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LAND USE CHANGE IN VIEW OF SMALL TEA GARDENS & ITS IMPACT ON BIODIVERSITY IN AND AROUND TITABAR

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ABSTRACT: Tea industry of Assam plays a dominant role in the economy of the state. Recently, a number of small tea growers have made an entry into the tea industry in Assam, which has made a significant impact on the pattern of agricultural land use, creation of rural employment, economic benefit and most significantly on the biodiversity of the area. The present study focuses to know about the changes in land use due to small tea cultivation in Titabar of Jorhat, a district of Assam and its impact on the biodiversity of the area.

The small tea growers of the study area converted the fallow lands, waste lands, grazing lands etc. into the tea gardens within the last two decade, which changes the pattern of land use of the area. The farmers had cleared their plots under bamboo land, miscellaneous and indigenous trees for tea gardening which directly affects the biodiversity of the area. The primary data have been collected by field visit to the study area to substantiate the objectives of the study. Seven villages of Titabar and a total number of 50 small tea growers were selected randomly as sample for study.

The study attempts to establish a relationship between the small tea cultivation and land use change. Growth of small tea cultivation is the prime cause of depletion of many valuable forest resources including animals, birds, medicinal plant and nutritious fruits, resulting in loss of flora and fauna in the area.

KEYWORDS: Small tea cultivation, spatial change, temporal change, flora, fauna.

1 INTRODUCTION

Tea is the ancient beverage and the most popular drink in the world [2]. The concept of small tea cultivation was initiated during the seventies by the Janata Government of Assam. The Honourable Minister of Agriculture, Soneswar Bora suggested the idea of tea in homestead garden and unutilized land for increasing farm income [3]. Along with the other part of Assam, the small tea cultivation was initiated in Titabar during the early part of eighties. In 1982, noted farmer Rudrakanta Saikia inhabitants of Chakial, in west Titabar initiated this small tea cultivation and later other farmers of area were begun to practice this culture commercially [3]. Total small tea growers of the area are 1657, according to the e-directory of small tea growers of Assam, for Titabar block of Jorhat district. The villagers who have small tea gardens are the member of Association of small tea growers of Assam, and some of them are the member of *Association of khudra sah khetiok santha of Titabar ancholic.* The small tea growers of the study area converted the fallow lands, waste lands, grazing lands etc. into the tea cultivation within the last two decade, which has changed the existing land use pattern of the area. Changes in land use due to the small tea gardens affects the environment and biodiversity of the area both directly and indirectly.

In the present study land use change due to small tea plantation and its impact on the biodiversity of the area have been analysed using the traditional survey method i.e. schedule and interview method. Three time period have been considered i.e. 1980-1990, 1990-2000, 2000-2013 to analyse the aims and objective of the study.

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2 STATEMENT OF THE PROBLEM

Tea industry of Assam have a valuable significance for the economic growth of the state. In the present study an analysis is done for the Titabar subdivision of Jorhat district of Assam to ensure the growth of small tea cultivation and its impact on land use change and biodiversity of the area. The small tea gardens have changed the economic livelihood by creating the self- employment opportunity to the people of the villages. Though small tea cultivation is a good employment opportunity but it has some undesirable effects to the surrounding natural environment of the area. This practice lead to not only agricultural land uses change but also lead various kinds of environmental problems.

The traditional cultivation of bamboo forest, areca nut, sugarcane, orange, pineapple, citronella, thatch used for roofing purpose , kitchen gardening etc. have been replaced by small tea cultivations. The small tea cultivation has also occupied the areas under agricultural land, grazing lands and government fallow land including their own lands. Within a short period of last two decades, small tea cultivation has brought a long term socio-economic and environmental changes in study area.

Due to small tea gardens many of the farmers have cleared their plots under bamboo land, miscellaneous and indigenous trees. Areas under sugarcane, mustard, turmeric, ginger, vegetables etc. have become tea gardens. This is the prime cause of depletion of many valuable forest resources including plants, animals, and birds. Medicinal plant like Neem, Citronella, king tonic, curry leaf, various nutritious fruits like guava, pineapple, *leteku, paniol*, plum, pear, sugarcane etc. various types of vegetables including ginger, turmeric, pumpkin, cauliflower etc. have become extinct.

Various type of environmental and human problem is occurring in the study area due to the use of chemical fertilizers and other toxic chemicals in tea gardens, which are dangerous to human health. The muga silk worm which are known as precious resource of Assam are very drastically affected by those chemicals ,and the traditional practices of muga and raw silk have lost their significance in Titabar area. Many of animals and bird species vanished due to the loss of their habitat which directly affects the biodiversity of the area.

Therefore a study is require to find out how the agricultural land is changing temporally in view of small tea gardens and biodiversity loss of the area so that some beneficial step or measures will be adopted.

