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Climate Change And Stumbling Threat On Agriculture: Sustainable Development On Shifting Cultivation In Manipur

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Abstract:

Rapid increase in population and wants more benefits for easy means of living, man seeks more lands and profits to attain their satisfaction. The earth's temperature has historically been habitable due to deforestation, but due to enforced actions, severely affected agriculture. The objectives of the study are to identify the impact of deforestation and ecological imbalance as well as environmental degradation in the state. The present study is based on secondary data collected from Census, e-sources, publications as well as from field visits. The finding data are depicted with charts and graphs. The climate of Manipur is mostly affected by location, altitude, the direction of the dominant winds, seasonal rhythm, etc. Deforestation for shifting cultivation of various rabbi and kharif crops, including paddy and poppy plants are terrifically degrading in both soil and environment. Agriculture and climate are closely linked to global processes. Gradually increasing of temperature, uncertain floods, droughts and hailstorms are very common in the state. The majority of the state's development policies have been cantered on "growth first, cleanup later," with environmental concerns receiving little attention and little policy priority. As a result, the state's agriculture, forests, soil quality, freshwater ecosystems, health risks, air quality, and biodiversity have all declined. To keep these in mind, an alternative permanent solution is highly needed.

Keywords: Climate Changes, Soil degradation, Seasonal Crops, Deforestation, Biodiversity

I. INTRODUCTION

Agriculture and climate are closely linked to global processes. Agriculture is impacted by even little changes in the environment. At the moment, "climate change" is a defining issue. The global climate system is undergoing numerous notable long-term changes that are evident everywhere. Green House Gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydro fluorocarbons (HFCs), etc., capture tremendous amounts of heat and energy from the sun that strike the earth's surface, increasing atmospheric temperature. Specifically, the CO_2 levels are at peak and its concentration has reached up to 410 ppm (Scripps) at present, which is a principal cause of warming effect. Geographical and phonological shifts occur due to the modification in ecological construction through global climate change (Van et al, 2008). Rising sea levels, an increase in the frequency of extreme weather events, modifications to precipitation patterns, and the spread of deserts are all effects of climate change or global warming. Global mean sea levels are expected to rise from 18 cm to 140 cm by the year 2100 (IPCC, 2007). The world has been facing environmental problems for the last 15 years (Sathaye, 2007). The greatest temperatures in a number of European regions over the previous 100 years were recorded in 2019. South Asian countries have been negatively impacted by climate change for the past few years due to a variety of climatic variations, including devastating floods, cyclones, droughts, storms, heat waves, melting of glaciers, changes in the pattern and rate of precipitation, diseases in agricultural productivity, shortages of fresh water, damage to the ecosystem and environment, etc.

To reverse these detrimental alterations, intervention must be taken as soon as feasible. The Marshall Island pledged to minimize the Carbon emission rates by 32 percent by 2025 with a net total of zero emissions by 2050 (Saddington and David, 2016).The State Action Plan on Climate Change (SAPCC) is a dynamic and adaptable framework for policy that implements changes at the municipal, state, and federal levels through an ongoing process of interaction. The National Government gave the directive to develop a logical national framework under the National Action Plan on Climate Change (NAPCC) umbrella. ICAR supported in the technical backstopping and large-scale awareness in all the regions of the country towards climate change adaptation and co-benefits derived through adaptation process (Srinivasarao et al., 2016a).

Objectives:

- To examine the emerging impact factors of deforestation on the environment and climate change in the state and geo-hydrological environmental degradation to the river basin areas.
- To examine the severe ecological imbalance, emerging critical issues on the relationship between climate change and deforestation as well as socio-cultural imbalance amongst the communities.
- Crisis shortage of water in the state. The study would provide an overview of the people's perception regarding deforestation and its impact on climate change and environmental degradation under the direct influence of anthropogenic activities.

