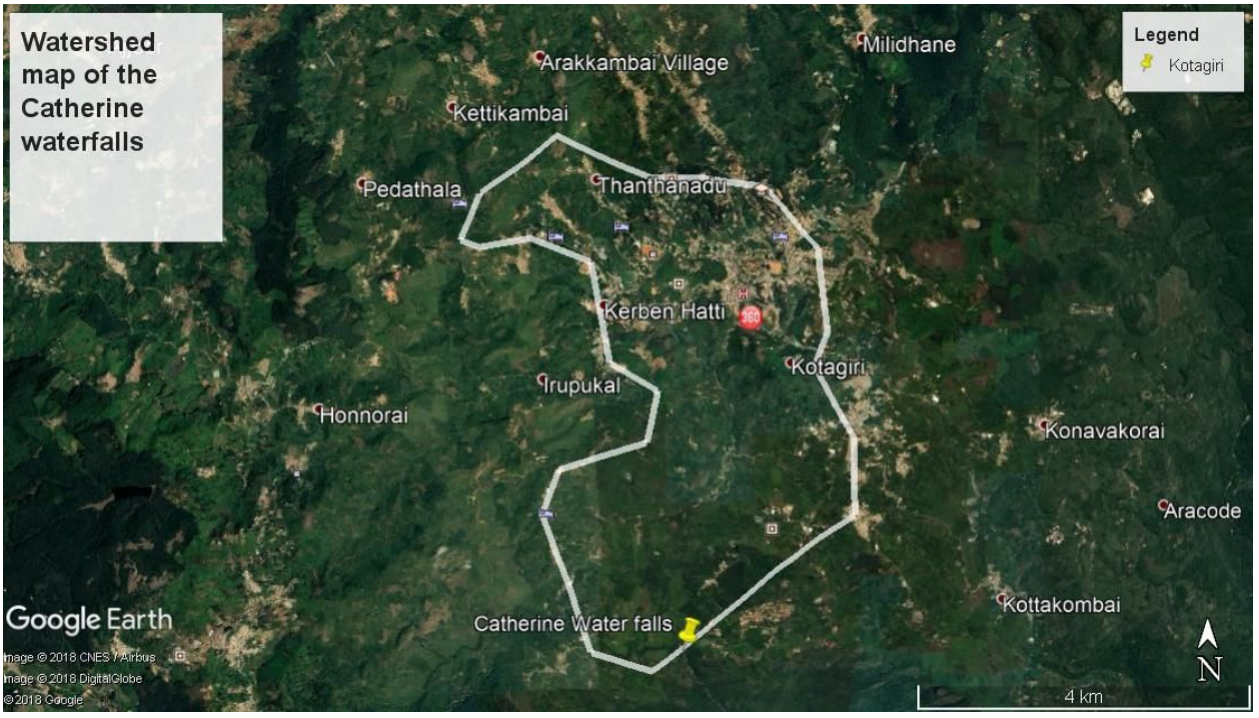


*Fig. 4.1: Google Earth Image of the catchment of the Catherine Waterfalls*

With the help of the Google Earth Pro, we were able to map the land use pattern in the area and convert the same to the map by QGIS. This enabled us to calculate the area for different classes the map has been classified in.

The major land-use classes we classified the area is - Built Up, Rock Outcrop, Tea Estate, Tree Cover and Wetland-Agriculture Area. The tree cover over here doesn't specifically entitle to the forest cover, rather it means tree or small bushes cover on land. Also, the Built-up includes all sorts of human settlements and construction area within the study area. The Catherine Falls Catchment Land Use Map for 2012 and 2018 (*Fig 4.2 and Fig 4.3*) were created for the same. The area calculated for both the years shows that the major land proportion was of the tea estate (*Chart 4.1 and Chart 4.2*). The majority of built up is concentrated in and around the Kotagiri and the lower portion of the catchment primarily comprises of the tea estate. However, change has been recorded for all the classes during the time frame.

