J. Chem. En. Sci. A.,Vol. 6, No. 1 (2019), pp.1–8

CHITKARA

Journal of Chemistry, Environmental Sciences and its Applications

Journal homepage: https://jce.chitkara.edu.in/

Impact of Land Use Change on Climate: A Study of Tripura

Vipin Solanki* **and Aparna Joshi**

Lovely Professional University, Punjab-144001, India

Email: vpn.solanki@gmail.com*, ax2000@rediffmail.com

ARTICLE INFORMATION

Received: May 06, 2019
Revised: July 22, 2019
Accepted: August 12, 2019
Published Online: September 11, 2019

Keywords:
Land use, Tripura, Agricultural land use, Land holdings, Non-agricultural land use

DOI: 10.15415/jce.2019.61001

ABSTRACT

Land use is the human utilization for money, private, recreational, conservational and administrative purposes. The idea of land use is firmly interwoven with human network advancement. Examples of human turn of events and land use have molded the earth legitimately and internationally since ancient occasions. Current improvement designs, along with highlights of the common habitat and the outcomes of past advancement exercises, decide future advancement openings, and furthermore the requirement for rebuilding or upgrade of natural assets.

North-east India is the abode of highly endemic flora and fauna preserving the pristine environment with little human interference until recent times. However, for past two decades a drastic change in the land use pattern in the region has been observed which may threaten the fragile ecological balance of the region. Tripura, known as one of the seven sisters, is a bamboo resource and second largest rubber producer in India. Tripura has the highest number of primate species found in any Indian state. However, as compared to its other sisters, the state is economically backward. The land use of the state is undergoing rapid change which is facilitated to a great extent by rapidly increasing population. The present paper deals with the changing land use of Tripura especially in the last two and a half decades. The objective of the study is to analyse the changing land use of the state in general and changes in agricultural and non-agricultural land use in particular based upon the data collected from secondary sources like Statistical Abstract of Tripura, Population Tables of Census 1991, 2001 and 2011 along with the information collected from various government websites.

1. Introduction

Land cover (LC) change is one of the most significant and effectively discernible pointers of progress in biological system administrations and vocation emotionally supportive networks. Financial drivers can actuate changes in LC that may disturb social and cultural practices and the organizations related with overseeing normal assets, which thus expands individuals' weakness to environmental change (Gilani *et al.*, 2014). Urban communities are dynamic; this is on the grounds that change is unavoidable. These progressions can be credited to one factor or the other relying upon financial, political and climatic state of a given territory. In any case, one basic factor behind city change both as far as size and example continues as before for most urban communities, for example "populace development". All things considered, different elements crediting to Land Use Land Cover (LULC) change are straightforwardly or in a roundabout way reliant on population upliftment (Kafi, Shafri & Shariff, 2014). Land use and land cover change has become a focal segment in current methodologies for overseeing normal assets and checking ecological changes. Survey the Earth from space is currently pivotal to comprehend man's exercises on his common asset base after some time. In circumstances of quick and frequently unrecorded land use change, perceptions of the Earth from space give target data of human usage of the scene. Over the previous years, information from the Earth detecting satellites have gotten crucial in mapping the Earth's highlights and frameworks, overseeing characteristic assets and contemplating natural change (Kaul & Sopan, 2012)

Land use rehearses for the most part create over a significant stretch of time under various ecological, political, segment, and financial conditions. These conditions frequently fluctuate and directly affect land use/land cover. To all the more likely comprehend the effect of land use change on earthly biological systems, the components influencing land use change must be completely analysed. Land use and land cover (LULC) changes have become a focal segment in current methodologies for overseeing common assets and observing ecological changes (Muttitanon & Tripathi, 2008).

ISSN No.: 2349-7564 (Print) ISSN No.: 2349-7769 (Online) Registration No. : CHAENG/2014/56905

Escalation of agricultural exercises is the rule purpose behind land use land cover change (LULC) especially in tropical areas (Geist & Lambin, 2002). Fundamental reasons for LULC changes prompting deforestation and land corruption incorporate fast monetary turn of events, population development and neediness (Porter-Bolland *et al.*, 2011).