Study Area

The state is bound with Nagaland in the north, Mizoram in the south, Myanmar in the east, and the Cachar district of Assam in the west. The state lies between 92°58'E to 94°45'E longitudes and 23°50'N to 25°42'N latitudes with a total geographical area of 22,327 sq. km. of which a very important plain of 1,843 sq. km. being only about 8.3 percent of the whole area of the state constitutes the central valley. The hills and mountains cover 20,484 sq. km. (91.7 percent). Manipur valley stands, at a height of 790 meters to 2020 meters from the MSL, and therefore the valley of gorgeous oval shaped with fertile alluvial plain is of lacustrine formation. The mountain ranges act as a barrier to the cold winds from the North and prevent the Cyclonic storms that originate from the Bay of Bengal.

Methodology

The present study is based on secondary data collected from secondary sources, both published and unpublished data, sources, and from government publications viz. Statistical Handbooks of Manipur, Directorate of Economics and Statistics, Government of Manipur, Public Works Department, Government of Manipur, Basic Road Statistics of India 2018-19, Economic Survey of Manipur 2019-20, as well as from field visits. The data will be presented in tabulated format and suitable maps, charts, and graphs to visualize the spatial dimensions of different phenomena.

II. DEFORESTATION AND CLIMATE CHANGES IN MANIPUR:

Because of the deterioration of the natural environment, the world in which we live is abnormal now. This has increased the risk of climate change, which could lead to uneven rainfall, extremely high temperatures, dwindling water bodies, ice caps melting, sea levels rising, an increase in natural disasters like pandemics, floods, droughts, cyclones, earthquakes, and landslides, as well as other effects like decreased crop yields, starvation, and hunger. One of the worst effects of the broken ecosystem, which exacerbates the climate change catastrophe, is the world wars (NRDC, 2022). Any developmental initiative that gives disproportionate and indiscriminate devastation of the forest, land, river, and natural resources deteriorates eco-system and jeopardizes the entire environment coupled with the threat of survival defines environmental injustice" (Jajo, 2023). Therefore, the primary cause of the current climate problem is environmental injustice.

Climate change is bound to have far-reaching implications on tribal societies even though they have traditionally lived in close harmony with nature (Mizo, 2022). Since it threatens to upend their traditional ways of life and production through land degradation, agricultural shifts, altered rainfall patterns, and increased pests and diseases, they see climate change as a matter of anthropogenic activities. The state's untamed highland areas are home to the indigenous communities, who make up the minority in terms of population. Their local weather, water supplies, agricultural methods, and productivity are starting to show the consequences of climate change, which has further impacted their human security, economies, cultures, and social cohesion. In the country, Manipur ranks fourth in the vulnerability index for climate change, as

declared by the government of India (IFP, 2021). Chandel is the most vulnerable district to climate change, Directorate of Environment and Climate Change joint director (T. Brajakumar, 2022)

The state has a vast area of forest covering as much as 17,418 sq. km which forms about 78% of the total geographical location of the state. The actual area under forest is about 15% higher than the recorded forest area of the state. Of the total forest area, reserved forests and protected forests account for 1,467 sq. km. and 4,171 sq. km., during 2019-20. Among the north-eastern states, 257 km2 (0.39 %) of forest cover was lost in Arunachal Pradesh, 15 km2 (0.05 %) in Assam, 73 km2(0.43 %) in Meghalaya, 186 km2 (1.03 %) in Mizoram, 235 km2(1.88 %) in Nagaland, 1 km2 (0.03 %) in Sikkim, and 4 km2(0.05 %) in Tripura (ISFR, 2021).

Table-1
Forest Cover in North East States-(2021 Assessment) (in Sq Km)

States of NE	Geographical Area	Total Fores cover	% of Forest cover to GA	Changed in forest cover	scrub
Arunachal Pra	83,743	66,431	79.32	-257	797
Assam	78,438	28,312	36.09	-15	228
Manipur	22,327	16,598	74.34	-249	1,215
Meghalya	22,429	17,046	76.00	-73	663
Mizoram	21,081	17,820	84.53	-186	1.00
Nagaland	16,579	12,251	73.90	-235	824
Sikkim	7,096	3,341	47.08	-1	296
Tripura	10,486	7,722	73.64	-4	33
Total	2,62,179	1,69,521	64.66	-1,020	4,057