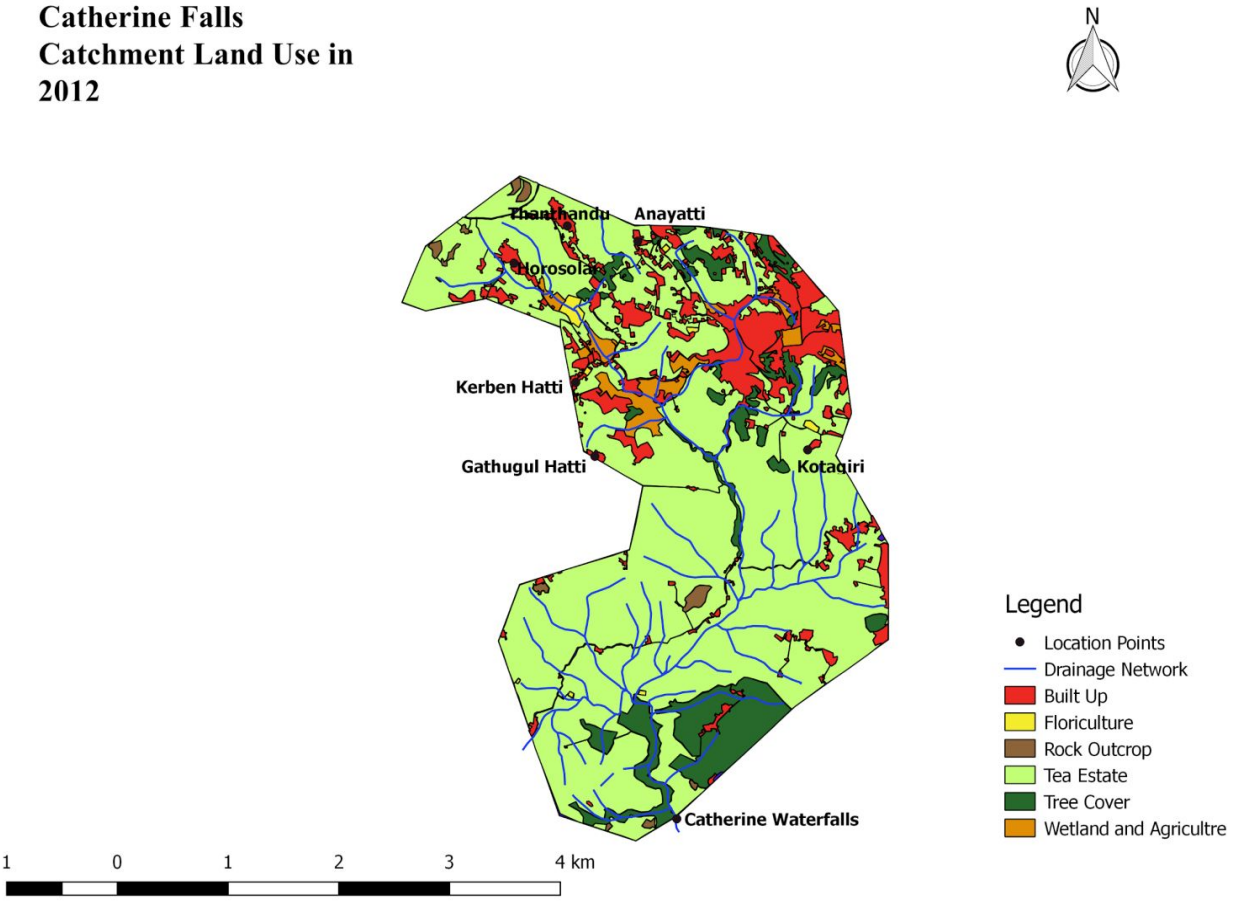


*Fig. 4.2: Map of the Catherine Falls Catchment Land Use in 2012*

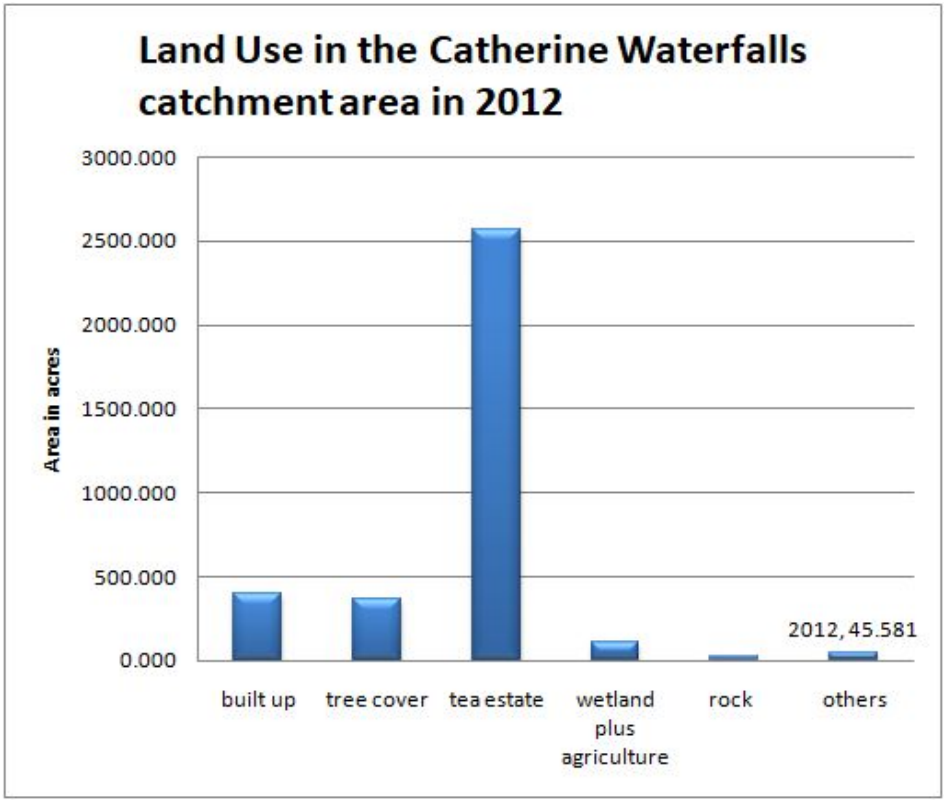


*Chart 4.1: Land Use in the Catherine Waterfalls catchment area in 2012*

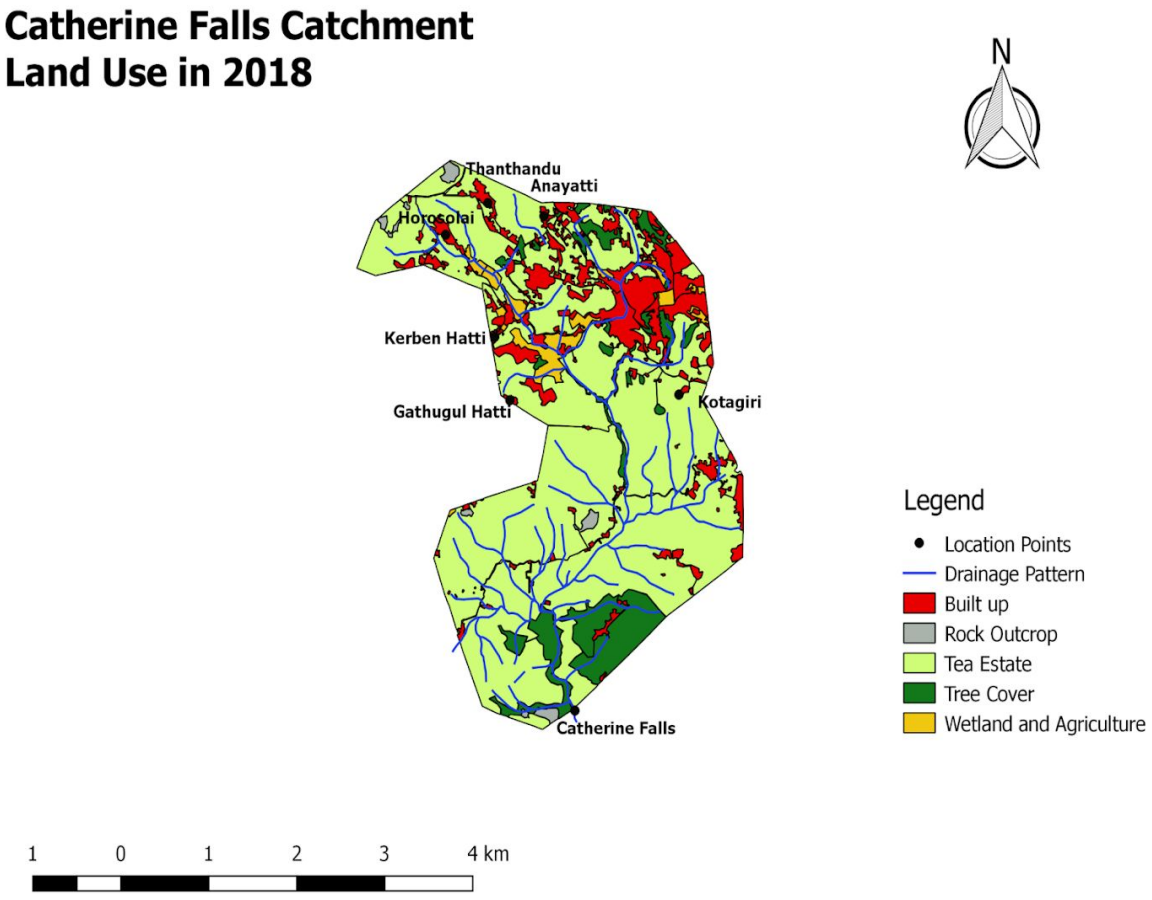


*Fig. 4.3: Map of the Catherine Falls Catchment Land Use in 2018*

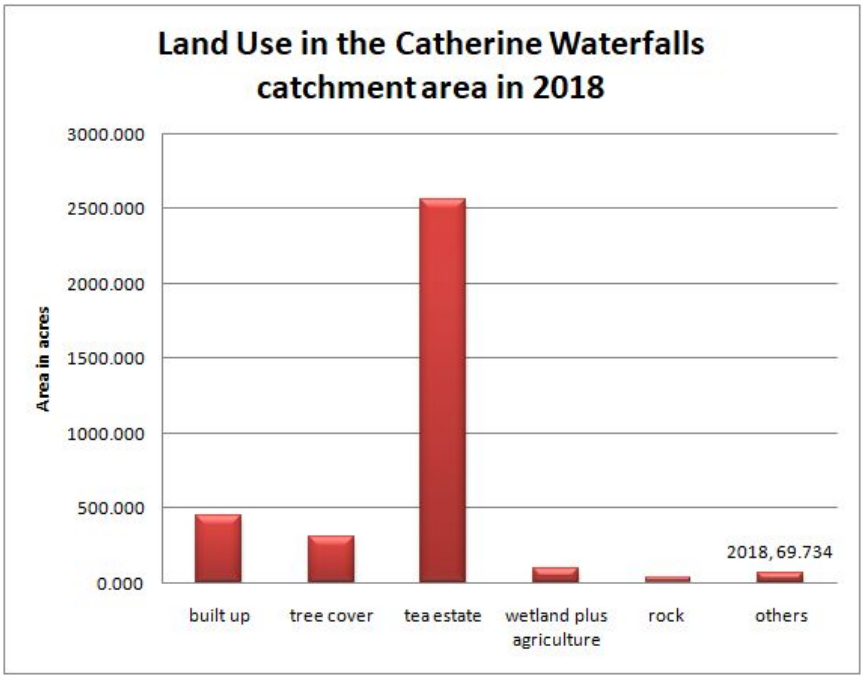


*Chart 4.2: Land Use in the Catherine Waterfalls catchment area in 2018*

## (B) KOOKALTHORAI

The Kookalthorai watershed of the Kookalthorai Stream is over an area of 6848.8 acres. Kookalthorai is primarily an agricultural community comprising about 500-700 households.


*Fig. 4.4:Google Earth Image of the Kookalthorai Watershed*

Using Google Earth Pro, we were able to map the land use pattern in the Kookalthorai area and convert the same to the map by QGIS. This enabled us to calculate the area for different classes the map has been classified in.

The major land-use classes we classified the area is - Built Up, Rock Outcrop, Tea Estate, Tree Cover and Wetland-Agriculture Area. The tree cover over here doesn't specifically entitle to the forest cover, rather it means tree or small bushes cover on land. Also, the Built-up includes all sorts of human settlements and construction area within the study area.

From the Land Use map of Kookalthorai area (*Fig. 4.5 and fig. 4.6)* it is evident that the major land is covered by tree cover followed by the tea estate (*Chart 4.3 and chart 4.4)*. The tree cover is majorly confined to the NE area, whereas the tea estate covers the SW area of the watershed. The agriculture fields and the human settlements are located in the center because being a valley there is easy availability of the water and fertile land for the livelihood.