Tripura is located in the north eastern part of India (23.9408° N, 91.9882° E). It is flanked toward the north, west, and south by Bangladesh, toward the east by the territory of Mizoram, and toward the upper east by the province of Assam. It is among the littlest of India's states and is situated in a confined bumpy area of the nation, with different indigenous individuals or clans representing a huge bit of the populace. The State capital is Agartala, close to the Bangladesh outskirt in the north western piece of the state. The state covers a geographical area of 4,049 square miles (10,486 square km) and is home to a population of 3,671,032 people as per 2011 census data.

Tripura is one of the eight sisters among the Northeastern states of India which belongs to the rich biodiversity hotspot zone of India. However, major influx of population from neighbouring Bangladesh (erstwhile East Pakistan), before and after independence, created major change in land use/land cover pattern of this State in general. Natural forests were converted to build up areas and agricultural lands (Debnath, Das, Ahmed & Bhowmik, 2017).

Shifting Cultivation or cut and consume agriculture practices (privately called as Jhum) is the primary type of agriculture in the hilly regions (privately called as Tilla) of Tripura in the north-eastern area of India by the indigenous individuals. Jhum agriculture practices begins with cutting and consuming of trees and prompts debasement of woods or deforestation in the uneven zones where they utilized the land to do jhum. Deforestation effects nature negatively which eventually prompts environmental change which these days a matter of worldwide concern and numerous universal, national and territorial level offices are chipping away at it. Deforestation may likewise influence the greenery which is existing in the forests (Longkumer, Raj & Solanki, 2019).

2. Combined Effects of Climate and Land Use Change

Changing land use is one of the important drivers for climate change of a given reason. The combined effect of land use with some more drivers impact the biodiversity which further responsible for climate change in a long run (Oliver & Morecroft, 2014). Mantyka-Pringle *et al.* gathered 1319 examinations on the impacts of living space misfortune from around the world and led a meta-investigation on associations between living space misfortune impacts and atmosphere (Mantyka-pringle, Martin & Rhodes, 2012). Normal aggravation systems, for example, disintegration, flooding, and fierce blazes are totally influenced by anthropogenic land use. For instance, deforestation decreases soil solidness prompting expanded soil disintegration rates (ZHENG, 2006).

The main objective of this research paper is to analyse the decadal land use change of Tripura and its relation with other north-eastern states and its implication on climate. The research is based on secondary data collected from various governmental and non-governmental websites.

3. Study Area

Tripura, province of India. It is situated in the north eastern part of the subcontinent (23.9408° N, 91.9882° E). It is circumscribed toward the north, west, and south by Bangladesh, toward the east by the territory of Mizoram, and towards northeast by the province of Assam. It is among the littlest of India's states and is situated in a segregated hilly area of the nation, with different indigenous people groups or clans representing a noteworthy bit of the population. The capital is Agartala, close to the Bangladesh outskirt in the north western part of the state. Area 4,049 square miles (10,486 square km). Population (2011) 3,671,032.

Table 1: Tripura Land Use

Sl. No	Land Use Pattern	Area (mha)
1	Geographical area	1.05
2	Land utilisation	1.05
3	Biomass producing area	0.92
4	Non-Biomass producing area	0.13
5	Biomass producing common land/Forest area	0.61
6	Biomass producing Private land	0.31
7	Percentage of Biomass producing common land	58.09%
8	Percentage of Biomass producing land	87.62%