3 OBJECTIVES OF STUDY

The present study is aimed to be carried out with the following objectives:

(a) To access the changes in land use pattern in Titabar due to small tea gardens.
(b) To establish a relationship between tea cultivation and land use change.
(c) To observe the impact on biodiversity due to change in land use pattern in the area.

4 ABOUT THE STUDY AREA

The study area forms a part of Titabar, sub-division of Jorhat district of Assam which is situated 20 km away from Jorhat city. The area is located between 26^{o}35'10 "N. latitude to 94^{o}9'36" E. longitude. In the west of Titabar, Golaghat district, Jorhat in the north, Moriani in the east and Naga hills in the south with a border boundary. The elevation of the area is 172 m. from the sea level, and it is under IST (UTC+ 5:30) time zone. The total geographical area of the sub-division is 630.07 sq. km. Agro–climatically the area is under upper Brahmaputra valley, with humid in summer and cold and dry, in winter season [5].Also the soil of Titabar is suitable for rice and tea cultivation. In the 2011 Indian census, the Titabar subdivision had a population of 17562. Males constitute 9227 of the population and females 8335, decadal growth rate is 132.76% [8].Titabar has an average literacy rate of 93.23%, higher than the national average of: male literacy is 94.15%, and female literacy is 92.20 %; 11% of the population is under 6 years of age [8]. Seven villages of Titabar are selected for the present study and total numbers of 50 small tea growers are randomly selected as sample for the study. These villages have been selected in consultation with the people of the area. Also suggestion was taken from the secretary of the association of small tea growers of Titabar ancholic in selecting the sample for study.

Initially, Titabar had only 45 numbers of growers in 1994, [3] and now it has raised into 1657 numbers again, at the beginning time the total area of small tea cultivation was only 15 hectors and now this sectors occupies 1300 hectares land in Titabar. Thus, within last two decades, plantation of small tea gardens has spreaded to every nook and corners of the study area.

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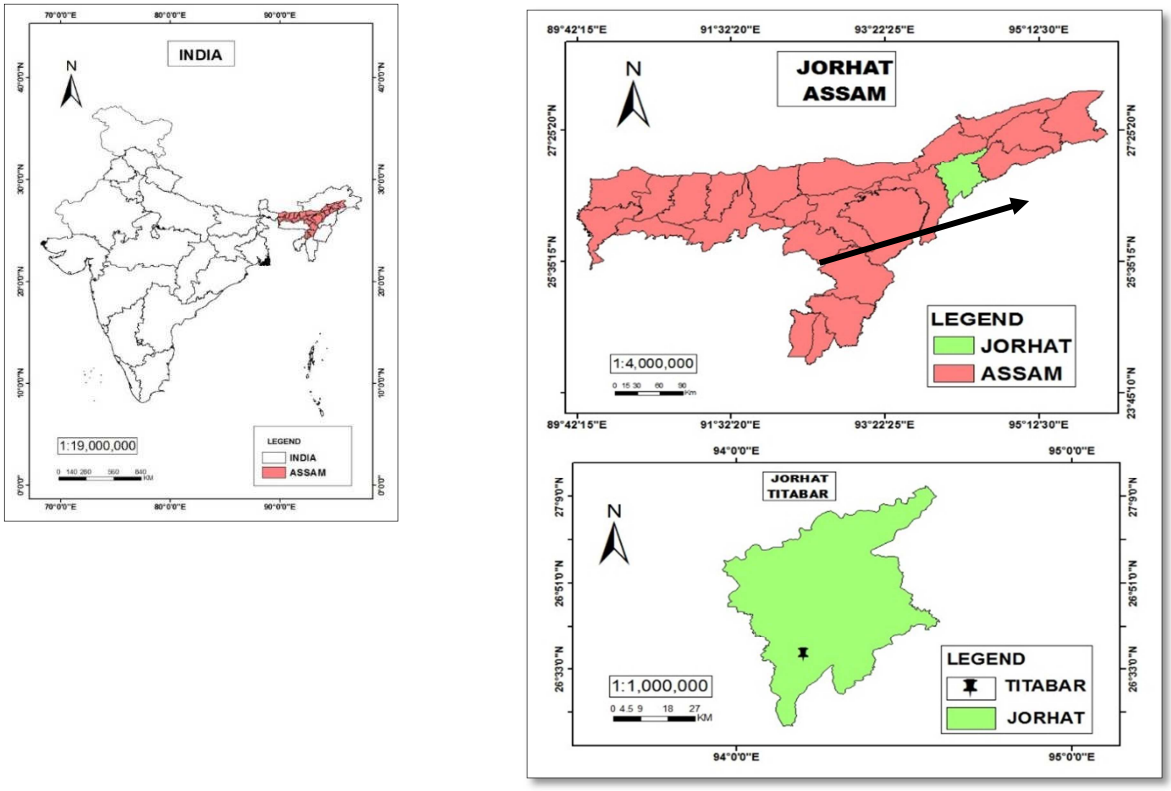

Fig. 1. Location map

Fig. 1 shows the location map of the study area

5 DATA BASE AND METHODOLOGY

To fulfil the present work both primary and secondary data are used. Primary and secondary sources. Spatial data in terms of location map is used in the study.