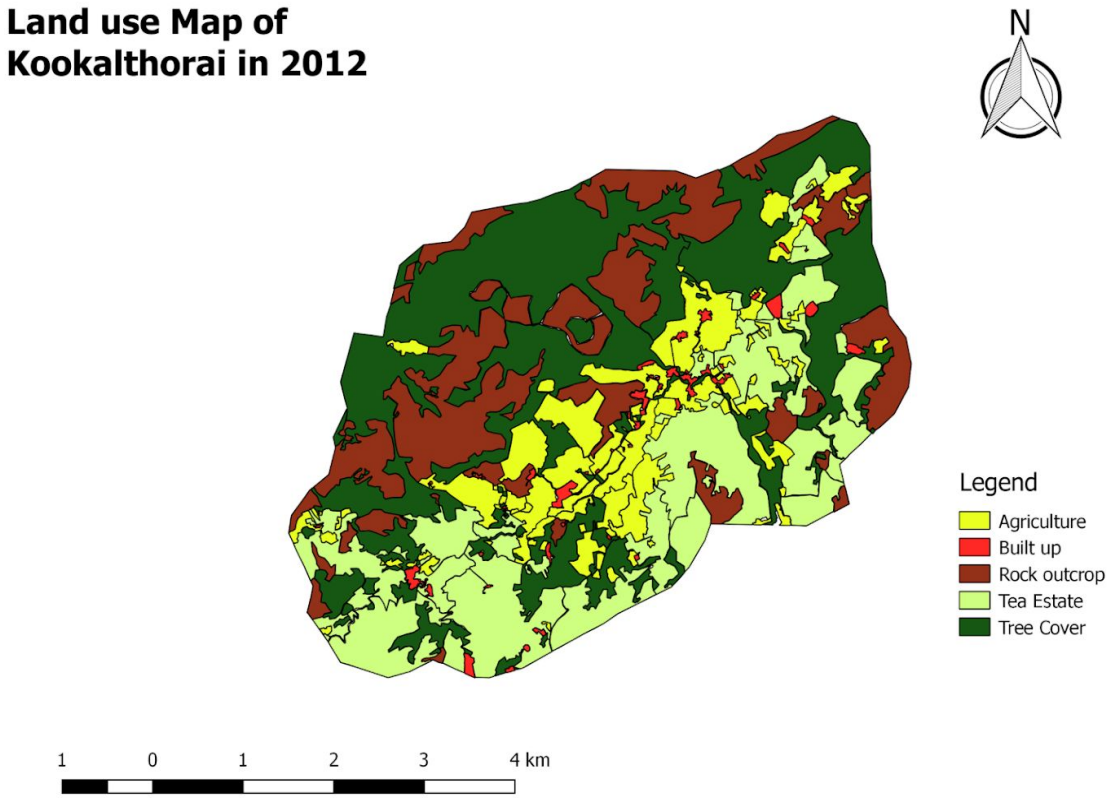


*Fig. 4.5: Land Use map of Kookalthorai in 2012*

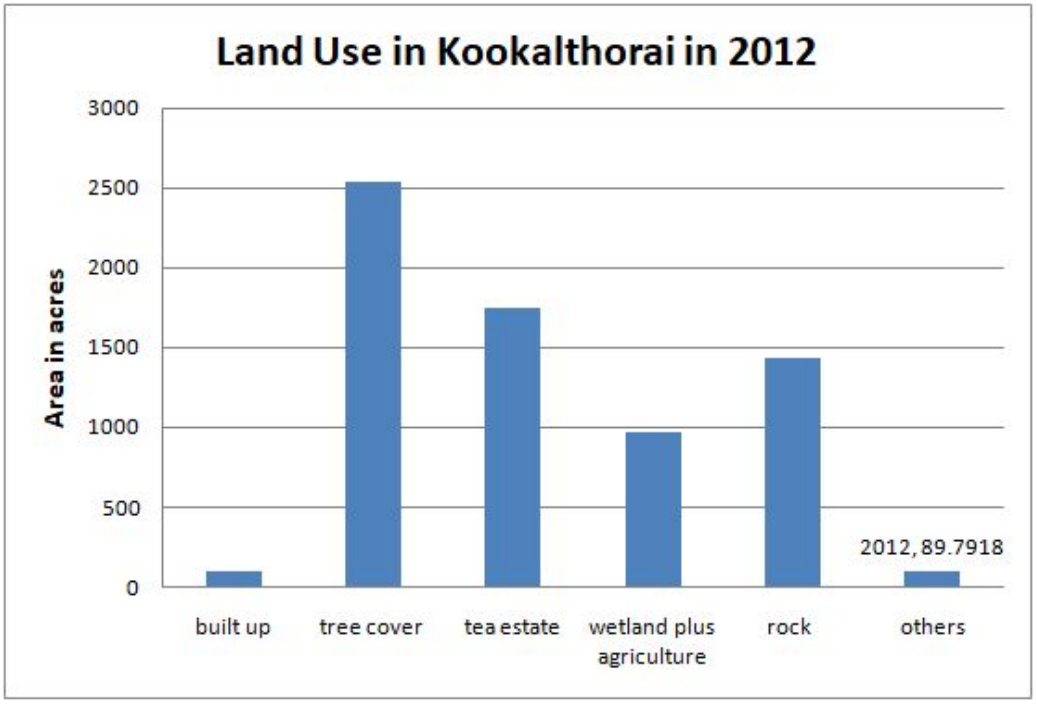


*Chart 4.3: Land Use in Kookalthorai in 2012*

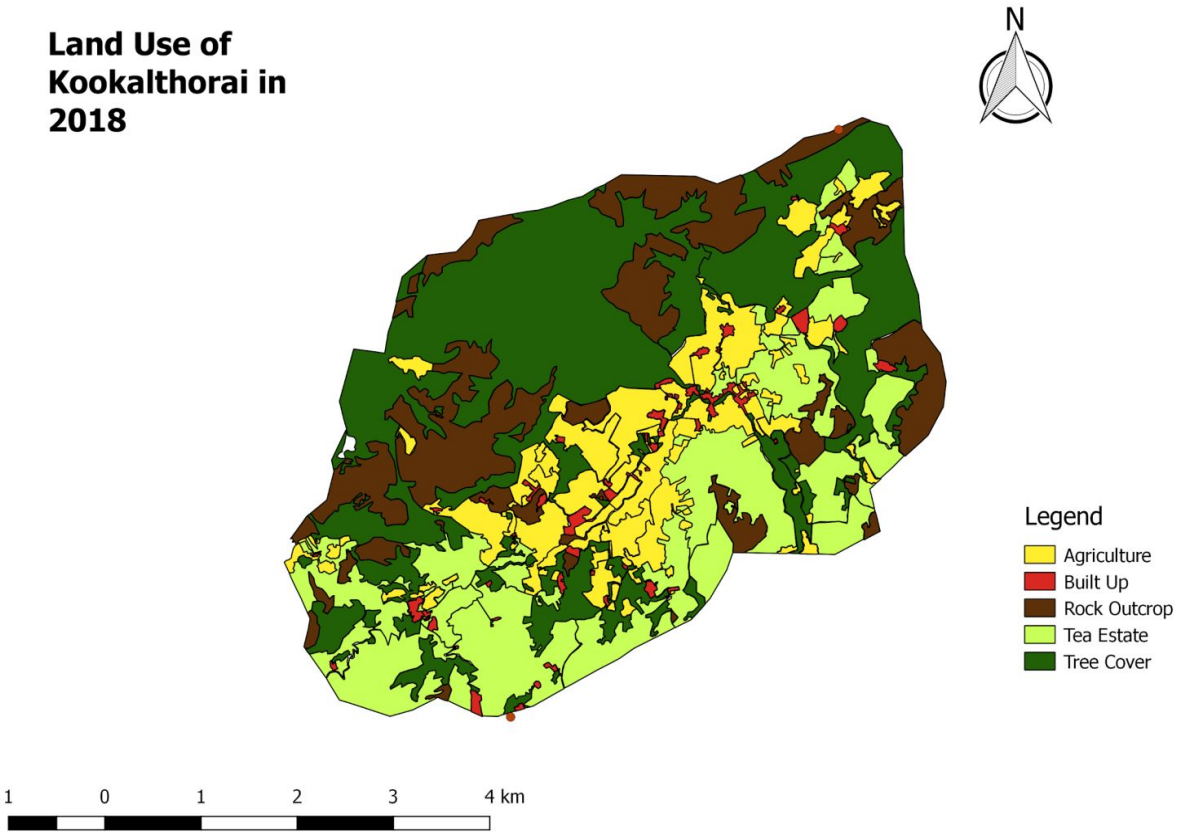


*Fig. 4.6: Land Use map of Kookalthorai in 2018*

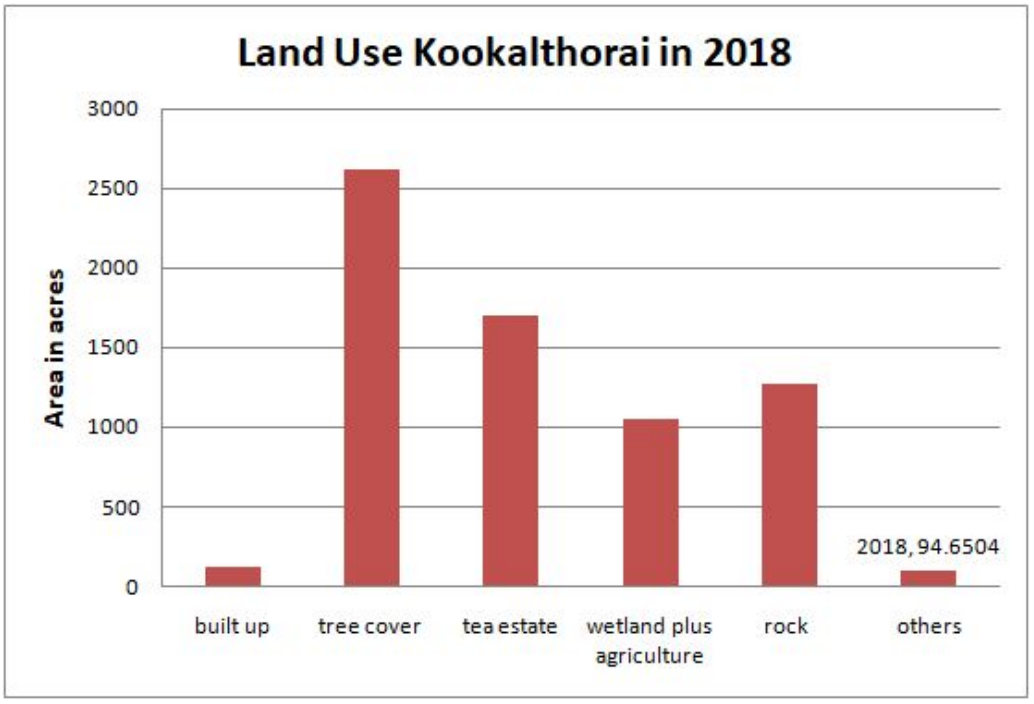


*Chart 4.4: Land Use in Kookalthorai in 2018*

# CHAPTER 5: ANALYSIS

## (A) CATCHMENT OF CATHERINE WATERFALLS

| | Area (in acres) | | Percentage(%) | |
|---|---|---|---|---|
| **Types of Land Use** | **2012** | **2018** | **2012** | **2018** |
| **built up** | 397.585 | 445.635 | 11.3 | 12.7 |
| **tree cover** | 365.841 | 311.959 | 10.4 | 8.9 |
| **tea estate** | 2571.091 | 2556.281 | 73.2 | 72.8 |
| **wetland plus agriculture** | 105.357 | 96.764 | 3.0 | 2.8 |
| **rock** | 25.075 | 30.157 | 0.7 | 0.9 |
| **others** | 45.581 | 69.734 | 1.3 | 2.0 |
| **TOTAL** | 3510.531 | 3510.531 | 100 | 100 |

*Table 5.1: Comparison of the land-use pattern in 2012 and 2018 in the Catchment of Catherine Waterfalls*

From Table 5.1 we can see that the major increase from 2012 to 2018 has been in the Built up area, i.e., from 11.3% to 12.7%. The main reason for the increase of population in the reason has been primarily due to boom of tourism in the nearby areas of Kotagiri. Ooty being a tourist destination nearby has led to opening of resorts, guest houses and home stays in Kotagiri. The main reason of increase in the real estate in the area is because of the availability at low rent. The other reason of this change is due to the migration of the people from the plain. According to the survey about 95.3% respondents said that there has been an increase in the built up in the area (*Chart 5.1)*.

With the advent of human activities, the deforestation was obvious and led to reduction in the tree cover i.e., from 10.4% to 8.9%. About 79.8% of the respondents said that tree cover had reduced (*Chart 5.2)*. Due to the decrease in tree cover, the overall water availability has reduced. One of the consequences of the decrease in the forest cover has led to increase in human-wildlife conflict.

Also, with time there has been decrease in both the tea estate and the agriculture fields from 73.2% to 72.8% and 3.0% to 2.8% respectively. About 60% of the respondents said that the tea estate has decreased due to three reasons. First being that the tea plantations are rain fed and past few years, Nilgirs haven't experienced a good rainfall, thus reducing the yield. Second is that the Tea plantations are labor intensive. The labor cost has increased but the profits are reducing. The third reason is that the tea market is decreasing; hence people are

shifting their livelihood option from tea to other alternatives. *Chart 5.4 and Chart 5.5* are representing the major occupation. People working in tea estate and agriculture have reduced from 23.3% to 9.3% and 16.3% to 4.7%. And there has been an increase in the salaried jobs and other jobs sector.