Sources: FSI, India States of Forest Report, 2005-2015

III. REDUCTION OF FOREST COVER IN MANIPUR:

According to the most recent edition of the India State of Forest Report (ISFR), between 2011 and 2021, the total area of forest cover in nine hill districts of Manipur decreased by 499 sq km (ISFR,2021) (Table 2). In addition to that, Manipur has nine hill districts and a total geographical area of 22,327 km^2. The report stated that the state had a total forest area of 17,090 sq km in 2011 but had decreased to 16,598 km^2 in 2021, indicating a reduction of 499 sq km. Manipur's total forest cover was 17,346 sq km in 2017, but it dropped to 16,847 km^2 in 2019 and 16,598 km^2 in 2021. The overall reduction of forest cover in the state from the year 2017 to 2019 was 499 km^2 and 249 km^2 from the year 2019 to 2021 and Churachandpur District lost 249.49 sq. km. (Table 2) (Chronicle, 2023).

Table 2.

District-wise forest cover and lost (2021) (in sq. km)

District	Geog Area	Very dense Forest	Mod. Dens forest	Open forest	Total	% of G A	Chang e from
Bishnup	496	0.00	0.99	20.51	21.50	4.33	-0.50
Chandel	3,313	10.76	950.42	1,902.17	2,860.35	86.43	-43.65
CC Pur	4,570	41.92	1,614.50	2,263.09	3,919.51	85.77	-249.49
Imphal	709	0.00	60.90	213.36	274.26	38.68	-3.74
Imphal	519	0.00	15.66	36.09	51.75	9.97	-2.25
Senapati	3,271	270.75	744.46	1,121.37	2,136.58	65.32	-47.42
Tamengl	4,391	388.90	1,726.75	1,728.79	3,844.44	87.55	-108.56
Thoubal	514	0.00	2.00	68.76	70.76	13.77	-2.24
Ukhrul	4,544	192.94	1,270.61	2,201.20	3,664.75	80.65	-41.25
Total	**22,327**	**905.27**	**6,386.29**	**9,553.34**	**16,846.90**	**75.46**	**-499.10**