Table 1. Data base

Data used	Description of the data	Sources
Primary data	Present land structure of the sample villagers, their area of small tea plantation, reason of plantation, the problem associated with small tea cultivation	Interviews, discussion, schedule methods observation methods
Spatial data	Shape file of the study area	Www.diva-gis.org,2013
Secondary data	History of the study area, location, topography of the area, population, biodiversity of the area	Books, newspaper, internet websites, journals, article www.aastga.org
	literacy rate	Statistical hand book of assam,2011

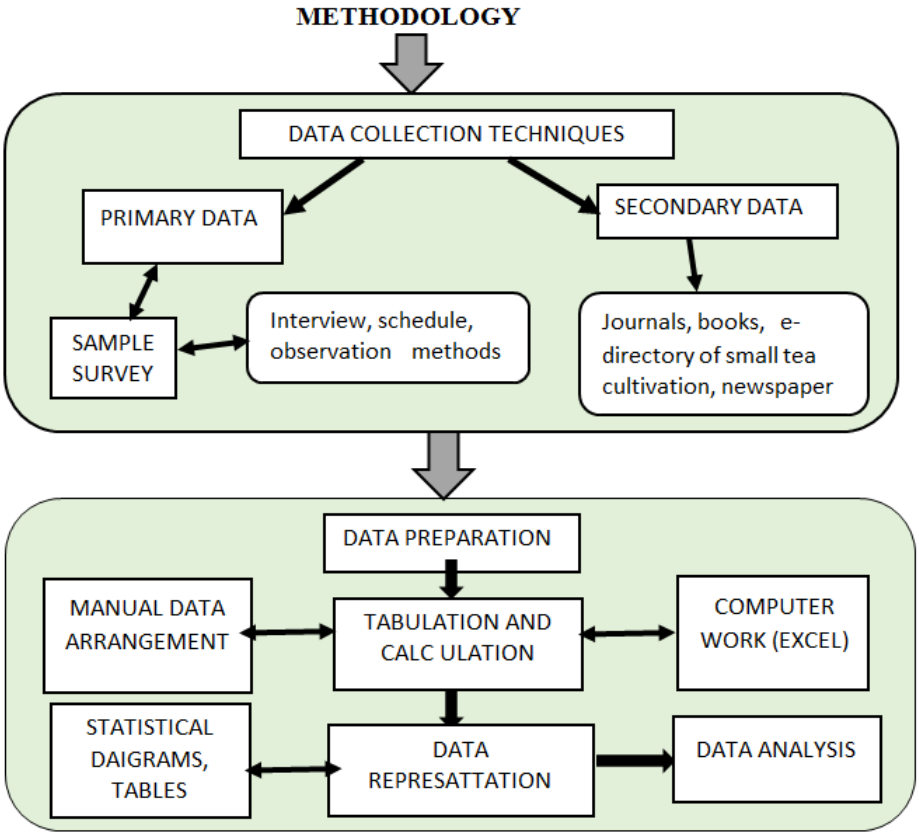

Fig: 2 Flow chart

Fig: 2 shows the flow chart of methods

In case of sample survey, we can obtain primary data either through observation or through direct communication with respondents in one form or another or through personal interviews. The selected respondents constitute what is technically called a sample [4]. Though there are several methods of primary data collection, the observation methods, interview method and schedule method are selected for present study. Primary data have been collected from the sample farmers by practical visit to the study area and person to person interaction to substantiate the objectives of the study. Due to various limitation of the observation and interview method through schedule etc. it is an expensive method,[4] it is can be used in a limited area of research, time consuming etc. 50 samples are selected for the study as per convenience.

In the study secondary data are used wherever it necessary. Various secondary data are collected from journals, articles, books related to the topic. Various website had visited to get some information which is helpful for the present study.

In this report three time period had chosen to show the agricultural land use change and loss of biodiversity in the study area. From 1980-2013, the years are divided into three stages – first one ranges between 1980-1990, second period is from 1990 to 2000. A range of 13 years is selected for the last time period in order to get all the updated information which are necessary for the present study.

These data collection techniques are may be more suitable than any others to assess all required information to fulfil the project.