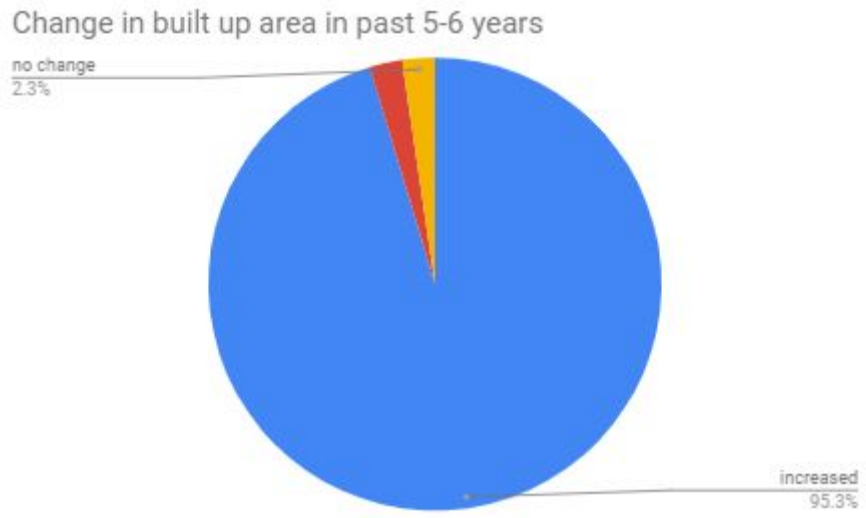


*Chart 5.1: Change in the built up area in past 5-6 years*

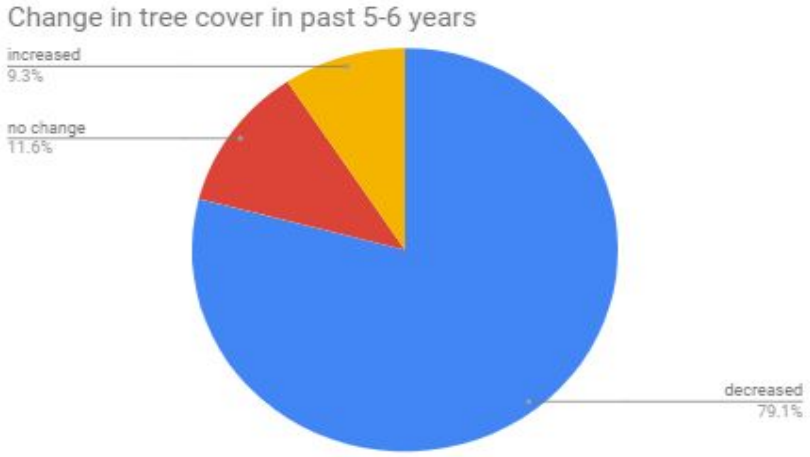


*Chart 5.2: Change in the tree cover in past 5-6 years*

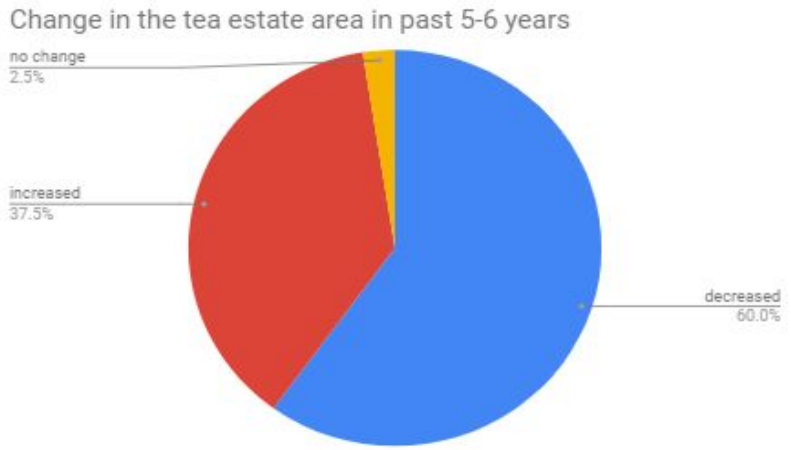


*Chart 5.3: Change in the tea estate area in past 5-6 years*


*Chart 5.4: Proportion of the major occupation 5-10 years back*


*Chart 5.5: Proportion of the major occupation at present*

## (B) KOOKALTHORAI

| | Area in acres | | Percentage (%) | |
|---|---|---|---|---|
| **Types of Land Use** | **2012** | **2018** | **2012** | **2018** |
| **built up** | 87.56 | 113.54 | 1.3 | 1.7 |
| **tree cover** | 2532.55 | 2620.43 | 37.0 | 38.3 |
| **tea estate** | 1747.38 | 1700.16 | 25.5 | 24.8 |
| **wetland plus agriculture** | 959.89 | 1049.70 | 14.0 | 15.3 |
| **rock** | 1431.62 | 1270.30 | 20.9 | 18.5 |
| **others** | 89.79 | 94.65 | 1.3 | 1.4 |
| **Total** | 6848.79 | 6848.79 | 100 | 100 |

*Table 5.2: Comparison of the land-use pattern in 2012 and 2018 in the Kookalthorai Watershed*

From Table 5.2 we can see that the major increase from 2012 to 2018 has been in the Built up area, i.e., from 1.3 % to 1.7%. Also, there has been an increase in the tree cover from 37.0 to 38.3%. Also, there has been an increase in the agriculture field area and decrease in tea estate are mainy due to the fact that tea market has gone down and people have shifted from tea pamtation to agriculture. They have opted for growing exotic and indigenous crops which are imported to bug cities and have improved their livelihood.
*Chart 5.11 and Chart 5.12* are representing the major occupation.