Sources: FSI, India State of Forest Report, 2021

Fig-2
District wise distribution of Forest Area and Loss, 2017-2021

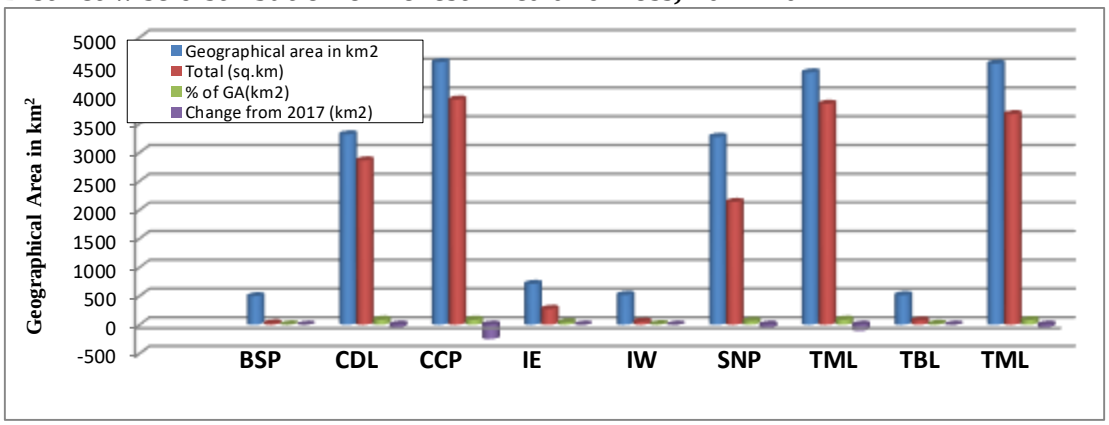


Table-3
District wise Open Forest Cover in Manipur

		2001	2003	2005	2007	2011	2013	2015	2017	2019
District	**Total Area**	**Open Forest**								
Bishnupur	496	8	14	16	20	20	20	20	21	20.51
Chandel	3313	1906	1935	1955	2065	2085	2055	2097	1926	1902.17
CCpur	4570	2933	2800	2744	3068	2555	2579	2626	2464	2263.09
Imphal/ E	669	125	162	160	173	167	167	190	217	213.36
Imphal/ W	599	25	40	28	30	31	31	39	38	36.09
Senapati	3271	1554	1320	1251	1130	1080	1080	1126	1161	1121.37
Tamenglong	4391	2229	1951	1966	2063	1839	1820	1766	1809	1728.79
Thoubal	514	21	28	38	52	52	51	97	71	68.76
Ukhrul	4544	2415	2431	2464	2504	2380	2365	2381	2221	2201.2
Total	**22327**	**11216**	**10681**	**10622**	**11105**	**10209**	**10168**	**10342**	**9928**	**9555.34**

Sources: State of Forest Report, 2001-2019, Forest Survey of India

IV. JHUM CYCLE:

The jhum cycle is influenced by the pressure of population, nature, and density of forests, terrain, angle of slope, texture of soil, and the average annual rainfall. The rapid increase in tribal population in the hill districts of Manipur, reaching 3.41% in the 2011 Census, has put significant pressure on the availability of land. In the past, shifting/ jhum was a cycle of cultivation that lasted 20 to 25 years. However, because of an ever-increasing population, deforestation caused by the need for more food, shifting cycles now typically last 5 to 10 years and occasionally as little as 3 years (Singh, 2016) Which hurts eco-restoration, the ecological process of forests, and geomorphology? With the usage of alder trees, the soil receives the same amount of nutrients back in 4 to 5 years as it would in a 15 to 20-year Jhum cycle (Ramakrishnan, 1992).

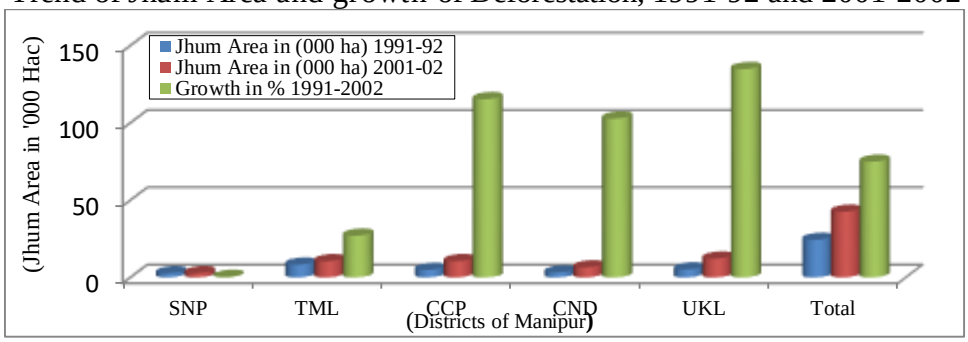
Table-3
Showing the total Jhoom area and Percentage in hill districts of Manipur, 1991-2002

District	Total Area ('000 ha)	Jhum Area in ('000 ha)		% to total jhum area		Growth in %
		1991-	2001-02	1991-92	2001-02	1991-2002
Senapati	327.1	2.73	2.74	11.24	6.45	+ 0.37
Tamenglong	439.1	8.26	10.49	34.00	24.70	+ 27.00
CC Pur	457.0	4.90	10.55	20.17	24.84	+ 115.31
Chandel	331.3	3.22	6.53	13.26	15.38	+ 102.79
Ukhrul	454.4	5.18	12.16	21.33	28.63	+ 134.75
Total	2008.9	24.29	42.47	100.00	100.00	+ 74.85

Sources: Crop-Estimation Survey, Government of Manipur 2007

According to a Report on Crop-Estimation Survey (Government of Manipur 2007), the area under jhum in the hill districts of Manipur has grown by about(+74.85%) between 1991 and 2002 (Table-3 and Fig-3). Among districts, Ukhrul recorded the highest growth (+134.75 %) and Senapati, the lowest (0.37 %). Churachandpur recorded (+115 %) and Chandel district increases (+102.79 %) in the state during 1991-2002 (Fig-3).