6 DATA ANALYSIS AND PRESENTATION

After collection of data by observation, person to person interaction and from various sources, all are observed, tabulated, calculated and analysed. After conversion of data into tabular form and calculation by analysing the final outcome of study area appears.

The best possible and suitable cartographic techniques and statistical techniques are used to show the collected data. Pie diagrams, graph, bar diagrams, tables, models, photographs etc. are used to show the outcomes. Almost all collected data are presented with text.

7 RESULTS AND DISCUSSION

7.1 TEA CULTIVATION IN THE STUDY AREA

Plantation of small tea garden became an essential part of economic activities of the people of the study area. Also cultivation of small tea garden gives high return to the planter throughout the year. Previously, the villager had poor idea about the benefit of small tea gardens, but under the

Encouragement of the honourable minister of agriculture Soneswar Bora about the small tea gardens some of the villagers had started the plantation of small tea gardens. Some of the villagers opined that small tea cultivation also creates self-employment opportunities' to the young generation.

At first only one villager had cultivated small tea garden among the 50 sample villagers in the study area, in 1982. But in later years the number of small tea garden came up with time. Seven villages of Titabar had visited for the study and by visiting those villages it was found that present land under tea of sample villagers is 447 bigha. The table no 2 shows the different names of villages that had already visited and number of samples taking from each village. Each sample represents a villager having small tea garden in the study area.

The table no 2 shows that the land under small tea garden is 447 Bigha of the total land of the farmers i.e. 1,793 bigha. Area under tea of Chakial and Molia gaon are comparatively higher than other villages i.e. 89 and 91 bigha. Area under small tea garden is same for Jakaisuk and Dholikuh, 72 bigha. Thus, the entire study area experienced a phenomenal growth of small tea gardens in the recent periods.

Table 2. Name of the villages with the numbers of sample and land structure of each

Village name	Numbers of small tea garden surveyed	Area under tea (bigha) & %		Total area of land (bigha) and %	
1 .Kachari 2no. Bebejia gaon	5	51	11.4	145	8.08%
2. Chakial gaon	4	89	19.92	262	14.61%
3.Dholikuh	7	72	16.1	276	15.41%
4.Namchungi	8	38	8.5	152	8.47%
5.Jakaisuk	10	72	16.11	321	17.90%
6.Burah gaon	6	34	7.61	163	9.09%
7.Molia gaon	10	91	20.36	474	26.43%
Total -	50	447	100.00	1,793	100.00%

7.2 STATUS OF SMALL TEA GARDENS FROM 1980-2013

To show the land use change in view of small tea gardens three time period was selected. After analysing the collected information the study reveals that in the period from1980-1990 only one farmer among the 50 sample villagers had small tea garden. But it has raised into 16 numbers in 1990-2000 and again it has raised into 33 numbers in 2000-2013 in the study area. The sample villagers who started small tea cultivation within 1990-2000, they had extent their area of plantation in later years. After observing the data it is proved that within the year 2000-2013 the study area experienced a phenomenal growth of small tea gardens. Except four (4) samples who started tea cultivation within 1980-2000, thirteen (13) numbers of villagers had extent their area of plantation within 2000-2013. Twenty (20) numbers of new small tea growers have started their area of plantation years under 2000-2013. The table shows the growth of small tea grower's from1980 to 2013.

Table 3. Growth of small tea growers

Time	No of new grower	No of growers who later extent the area of plantation	Total no. Growers
1980- 1990	1	0	1
1990-2000	15	1	16
2000-2013	20	13	33

The figure: 3 represent the Table no 3. It shows how the numbers of growers increases from 1980-2013 among the sample villagers.