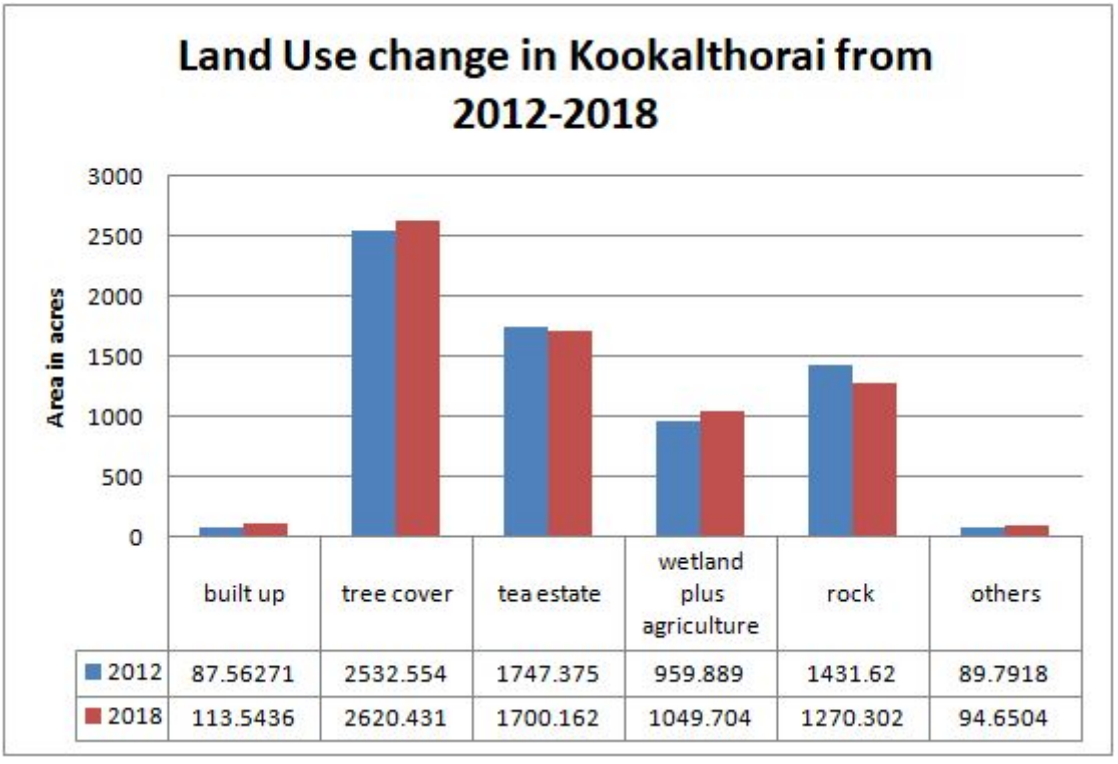


*Chart 5.6: Land Use change in Kookalthorai from 2012-2018*

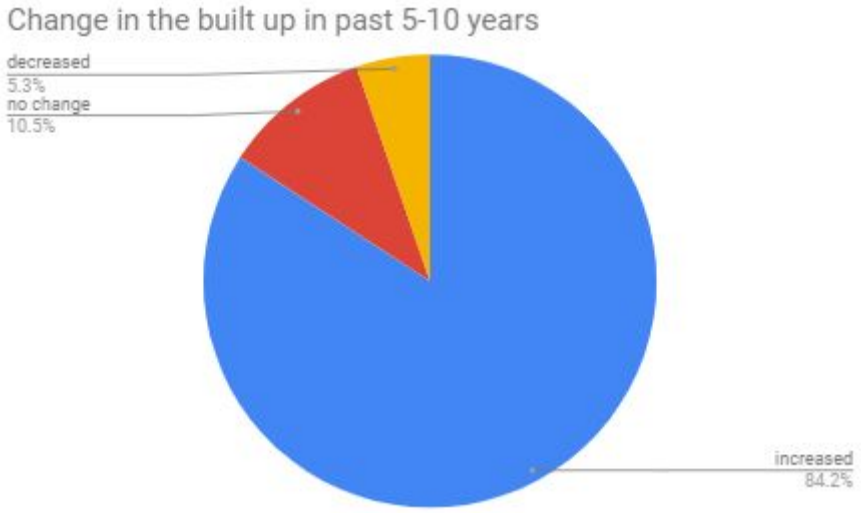


*Chart 5.7: Change in the built up in past 5-6 years*

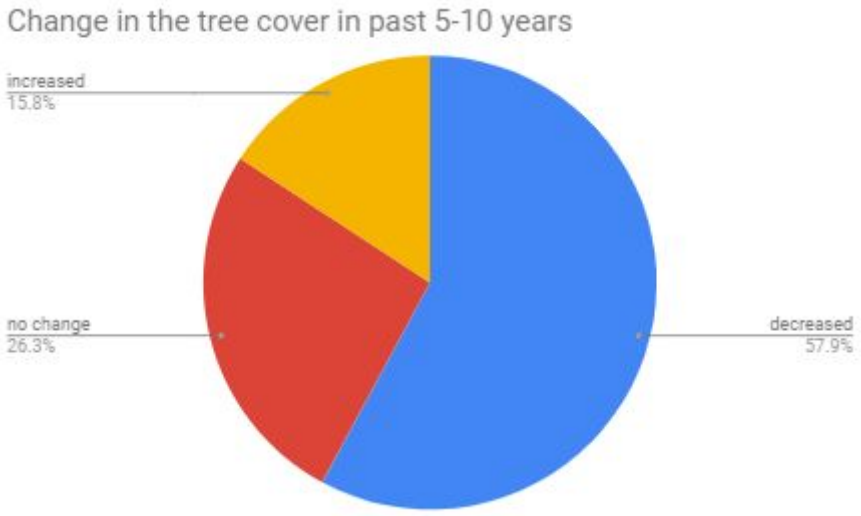


*Chart 5.8: Change in the tree cover in past 5-6 years*

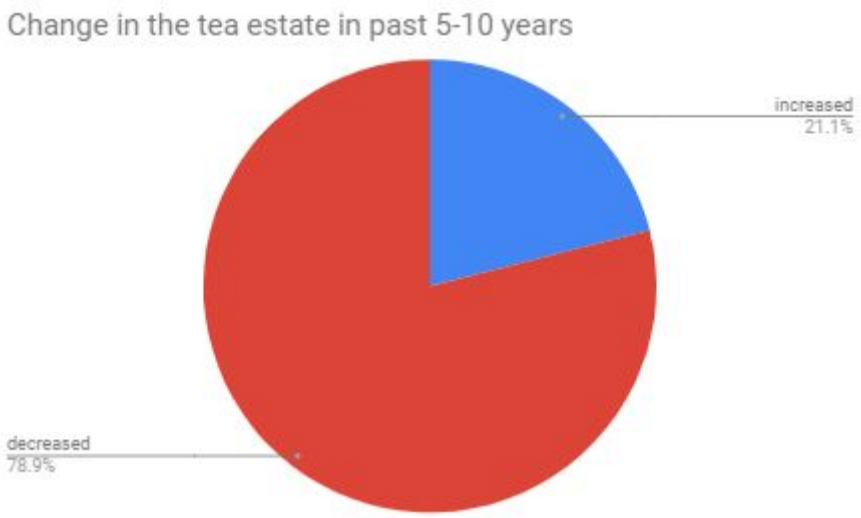


*Chart 5.9: Change in the tea estate area in past 5-6 years*

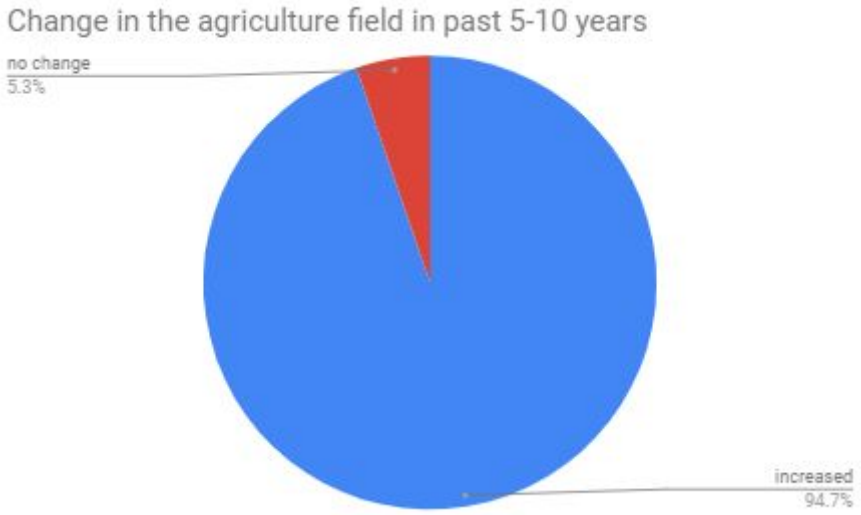


*Chart 5.10: Change in the agriculture field area in past 5-6 years*

*Chart 5.11: Proportion of the major occupation in the area 5-6 years back.*

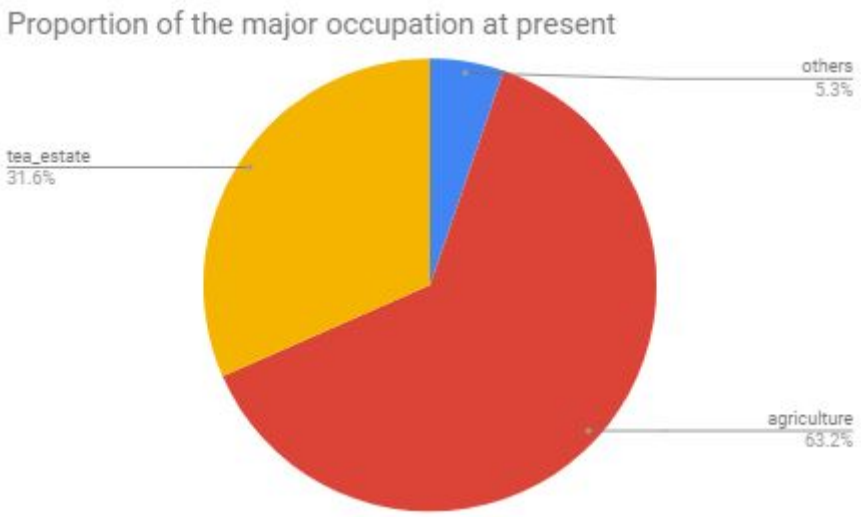


*Chart 5.12:Proportion of the major occupation in the area at present.*

## TRADITIONAL PRACTICES REGARDING WATER SOURCES

Apart from documenting the change in the land use, we wanted to document the traditional practices related to water sources and land. However, their religious beliefs more of were indirectly related to the conservation and protection of their water resources. The sacred grooves were considered to be of religious importance and were associated with religious practices. After the perception survey we found that in Kookalthorai some families and farmers were following the religious practices of worshiping the water sources-yearly during the summer season known as the "Mazai Pooja" by few at the Seruel temple. It involved worshiping the spring. Whereas Kotagiri being the semi-urban area none of the respondents followed such traditional practices regarding water and land but some of the respondents reported that their ancestors in the villages used to perform some traditional practices of worshiping their water source. We believe that the main reason behind such traditional practices is linked to ecological conservation.

*Fig. 5:Image of Scared group area*

# CHAPTER 6: LIMITATIONS AND SUGGESTIONS:

## LIMITATIONS-

1. Timing constraints was the main issue.
2. Some of the suggestions and recommendations were mainly based on observations.