Fig-3
Trend of Jhum Area and growth of Deforestation, 1991-92 and 2001-2002



The rich biodiversity and forests are being destroyed by the increase in Jhum Area, the intensity of Jhuming, and the decrease in the Jhum cycle brought on by rapid population growth(ENVIS, 2015**).** The area is on the verge of total degradation due to the loss of topsoil, fertility, and vegetative cover, which will eventually result in a barren wasteland. The state's forests are being rapidly cleared for a variety of reasons, including hunting and "burning" the forest for shifting cultivation (a practice known as "Jhuming"), while locals' occasional felling of trees for fuel wood hardly counts. Manipur's total jhum area increased by 74.85 hectares between 1991 and 2002, from 24.29 ha in 1991-1992 to 42.47 ha in 2001-2002 (Table-2) (ENVIS, 2015)

V. SHIFTING CULTIVATION: PROBLEMS AND PROSPECTS:

Clearing of jungles is the prerequisite of shifting. The felling of trees and clearing of bushes, however, accelerate soil erosion and accentuate variability of rainfall which may lead either to droughts or floods. The overall impact is the decline in soil fertility. The ecosystems lose their resilience characteristics. The population dependent on shifting cultivation faces a shortage of food, fuel wood, and fodder. Consequently, the nutritional standard goes down. These processes culminate in social poverty and ecological imbalance. Regarding the problem of environmental degradation in Manipur, the following factors may be analyzed as the main causes of environmental degradation in Manipur:

- Rapid growth of the population
- Uncontrolled growth of urbanization
- Expansion and intensification of agriculture, mainly through shifting cultivation practices, destruction of natural habitats, and
- Large-scale development projects (dams, industries, railways, etc.)

VI. TEMPERATURE AND RAINFALL OF MANIPUR:

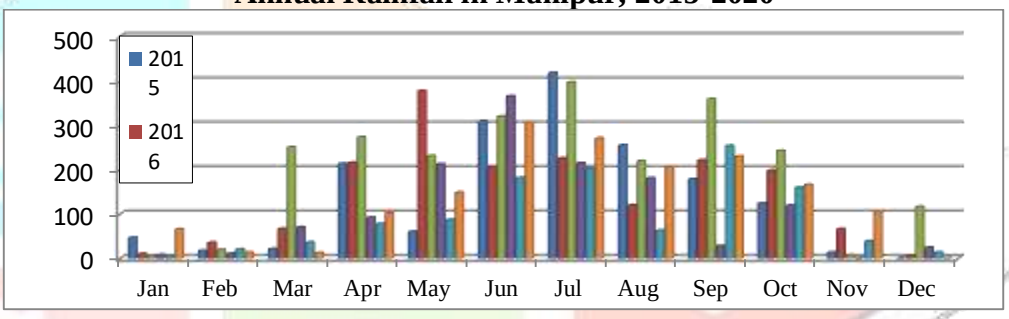
Manipur has always had pleasant, moderate temperatures, but in recent decades, the region has seen record highs. At 32.7℃ in May 2012, the Meteorological Observatory Unit in Imphal recorded the highest temperature since 1952. The unit of July 2014 reading of 32.8 ℃ was the highest since 2012. (Table-3 and Figure-3). Manipur had another record of soaring temperature. Moreh Town in Chandel District records 39.4 °C, the highest in the history of Manipur (Mercury Hits 39°C, (Sophia *et al*, 2020). Manipur recorded this year's maximum temperature so far as Tengnoupal district touched 40°C on April 13, 2023, according to data from the state directorate of Environment, climate and Change (Hindustan Times, 2023).

Table-4
Month-wise Rainfall recorded by the ICAR, Manipur, 2015-2020 (in mm)

Month	2015	2016	2017	2018	2019	2020
Jan	46.6	10.1	3.7	7.8	3.4	65.8
Feb	17	35.8	19.4	10.6	20.3	13.3
Mar	21.3	66.8	250.6	70.2	36	12.1
Apr	213.4	215.4	273.3	91.9	77.6	102.8
May	60	377.3	230.9	212.3	87.1	148.6
June	309.6	205.3	319.8	365.7	181.4	307.4
July	418.2	225.6	396.8	214.7	202.6	270.8
Aug	254.9	119.8	219.3	180.8	62.9	205.7
Sept	178.5	221.5	359.2	27.9	253.7	229.9
Oct	124	198.3	242.6	119.1	159.8	165.8
Nov	13.3	66.2	7.5	0.4	38.7	104.9
Dec	0.4	5.8	116.3	24.3	13.6	0
Total rainfall	1657.2	1747.9	2439.4	1325.7	1137.1	1627.1