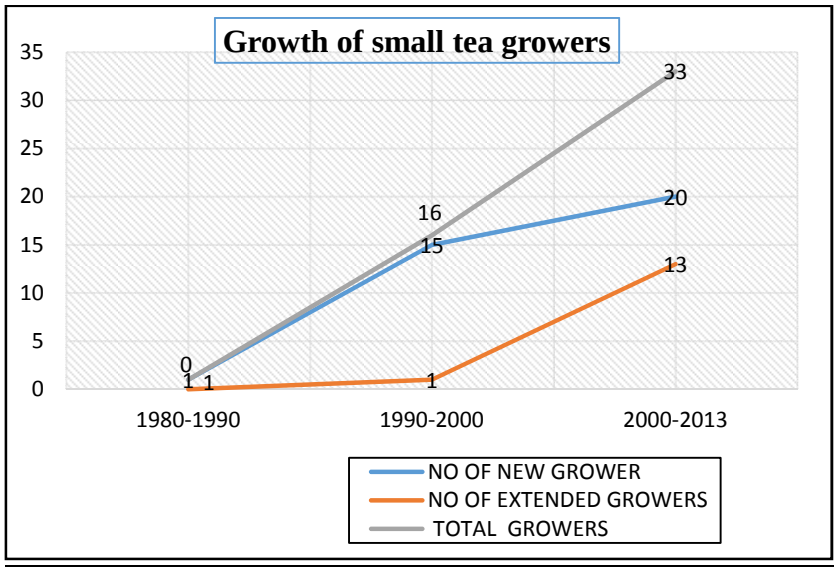

Fig: 3 Growth of small tea growers

Fig.3 shows the graphical representation about the growth of small tea growers

7.3 PATTTERN OF TEMPORAL CHANGE

Plantation of small tea gardens has been gradually changing from time to time in Titabar. Before 1980 the farmers of the area were not aware about the plantation of tea and its economic importance. But after 1982, when small tea cultivation was introduced by Rudrakanta Saikia, for the first time the practice of small tea became started.

By tabulation and calculation the data, it is found that, within last two decades the study area got abrupt change in small tea cultivation. Within this time period, from 1980 to 2013, total land of 447 bigha under various sector converted into tea. In 1980-1990, twelve (12) bigha of land reclaimed by small tea gardens, 159 bigha of total land was reclaimed by small tea gardens in next period. In recent period, 276 bigha of total land replaced by small tea gardens. The below diagram represents the temporal change of small tea gardens.

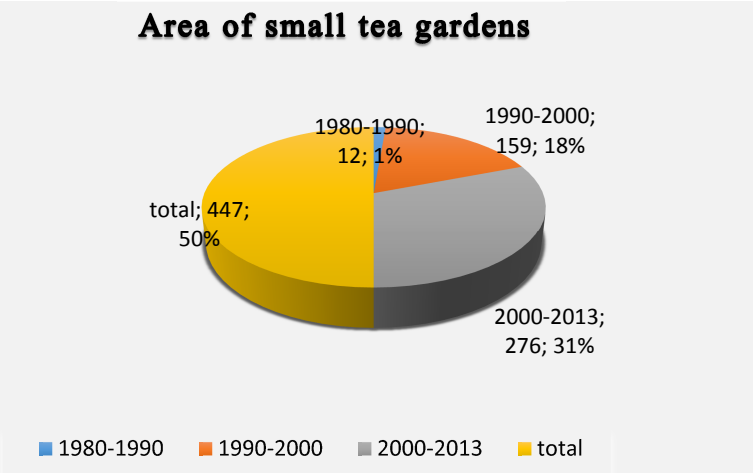

Fig 4: area of small tea cultivation

Fig.4 shows the temporal changes in area of small tea gardens year- wise

Figure: 4 shows that from 2000 to2013 the percentage of land converted into small tea garden is comparatively high than other two time periods. Thus, about 447 bigha land of total land of sample villagers i.e. 1793 bigha are converted into small tea gardens within last two periods. The study reveals that the highest conversion of land into small tea garden is held during 2000-2013.

The fig: 5 helps to understand the conversion of land into small tea gardens from various Sector better. Here the amount of area under various categories are mentioned in bigha.

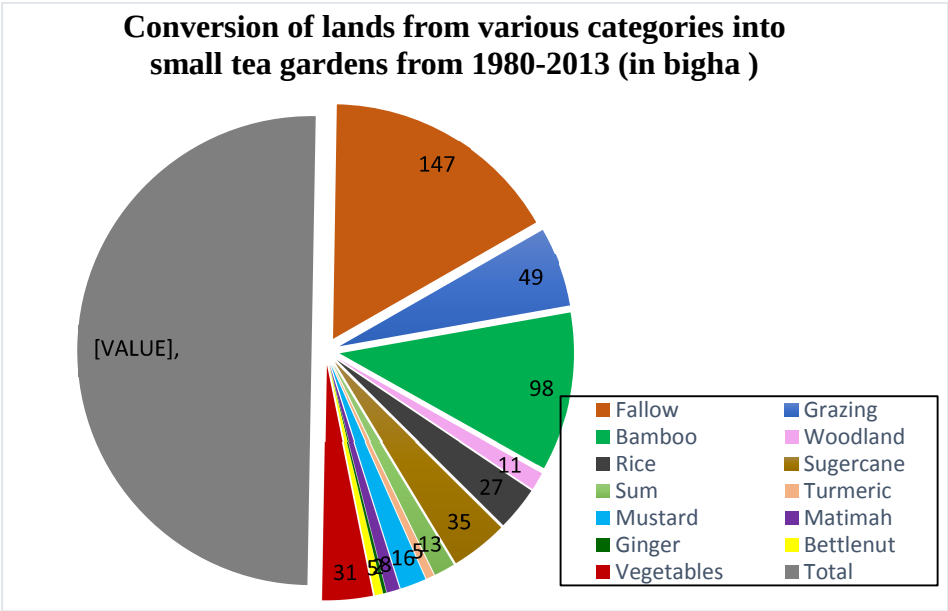

Fig: 5_Conversion of land into small tea garden

Fig.5 shows the land area that converted into small tea gardens during the period of 1980 - 2013