Source: (ENVIS, 2013) *mha- million hectare

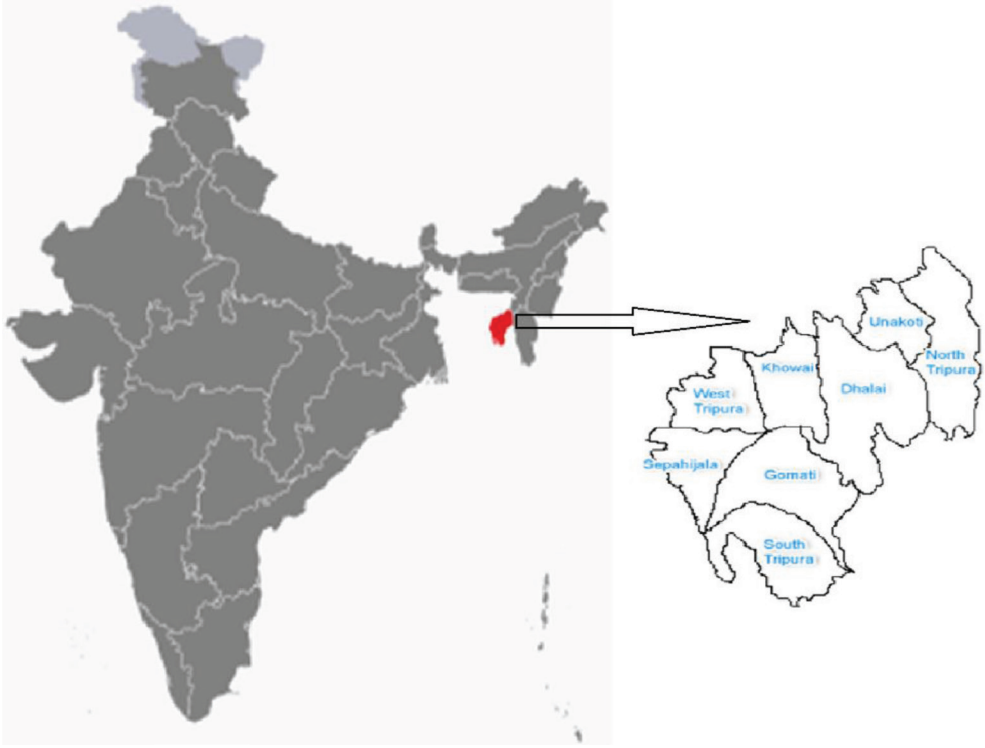

Figure 1: Location Map of Tripura.

3. Changing Land-Use of Tripura

The land-use of Tripura has undergone quite interesting changes in the last 22 years from 1995 to 2017. On one hand, there has been an increase in the forested area in the State, the area under culturable wasteland, on the other hand, has also increased greatly especially due to the shortening of the *jhum cycle* which has been reduced to 2-3 years from previously 20-30 years (Das & Das, 2014).

The area put to non-agricultural use was 134500 hectares in 1995-96 which had increased to 147413 hectares in 2016-17, thereby, registering a growth rate of 9.6 per cent and adding a total area of 12913 hectares during a period of 21 years. The area under permanent pastures and other grazing lands had greatly reduced over a period of time. The area under this land use was 3737 hectares in 2006-07 (the data is unavailable prior to this point), which fell down to 944 hectares in 2016-17, thereby, registering a decline of 2793 hectares and negative growth rate of 74.74 per cent. Similarly, there has been a substantial decline of 15475 hectares in the land under miscellaneous tree crops and groves not included in net sown area over the period 1995-96 to 2016-2017 displaying a negative growth rate of -59.52 per cent. On the other hand, the area under cultivable waste land had an exponential growth of 328.48 per cent where the area increased from 660 hectares in 1995-96 to 2878 hectares in 2016-17. Although the total increase in the area under this land use had been 2218 hectares, there had been fluctuation in area in between years as the area had increased to 3777 hectares in 2006-07. After recording a decline of 437 hectares in 2007-08 and no change in 2008-09, it again increased by 389 hectares in 2009-10. However, there has been a constant decline in the area under this land use after 2009-10. Overall, the combined land under permanent pastures & grazing lands, miscellaneous tree crops and groves and cultivable waste land had decreased from 26600 hectares in 1995-96 to 14347 hectares in 2016-17, recording a negative growth rate of 46.06 per cent (Table 2). The total fallow land in the state had decreased from 3901 hectares to 2493 hectares during 1995-96 to 2016-17. However, the area under this land use was as high as 5862 hectares during 2007-09 and remained fluctuating throughout the study period. Overall, the growth rate of total fallow land had been -36.09 per cent. Interestingly, while the area under fallow other than current fallow land had increased greatly, the area under current fallow land, on the other hand, had recorded enormous decrease during 1995-96 to 2016-17. The change in the area under fallow other than current fallow land and current fallow land for the study period had been (+) 895 hectares and (-) 2303 hectares, respectively, thus, displaying a growth rate of 127.86 per cent and -71.95 per cent for

fallow other than current fallow land and current fallow land, respectively (Table 2).