Source: Economic Survey, Manipur 2020-21

Fig-4
Annual Rainfall in Manipur, 2015-2020



The average annual rainfall at Cherrapunjee from 1973-2020 (48 years) is **11,621.0 mm** (i.e. 38.12 feet- i.e. 457.51 inches). In 1974 it had rained 24,555.3 mm

Table-5
Monthly Max and Min Temperature as recorded by ICAR, Imphal West, Manipur, 2010 to 2016: ***(0C)***

Year	January		February		March		April		May		June	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2010	23.30	4.30	23.70	6.50	28.70	12.70	29.00	18.40	27.90	20.10	27.30	22.00
2011	20.80	5.40	23.20	7.20	26.00	11.80	28.20	15.50	28.20	19.20	29.80	22.00
2012	22.00	5.20	26.00	5.80	28.70	11.10	28.00	15.50	32.70	18.60	31.90	21.90
2013	23.10	3.00	28.00	7.70	29.00	10.70	28.80	15.50	26.80	19.40	31.60	22.00
2014	24.00	4.60	23.80	6.70	28.00	10.40	30.50	14.60	30.10	19.00	31.00	21.90
2015	22.70	7.40	23.70	6.70	28.50	11.00	26.40	16.10	28.90	18.60	29.40	21.90
2016	22.13	4.62	25.10	9.56	27.59	12.60	28.36	17.07	29.46	21.32	31.35	22.09

Year	July		August		September		October		November		December	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2010	29.00	22.70	29.50	22.60	28.60	21.60	27.60	18.50	25.30	7.70	21.60	7.30
2011	30.70	22.00	30.40	21.80	30.30	21.40	28.70	17.80	27.00	9.20	24.00	5.60
2012	32.30	22.80	31.50	22.40	29.80	21.70	29.40	17.50	26.60	12.00	22.80	4.90
2013	30.80	22.60	30.80	22.00	30.30	21.30	29.30	18.00	27.60	9.60	22.70	5.60
2014	32.80	23.00	32.00	22.40	30.60	21.40	29.20	17.10	28.00	11.70	23.40	6.20
2015	27.80	22.20	28.90	22.40	29.70	21.50	27.90	19.70	25.60	11.40	21.74	5.85
2016	30.41	22.27	31.00	22.41	29.39	21.90	28.60	19.48	24.91	12.33	23.68	8.30

Source: Statistical Handbook Manipur 2016-17

On April 13, 2023, Manipur recorded its highest temperature, reaching 40 degrees Celsius. Tengnoupal, a hill town, had experienced four days with temperatures above 39.9 degrees Celsius (Imphal Free Press, 2023). During 1953-1998, the Meteorological Observatory Unit (MOU)in Imphal recorded a maximum temperature of 21oC-29oC. The highest temperature recorded in Manipur was 36 degrees centigrade on April 14, 1999, in Imphal (ToI, 2014). On September 21, 2024, Manipur recorded a temperature of 42.16 degrees Celsius (IFP, 2024).

VII. DEFORESTATION AND POPPY PLANTATION IN MANIPUR:

Our rich biodiversity is under threat due to the massive deforestation that has occurred in many parts of Manipur's hills for poppy plantations This disturbance of the ecological balance could spell the end of humanity if it is not stopped immediately. Of the 15,497 acres of land where poppy cultivation was found in the past five years, 13,122 acres were in Kuki-Chin-dominated areas, 2,340 acres in Naga-dominated areas, and 35 acres under others (Table-6) (NAB, 2023). In addition to other concerns like social problems, health problems, family issues, etc., the progressive and quick expansion of poppy cultivation in Churachandpur, Chandel, and Ukhrul Tamenglong districts has raised serious concerns about the threat of environmental degradation.