The figure-5 shows the area of lands under various categories which ultimately turned into small tea gardens within 1980-2013. The area under fallow land (147) bamboo land (98) grazing (49) and sugarcane (35) is relatively high than the other categories. The others like woodland is 11 bigha, sum is 13 bigha, rice is 27 bigha, turmeric is 5 bigha, mustard is 16 bigha, ginger is 2 bigha, bettlenut is 5, matimah is 8, vegetables is 31 bigha. Thus, the numbers of small tea gardens in the study area are came up with time.

7.4 PATTERN OF SPATIAL CHANGE

Nearly 85% people of the study area are associated with small tea gardens. And rest 15% also on the way to start the plantation of small tea gardens. In early part of 80's in the study area plantation of small tea gardens was only in Chakial gaon. The next village to cultivate small tea gardens was kachari gaon in 1991. Malia gaon in 1992, Jakaisuk and Burah gaon in 1993 came immediate next to kachari gaon in view of beginning of small tea gardens in the study area. Thus, the practice of small tea gardens has spreaded to the other village's i.e. Dholikuh (1994) and Namchungi (1995) in later years. Thus, the cultivation of small tea garden was spatially changed with time from one to another gaon in the same area of study.

Thus, after analysis the collected data the status of present land under possession of sample villagers can be obtained. The present total land of sample villagers under rice is 1155 bigha, tea is 447 bigha etc. are given in the figure- 6.

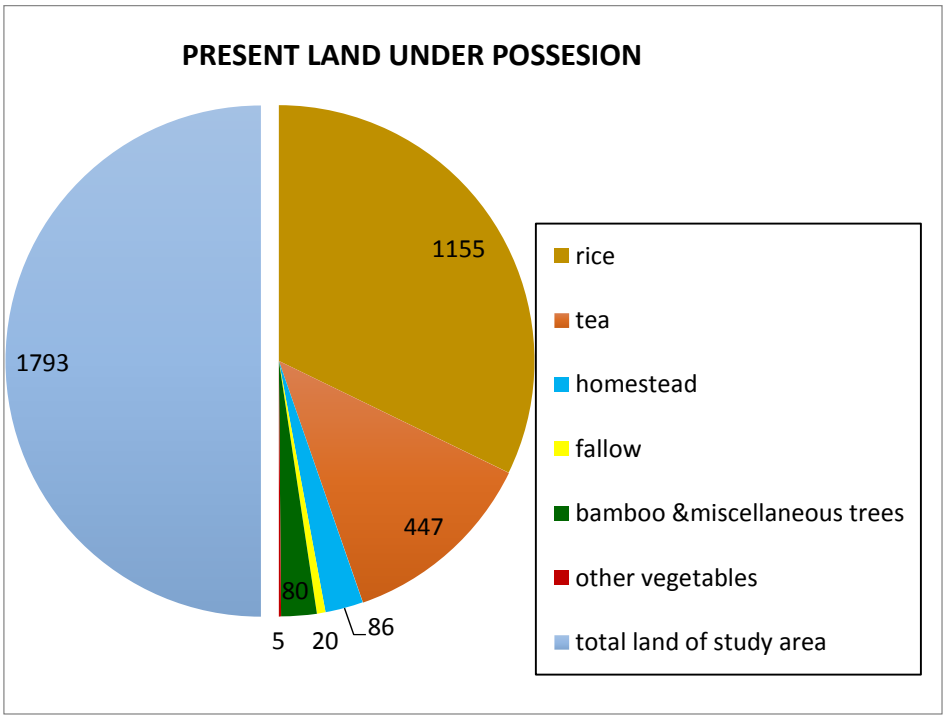

Fig: 6 Present land under possession

The figure-6 shows that in the study area the amount of vegetables is very less than others, on the other hand area under rice and tea is highest than other categories.

8 SMALL TEA CULTIVATION AND BIODIVERSITY OF THE STUDY AREA

8.1 IMPACT ON BIODIVERSITY

The term biodiversity refers to the number of organic species confined to an ecosystem territory. A reduction of biodiversity, indicates instability and impending danger of the system. Because, a reduction of organic population and its varieties account for unhealthy relations among existing organisms, nutrient shortage and ultimately causes extinction of more species. Those living species have their complimentary role upon one another to keep the system at a balance state of functioning. Therefore, the ecological balance of the ecosphere depends on biodiversity richness. Indeed a reduction of biodiversity is an immediate cause of ecological imbalance.