The total cultivated area in Tripura had shown a decline of -8.48 per cent as there has been a decrease in the area under this landuse by 23918 hectares during the study period. The net shown area had declined by 22510 hectares (-8.10 per cent) while the area sown more than once had increased by 38050 hectares (19.31 per cent) resulting into an increase of 15540 hectares in the total cropped area, thus, growing nominally by 3.27 per cent. The increase in area sown more than once had also improved the intensity of cropping in 2016-17 (192 per cent) by 12.28 per cent over 1995-96 figure (171 per cent, Table 2).

Table 2: Land-Use of Tripura, 1995-2017

Year	Geographical area	Area under forest	Land not available for cultivation			Permanent pasture & other grazing land	Other un-cultivated land excluding			Fallow land			Net sown area	Area sown more than once	Total cropped area	Cropping intensity (%)
			Land put to non agricultural use	Barren unculturable land	Total (4+5)		Land under misc. tree crops & groves not including in net area sown	Cultivable waste land	Total (7+8+9)	Fallow land other than current fallow	Current fallow	Total				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1995-96	1049169	606168	134500	NA	134500	NA	26000	660	26600	700	3201	3901	278000	197000	475000	171
1996-97	1049169	606168	134500	NA	133500	NA	27151	660	27751	700	2050	2750	279000	194000	473000	170
1997-98	1049169	606168	134500	NA	133500	NA	27151	660	27751	700	1050	1750	280000	205000	485000	173
1998-99	1049169	606168	134500	NA	133500	NA	25500	660	26100	700	1701	2401	281000	207000	488000	174
1999-2000	1049169	606168	134500	NA	134500	NA	27151	660	27751	700	1050	1750	279000	200800	479880	172
2006-07	1049169	606168	136754	2000	138754	3737	14238	3777	21752	1070	3250	4320	255077	193858	448935	176
2007-08	1049169	606168	137320	1843	139163	3252	14214	3340	20806	2120	3742	5862	253909	134150	445681	176
2008-09	1049169	606168	137320	1843	139163	3252	14214	3340	20806	2120	3742	5862	255242	134150	448020	176
2009-2010	1049169	606168	131465	8213	139178	2766	14118	3729	20613	1759	2607	4366	255511	145122	446703	175
2011-12	1049169	629426	143234	NA	143234	1889	12758	3449	18096	1730	1200	2930	255485	217009	472494	185
2012-13	1049169	629426	144440	NA	144440	1679	12248	3070	16997	1712	1380	3092	255213	219155	474368	186
2013-14	1049169	629426	145389	NA	145389	1345	11695	3020	16060	1729	1495	3224	255070	219428	474498	186
2014-15*	1049169	629426	146155	NA	146155	1130	11213	3020	15363	1715	1150	2865	255360	228128	483488	189
2015-16*	1049169	629426	146920	NA	146920	1077	10684	2878	14639	1635	1096	2731	255460	230217	485677	190
2016-17*	1049169	629426	147413	NA	147413	944	10525	2878	14347	1595	898	2493	255490	235050	490540	192
Growth Rate (%)	NA	3.84	9.6	NA	9.6	-74.74	-59.52	328.48	-46.06	127.9	-71.95	-36.09	-8.10	19.31	3.27	12.28

Source: Statistical Abstract of Tripura, 2014 (*Economic Review of Tripura, 2016-17).

North-east India is the home to largest forest cover in the country and exhibits the most pristine environment. A substantial portion of the Total Geographical Area (TGA) in the eight states of this region is under forest cover. The total forested area in north-east India has increased from 638879 km^2 in 1995 to 708273 km^2 in 2017, thereby recording an increase of 69394 km^2 with a growth rate of 10.86 per cent over a period of 22 years.