Table-6
Community-wise Poppy Cultivated Area in Manipur: 2017-2023 (App. area in acres)

Sl No	Community	Year-wise Area of Poppy Cultivatio (Acre)in Manipur, 2017-2022						
		2017-18	2018-19	2019-20	2020-21	2021-22	2022-23	Total
1	Kuki-Chin	2001	2174	1670.5	3871	2,600.8	804	13121.8
2	Nagas	229	67	626	763	305	350	2340
3	Others	0	0	10	0	25	0	35
4	Total	2230	2241	2306.5	4634	2930.8	1154	15496.8

Sources: NDTV Newspaper Report, May 16, 2023

Excessive use of Pesticides, herbicides, and chemical fertilizers; mostly (DAP) Di-Ammonium Phosphate regularly on the hill ranges to grow poppy plants has seriously affected biodiversity (OECD, 2020). Trekking through the hill ranges planted with poppies reveals no signs of animals or birds, not even a single burrowing animal, and no insects buzzing. The catchment areas that supply a steady supply of water for the rivers that flow downward were greatly impacted by the deforestation in the hill tract due to shifting cultivation; however, this is no longer the case since the forest was cleared to make room for the growing of poppies. This is a major factor in climate change as well as causing water shortage in the hill areas.

Chemical fertilizers & pesticides dissolve in the water and become toxic which makes it unfit for human consumption. The Assistant Conservator of Forest (ACF) stated that excessive use of fertilizers affects humans in different ways, adding that it reduces natural soil fertility, increases soil erosion, which directly impacts the flow of water, drying up of river beds, increases siltation, etc. (Zimik,2023). The progressive and rapid expansion of poppy cultivation in the Ukhrul and Churachandpur districts has become a serious concern over the threat it poses to the environment apart from others (Mungchan, 2021). In certain places, the natural vegetation has changed as a result of the ongoing destruction of forests, which has an impact on the natural cycle. In addition to destroying illegal poppies, the Manipur government's "War on Drugs" should also involve educating the locals about the disturbing truths about poppies and their detrimental effects on the entire ecosystem. (Indian Express, 2023). According to ecologists and environmentalists, jhum or slash or Primitive subsistence agriculture or shifting cultivation is economically unviable and ecologically unsustainable (Singh, 2022).

VIII. RECOMMENDATION:

Deforestation in the state is very high and jhum cycle is very short, maximum of 3-4 years because of the excessive increase in tribal population in some communities. Being a short cycle of jhum cultivation-flash floods, mudslides, soil deterioration, and the loss of fertile topsoil become a yearly occurrence once the rainy season starts. Nevertheless, jhum or shifting cultivation in the hill areas of the state mainly for poppy plantation in the far border hill slopes of the state, particularly to the tribal peoples, it is a burning

question of soil degradation, ecologically and environmentally unsustainable. Cultivation of cereal crops and edible foods is not worth much to soil erosion and it can replace topsoil but cultivation of poppy plants damages topsoil and valuable plants as farmers use herbicides, excessive fertilizers, and insecticides. Permanent cultivation is generally practiced in the valley districts while shifting cultivation is practiced in some pockets in the hill areas. Recently, on the evening of June 30, 2022, a massive landslide took place in the Noney district of the Indian state of Manipur close to the Tupul Railway construction site. It is time to stop deforestation to preserve the ecological balance, social conflicts, and sustainability of our mother Earth. Plant more trees to ensure that they can support future generations of humankind and other living things in the soft cradle of the mother planet.

IX. CONCLUSION

The Global Water Partnership claims that as living standards rise and population density increases, water resources are coming under more and more strain. The 20th century saw a threefold increase in the world's population, which is expected to reach 10 billion by 2050 (Agriculture must provide for the needs of food. Rainfall-derived water availability and plant water requirements are gradually changing due to climate change. Extensive deforestation puts the region's ecosystems at risk of irreversible damage and leaves it exposed to hotspots for biodiversity. This will result in the rich biodiversity hotspots in the Manipur region being completely removed from the global biodiversity hotspot map, which would be a huge loss for our State and Nation.

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