In the study area, numbers of trees, animals, birds, and reptiles, insect like: butterfly etc. reducing day by day and some species have already being extinguished due course of time. A vast areas of land under various categories are converted into small tea gardens on behalf of economic development of the villagers in the study area. Reclamation of land under bamboo & miscellaneous trees, forest etc. for small tea gardens ultimately leads to extinction of flora and fauna of the study area. Therefore, an analysis on loss of biodiversity due to small tea gardens in the study area is undoubtedly necessary.

8.2 IMPACT ON FLORA

A few years ago the surveyed area had a rich heritage of species and genetic strains of flora and fauna. But in the recent period a lots of changes occur in the land use and biodiversity scenario. This is mainly because of growth of small tea cultivation in every nook and corner to the study area. Shrinkage of forest area and area under bamboo has led to near extinction of many valuable tree species, herbs, medicinal plants, indigenous fruits etc. Cutting of vegetation to open up small tea gardens decreases the numbers of trees having economic importance like sal, teak, *arjun* etc. day by day. Some villagers of the study area use to cultivate the crops like: beans, black gram, Brinjal, lady's finger, chilly, sesame etc. with small tea gardens. But after 3 years the cultivation of mix vegetables became impossible as tree brushes grows up. It might be lead to extinction of cultivation of such crops& vegetables. The flower species like: jasmine, *keteki, jayanti,* tube rose ,some unknown wild flower and the indigenous fruits, trees and medicinal plants as given under table no 4 have been continuously shrinking day by day, because of clearing of vegetation for small tea gardens. Some of them had already extinct and others are threatened of extinction.

Table -4 Name of some threatened plant species

Name of the trees	Name of the fruits	Name of the medicinal plant	Name of the vegetables
Banyan	Mango	Tulshi	Ginger
Arjun	Jackfruits	Curry leaf	Turmeric
Teak	Leteku	*Neem*	Mustard
Sal	Paniol	Aloe Vera	*Sesame*
Simalu	Pear	*Brahmi*	Mugbean
Amlokhi	Lichi	*Manimuni*	Pea
Amara	Pinieapple	*Dupor tenga*	Taruyan
Nahar	Guava	*Drun bon*	Fern
Bamboo	Blackberry	*Lizabari*	*Jilmil*
Beettle nut	Melon	*Pudina*	*Khutara*

Thus, due to cutting of the forest and reclamation of the lands under vegetables and crops by small tea garden undoubtedly affect the biodiversity of the study area.

8.3 IMPACT ON FAUNA

If forest is cleared for plantation of small tea gardens the animal's species which are living in the forest and the other species who depend on the forest for food are directly affected. After analysing the data it was found that, many types of birds and animals had already extinct and some of them are becoming rare.

According to the villagers loss of habitat is the main cause due to cutting of forest, bamboo, bettlenut etc. for small tea gardens which decreases the food of various fauna, finally reduces their number. Some other villagers told that use of toxic chemicals and pesticides on tea leaves affect their growth and production. The production of muga worm is the best example in that case. Before 90's the area was noted for traditional practice of muga &silk worm. But the people of the area now understood that the expansion of small tea cultivation and the use of chemical substantials in the tea cultivation has lowered the production of muga worm. This poses a serious threat to the traditional muga practice of the area and this precious resource of Assam is now in endanger in the study area. The toxic chemicals destroyed the muga & silk worm which ultimately leads to the conversion of land under som, soalu, digloti, mejankori etc. which acts as a feeder to the muga & silk worm or so called host plants are into small tea gardens. Use of such chemicals not only destroyed the harmful insects but also destroyed some useful insects. Thus, due to reduce of floral diversity and use of toxic chemicals various species, insects, harmful and useful both, which depend on those trees for food became endangered. The name of various birds and animals are given in the table no 5, some of which had already extinct and some are in endangered.

Table 5: Species under threat

Name of the birds	Name of the animals & insects

Crow	Fox
Kharali hah	Squirrel
Pakhila	Mongoose
Greater adjutant stork	Muga &silk worm
Egret	*Bon kukura*
Baya weaver	*Hepah*
Moupiya	Jahamal
Kingfisher	Rabbits
Crane	*Nigani*
Sparow	*Endur*
Dove	*Nypia*
Parrot	Honey bee
Eagel	Vumura
Vulture	*Gubarua*
Buzzard	-

8.4 IMPACT ON MAN AND ENVIRONMENT

Environment as we assume is the natural layout of a habitat pertaining to air water, land, plants and animal components. Entire course of human development is largely dependent upon resources reaped from the environment, which sometimes damage the ecological balance of the environment. After, interaction with the people of the study area it was found that every small tea growers use chemical fertilizers and pesticides in the tea plantation and they bought the chemicals from the local market and sometimes from nearest town. Almost every people have heard about the bio-medicine and eco-friendly pesticides. But they didn't use such eco-friendly pesticides ever. The small tea growers agree with the fact that, the chemical fertilizers, pesticides etc. are not properly used. The local people of the area sometime these toxic chemicals in rivers for fishing. Also lack of proper training and sometimes after having the training don't follow the proper methods of application May leads a serious problem to the environment.