Tripura had witnessed a remarkable increase in the forest cover to the tune of 2188 km^2 over a span of 22 years. However, when analysed temporally, this period can be divided into two parts – the period of increase in the forest area (1995-2005) followed by the period of decline in the forest cover (2005-2017). The forest cover, which was 5538 km^2 in 1995, increased to 8155 km^2 in 2005, leading to an increase of 2617 km^2 in forested

area whereas, it registered a constant decline in area since 2005. In 2017, the total area under forest cover was 7726 km^2, leading to a decline of 429 km^2 in forested area during 2005-2017. Despite of this, the state registered an overall growth rate of 39.51 per cent in forest cover during the period 1995-2017 which is highest among all the north-eastern states of India, followed by Assam, Meghalaya and Sikkim (Table 3). On the other hand, the states recording negative growth rate in forest cover are Nagaland, Arunachal Pradesh, Mizoram and Manipur which lost 1802 km^2, 1657 km^2, 390 km^2 and 212 km^2 of area, respectively during the same period.

Table 3: State-wise Forest Cover in North-East India (1995-2017) (Area in Km^2).

States/ UTs	1995	1997	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017	Growth Rate (%)
Arunachal Pradesh	68621	68602	68847	68045	68019	67777	67353	67484	67410	67321	67248	66964	-2.41
Assam	24061	23824	23688	27714	27826	27645	27692	27692	27673	27671	27623	28105	16.81
Manipur	17558	17418	17384	16926	17219	17086	17280	17280	17090	16990	16994	17346	-1.21
Meghalaya	15714	15657	15633	15584	16839	16988	17321	17321	17275	17288	17217	17146	9.11
Mizoram	18576	18775	18338	17494	18430	18684	19240	19183	19117	19054	18748	18186	-2.10
Nagaland	14291	14221	14164	13345	13609	13719	13464	13464	13318	13044	12966	12489	-12.61
Sikkim	3127	3129	3118	3193	3262	3262	3357	3359	3359	3358	3357	3344	6.94
Tripura	5538	5546	5745	7065	8093	8155	8073	7985	7977	7866	7811	7726	39.51
India	**638879**	**633397**	**637293**	**675538**	**67833**	**677088**	**690899**	**692394**	**692029**	**697898**	**701673**	**708273**	**10.86**

Source: Ministry of Environment and Forest, Govt. of India

As is well known, the north-eastern states of India have very thick forest cover occupying a substantial portion of the respective state area. Tripura has displayed a significant improvement in the percentage of the forest cover with respect to the Total Geographical Area (TGA) of the state. However, the analysis of the percentage of forest cover to the Total Geographical Area (TGA) during 1995-2017 revealed that the state of Tripura gained 20.87 per cent points of forest cover in this period although the maximum forest cover was recorded in 2005 from whereon the state lost 4.09 per cent points of forest cover in the next 12 years to reach 73.68 per cent of the total geographical area in 2017 (Table 4). Apart from Tripura, only three more states of north-eastern India witnessed an increase in forest cover in the same period, namely, Meghalaya (6.39 per cent points), Assam (5.15 per cent points) and Sikkim (3.06 per cent points). On the other hand, the most significant loss of forest cover was seen in the Nagaland followed by Arunachal Pradesh, Mizoram and Manipur which was 10.87 per cent points, 1.98 per cent points, 1.85 per cent points and 0.94 per cent points, respectively.

Table 4: State-wise Percentage of Forest Cover to Total Geographical Area in North-East India (1995-2017) (Area in Km^2).

States/UTs	TGA	1995	1997	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017
Arunachal Pradesh	83743	81.94	81.92	82.21	81.25	81.22	80.93	80.43	80.58	80.50	80.39	80.30	79.96
Assam	78438	30.68	30.37	30.20	35.33	35.48	35.24	35.30	35.30	35.28	35.28	35.22	35.83
Manipur	22327	78.64	78.01	77.86	75.81	77.12	76.53	77.40	77.40	76.54	76.10	76.11	77.69
Meghalaya	22429	70.06	69.81	69.70	69.48	75.08	75.74	77.23	77.23	77.02	77.08	76.76	76.45
Mizoram	21081	88.12	89.06	86.99	82.98	87.42	88.63	91.27	91.00	90.68	90.38	88.93	86.27
Nagaland	16579	86.20	85.78	85.43	80.49	82.09	82.75	81.21	81.21	80.33	78.68	78.21	75.33
Sikkim	7096	44.07	44.10	43.94	45.00	45.97	45.97	47.31	47.34	47.34	47.32	47.31	47.13
Tripura	10486	52.81	52.89	54.79	67.38	77.18	77.77	76.99	76.15	76.07	75.01	74.49	73.68