3. Weather and terrain conditions were the barriers
4. Availability of the respondents was also causing problem in conducting field survey and data collection.
5. Concepts covered needs a broader aspect with in depth analysis.
6. Authenticity is yet to be established.

## SUGGESTIONS:

1. Conservation strategies needed to be more stringent.
2. Government's activeness is needed to facilitate the proper supply and maintenance of the water resources and strict rules should be made for controlling the encroachment activities
3. Conservation of shola forest is must and promoting the plantation of native plant species instead of invasive species would add on more water to the soil.
4. Water Resources are needed to be preserved and conserved with encouraging and guiding the people with water harvesting techniques.
5. Sustainable efforts are needed to remove the invasive plant species which could provide the base for the other native plant species to grow.
6. People should be encouraged to go for the organic cultivation so that soil quality and water utility and availability is maintained.

# CHAPTER 7: CONCLUSION

Land use change analysis helped us to understand major land use pattern over the 6-10 years in the given study area and the possible reasons for the same. On comparison of the Google Earth imageries of 2018 and 2012 of both the study areas following the perception of respondents resulted in the findings that a major increase has been in the built-up areas due to flourishing tourism and major reduction in the Tea business and tree cover has also been observed in the kotagiri area.But in kookalthorai there hasn't been much change in the human settlements,agricultural field area has increased but water availability is one of the major problem over the past few years due to less rain, reduced tree cover and increased pesticides used reducing the productivity of the land and other resources.

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