Within last ten years contamination of water happen due to misused of chemicals. In Dholi river continuous death of fish population was found by the nearby villagers due to use of toxic chemicals. Thus this harmful chemicals affect the nearby paddy field and nearby drains as they flow down with the surface runoff and resulting the death of fish population and other aquatic animals. The use of chemicals on green leaves may be cause of air pollution. The tea factories in which tea manufacturing done with coal ultimately leads to air pollution.

The large scale use of toxic chemicals might be lead to poisoning of the ground water table. However no test have been till date on a ground water table. Thus if these chemicals may harm the environment to this extent, the people are automatically affected. The inorganic chemical fertilizers like euria, potash, super phosphates, insecticides like: Ennova which are used to kill the weed and pests disturbing tea brushes are the cause of various dangerous diseases and affect all useful and harmful elements of biodiversity. Acaricides, Grycile 24D which is use to destroy the red spider of green leaves are very injurious to human health and through various indirect means those materials comes to the human body. Also a serious problem occurs at the time of spraying such toxic chemicals. The spraying activity pollutes the atmosphere around the tea plants and people living in that area are inhale contaminated of air. This pollute air harm the children's, old people, patients more than normal people.

Thus, the use of toxic chemicals and insecticides in the small tea gardens might have severe adverse impact to all components of biodiversity, which ultimately affects the ecological balance and ecosystem of environment on that particular area.

9 CONCLUSION

After analysing the data it was found that in the study area there are various favourable geographical condition for cultivation of the tea. Although it was practiced behind time, it has come up very quickly and now it has attained a very distinctive position in the sector of economy of the study area.

The outlook of study shows, there is a direct relationship between growth of small tea gardens and loss of biodiversity in the study area. The major problem of small tea gardens is loss of biodiversity and changes to the environment that found in the study area. To open up small tea gardens nearly 85% people had cleared their land under forest, bamboo & miscellaneous trees, bettlenut, sugarcane even rice also. And other 15% also on the way to start small tea garden in the study area. Because of this conversion of land into small tea gardens in the study area one major cash crop i.e. sugarcane is gradually losing its importance. Also some indigenous fruits like: *paniols*, *leteku*, guava, tamarind, pear, etc. are rarely found in the study area.

With the growth of small tea gardens the study area got continuous changes in land use pattern. Which remarkably affected the biodiversity of the area.

Use of chemicals in tea plantation creates various environmental problems which affect the all elements of bio-diversity as well as human health. Due to the use of chemicals the muga culture of the area is adversely affected. The area under host plants like: sum, mejankori etc. are replaced by small tea gardens which provides the food for muga worm. .

9.1 SUGGESTION

To overcome the problems faced by the people and environment of the study area due to small tea gardens some effective steps are urgently needed. Implementation of such steps will help the small tea growers to keep a balance state between tea cultivation and environment of the area.

Indian tea production has been refused in some of the leading tea auction centre for higher concentration of toxic chemicals in the recent years. So the small tea growers should be aware about all update news related tea plantation. This will help them to think what may be the best way for plantation for earning high profit without over using the chemicals. Also the secretary of the association of small tea growers and the members should have to take some effective measure to bring the old position of Indian tea in the world market.

Quality of the tea products should be the best as it consumed orally by people and the health of the people dependent upon the quality of the tea. Therefore the tea growers should put importance for quality tea production, especially attention is to be given for growing tea by organic manure, bio-fertilizers, along with the bio-insecticides and eco-friendly pesticides.

The people of the study area are suggested that, reckless use of agricultural inputs like: chemical fertilizers, insecticides, pesticides, herbicides should be minimized as per regulatory barrier. Overuse and Misuse of such toxic chemicals must be stop or minimized immediately. They are suggested to take the proper training for tea cultivation, and requested to follow proper method of application.

People of the study area are suggested not to reclaim the area under food crops for cash crops like tea. They may be encouraged to raise the yield of rice in their area as because tea is not a substitute of rice. It would be better if equal importance is given to the valuable medicinal plants, vegetables, indigenous fruits, woods having economic importance and to conserve and protect them. . Thus, by follow these steps every small tea grower can minimize the loss of natural resources and environment at least to some extent.

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