Source: Ministry of Environment and Forest, Govt. of India. (*TGA-Total Geographical Area)

The land use land cover changes directly related with the climate of Tripura as natural disaster like flash floods, landslides, heavy downpour etc are become a common issue for their people. In the year 1995 to 2014, the most extreme yearly temperature recorded as 39.4 degree centigrade and it has seen in the year 2014 where the greatest temperature recorded as 33 degree centigrade in the year 1997. The pattern esteem has watched the expanding pattern of yearly temperature and it has expanded to 37 degree centigrade from 32 degree centigrade. The pattern of yearly temperature which is expanding a seemingly endless amount of time after year and it isn't the acceptable heading for future. The preparatory advances are to be taken in a matter of seconds by the peak authority with the end goal of controlling the pattern of expanding temperature (Bhowmik, 2019). In 2014 Tripura State Climate Change Cell was established under the Department of Science, Technology & Environment Government of Tripura.

4. Government Policies and Initiatives for Saving the Forest Cover

One of the most important and recent strategies adopted for Jhumia rehabilitation in Tripura is the raising of rubber plantations. The rubber plantation project was conceived to provide a lucrative alternative to Jhum cultivation. By the time of the 9th five-year plan, the raising of rubber plantation had become one of the main strategies for rehabilitation of Jhumias through the World Bank Aided India Rubber Project (Das, Choudhury & Roy, 2012).

Here the Central Government, Rubber Board and Bank had come together to aid the Tripura government to raise rubber plantations and development itself as the "Second Rubber Capital of India".

A proposal to amend a land reforms act to keep rubber plantations out of tea estate land and prescribe a ceiling for land holding has generated a lot of heat with 1,184 people and 40 organisations, including indigenous people and political parties, filing objections to the draft bill. While the tea planters have opposed the amendment on the ground that it will vest in government the surplus or uncultivated land in the tea gardens, that they use profitably for cultivating rubber, the Indigenous Nationalist Party of Twipra (INPT) is worried that it will affect the land rights of the indigenous people. The genesis of the unrest, which has seen land use change over the years, lies in the 10th amendment of the Tripura Land revenue and Land reforms Act, 1960.

Conclusion

Problems relating to Shifting cultivation or slash and burn agriculture (locally called as Jhum) are not new in Tripura. As early as 1876, W.W. Hunter in his book, 'Statistical Account of the Hill Tipperah' had marked that the "regression of forests had already started in hills because of shifting cultivation practiced by almost the whole population numbering less than 50000 who were all tribals".

However, one can without much of a stretch comprehend that this training is pervasive for the most part because of absence of feasible elective business openings. Jhumias are innate individuals who work on shifting cultivation or jhumming. In Tripura more than 10,039 hectares of land is under jhum development 10 years prior. Throughout the years the jhum economy has experienced numerous changes-land accessible for jhumming has diminished; prompting a shortening of the jhum cycle and a fall in wages. For this it is suggested that government needs to provide for alternate source of income by extending MGNREGA opportunities along with continued emphasis on rubber plantation. Allowing the use of the empty stretches of tea estates to grow rubber plantations will not only augment the income of the tea estates especially the ones under financial burden but will also provide financial support to the tribal population.

Land use/land cover effects must be assessed thoroughly as partof all future temperature change assessments. This includes not only climate effects within the regions where land use/land cover occurs, but also their role in altering hemispheric and global atmospheric and ocean circulations at large distancesfrom the placement of land use/land cover. We also conclude thata regional focus is far more appropriate so asto better understand the human effects on climate, including LULCC. it's the regional responses, not aglobal average, that produce drought, floods, and other societally important climate impacts.

Suggestions

- Alternate Source of Income by extending MGNREGA opportunities.
- Continued emphasis on rubber plantation.
- Allowing the use of the empty stretches of tea estates to grow rubber plantations which will not only augment the income of the tea estates especially the ones under financial burden but will also provide financial support to the tribals.

References

Bhowmik, K. (2019). Climate Change and Tripura. tripuraindia. Retrieved from https://www.tripuraindia.in/update/index/climatechange-and-tripura

Das, E., Choudhury, E., & Roy, A. (2012). The Success Story of Rehabilitation of Jhumias in Tripura-A Study

on Baramura-Deutamura Range. *International Journal of Engineering and Science*, 1(10), 25–29.

Das, S. & Das, M. (2014). Shifting Cultivation in Tripura - A Critical Analysis. *Journal of Agriculture and Life Sciences*, 1(1), 48–54.

Debnath, J., Das, N., Ahmed, I., & Bhowmik, M. (2017). Chronological Change of Land Use/Land Cover of the Muhuri River Basin from 1972 to 2016, Tripura, North-East India. *Indian Journal of Science and Technology*, 10(22), 1–18. https://doi.org/10.17485/ijst/2017/v10i22/1120678.

ENVIS (2013). ENVIS Centre: Tripura State Pollution Control Board. (Ministry of Environment & Forests, Govt. of India) Retrieved from trpenvis: http://trpenvis.nic.in/test/land_use.html

Geist, H. J. & Lambin, E. F. (2002). Proximate Causes and Underlying Driving Forces of Tropical Deforestation: Tropical forests are disappearing as the result of many pressures, both local and regional, acting in various combinations in different geographical locations. *Bio Science*, 52(2), 143–150. https://doi.org/10.1641/0006-3568(2020)052[0143:PCAUDF]2.0.CO;2

Gilani, H. *et al.* (2014). Decadal land cover change dynamics in Bhutan. *Journal of Environmental Management*, 148, 91–100. https://doi.org/10.1016/j.jenvman.2014.02.014

Kafi, K., Shafri, H., & Shariff, A. (2014). An analysis of LULC change detection using remotely sensed data; A Case study of Bauchi City. 7th IGRSM International Remote Sensing & GIS Conference and Exhibition. IOP Publishing. https://doi.org/10.1088/1755-1315/20/1/012056

Kaul, H.A., & Sopan, I. (2012). Land Use Land Cover Classification and Change Detection Using High Resolution Temporal Satellite Data. *Journal of Environment*, 1(4), 146–152.

Longkumer, M.T., Raj, M., & Solanki, V. (2019). Impact of shifting cultivation on environment: an assessment on the behaviour of the farmers in Mokokchung Village. *International Journal of Education*, 11, 351–366.

Mantyka-pringle, C.S., Martin, T.G. & Rhodes, J.R. (2012). Interactions between climate and habitat loss effects on biodiversity: a systematic review and meta-analysis. *Global Change Biology*, 18(4), 1239-1252. https://doi.org/10.1111/j.1365-2486.2011.02593.x

Muttitanon, W. & Tripathi, N.K. (2008). Land use/land cover changes in the coastal zone of Ban Don Bay, Thailand using Landsat 5 TM data. *International Journal of Remote Sensing*, 26(11), 2311–2323. https://doi.org/10.1080/01431160512331326666

Oliver, T.H., & Morecroft, M.D. (2014). Interactions between climate change and land use change on biodiversity: attribution problems, risks, and opportunities. *WIREs Clim Change*, 5, 317–335. https://doi.org/10.1002/wcc.271

Porter-Bolland, L. *et al.* (2011). Community managed forests and forest protected areas: An assessment of their conservation effectiveness across the tropics. *Forest Ecology and Management*, 268, 6–17. https://doi.org/10.1016/j.foreco.2011.05.034

ZHENG, Fen-Li (2006). Effect of Vegetation Changes on Soil Erosion on the Loess Plateau. *Pedosphere*, 16(4), 420–427. https://doi.org/10.1016/S1002-0160(06)60071-4

Journal of Chemistry, Environmental Sciences and its Applications

Chitkara University, Saraswati Kendra, SCO 160-161, Sector 9-C, Chandigarh, 160009, India

Volume 6, Issue 1 **September 2019** **ISSN 2349-7769**