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Land-use and its impact on environment: A study on Tengnoupal district, Manipur

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Abstract
This study aims to examine land use and its effects in the Tengnoupal District of Manipur. The district is primarily Kuki-dominated, where the land serves multiple purposes. According to the 2011 census, the district's total population is roughly 59,000. The document seeks to emphasize the overuse of land for building government facilities in the district, which also leads to adverse effects on the environment. The examination of land use in the district revealed that a majority of the residents are involved in shifting agriculture. However, only a few of them successfully began the practice of terrace farming in the Machi Block sub-division. Establishing agriculture and cultivating long-term cash crops is also taking place in the district, which helps mitigate soil erosion and sustain ecological balance. The review and study also cover forest exploitation via activities such as shifting cultivation, border fencing installation, and the building of Integrated Check Posts (ICPs).

Keywords: Land-use, soil, climate, development, agriculture, ecological, and cultivation

Introduction

Human activities have continuously altered the planet, yet the current scale and speed of transformation are unmatched. Approximately three-fourths of the Earth's terrestrial area has been modified by humans in the past millennium (Karina Winkler, et al., 2021) [2]. Understanding the historical changes in land cover is essential to evaluate potential future alterations and the effects these changes could have on people's lives. Alterations in land cover influence the atmosphere, climate, and sea level, or shifts in land cover happen in sufficient locations to accumulate to a notable overall effect (Meyer and Turner 1992). Land cover reflects human activities and therefore fluctuates with alterations in land-use and management practices. Therefore, land cover could serve as a reference point for uses such as monitoring forests and rangelands, generating statistics for planning and investment, biodiversity, climate change, and managing desertification (Di Gregorio and Jansen, 1998).

The current land utilization in the Tengnoupal district, Manipur, is suitable for exploration in the research domain. Examining the history and current state of economic practices utilized by individuals for their livelihoods throughout the district poses a significant risk to the environment, potentially resulting in severe adverse effects on the atmosphere, climate, and soil erosion. Furthermore, the land cover gradually decreases due to all these impacts. Conversely, land has consistently been a crucial element of development, particularly for tribal communities living in rural regions. All sustainable development resources stem solely from land resources. The Report of the Scheduled Areas and Scheduled Tribes Commission (1960-61), chaired by Shri U.N. Dhebar, has eloquently detailed the economic and emotional connections of tribal communities to their land. However, grasping their spatial and temporal manifestations is essential for understanding land use and land cover. As per the data from the UN (2016), more than 54.4% of the global population resided in cities in 2016, and it is anticipated to rise to 60% by 2030, placing additional strain on urban resources. The rise in development rates in emerging nations leads to the growth and expansion of numerous cities, causing a swiftly transforming urban landscape. This swift expansion without sufficient planning and infrastructure accelerates changes in land use and land cover, linked to declining ecosystem services and human welfare.

Study area

Tengnoupal District is situated in the southeastern region of Manipur, India. This area is found within a temperate and tropical rainforest zone, located between the latitudes 230 47'-250 41'N and the longitudes 930 61'-940 48'E, adjacent to Myanmar to the east. Tengnoupal district, established in December 2016, is predominantly a Kuki district. The highest elevation on the Indo-Myanmar Road in Manipur is in this district. Indeed, Tengnoupal is a tranquil and picturesque travel spot in the northeastern state of Manipur. Tengnoupal District encompasses roughly 1,200 square kilometers. The altitude varies from approximately 800m to more than 2000m above Mean Sea Level (MSL), leading to differences in climate and vegetation types. The district's geographical characteristics and landscape are quite distinctive when compared to other areas in Manipur. The tallest summit known locally as "Theose Mol" is situated just a few kilometers from the district headquarters. Visitors from both distant and nearby locations regularly came to this site each year, turning it into one of the district's tourist attractions. Tengnoupal village, the district headquarters, is situated at the highest elevation of National Highway 2, connecting Imphal and Moreh, at the northwestern edge of Myanmar. Nevertheless, because of its rocky terrain, the hilltops and their surroundings are unsuitable for crop production.

According to the 2011 census, the total population was recorded at just 59 thousand, with 30 thousand (51%) being male and 29 thousand (49%) females. Of this total population, 15% belong to the general caste, 1% to the scheduled caste, and 84% are from scheduled tribes. The district consists of approximately 12 thousand households, with an average of 5 individuals per family. About 71% of the population resides in rural areas, while 29% live in urban regions. The climate is chilly year-round, and in the

rainy season, clouds envelop the hilltops of the district, often causing fog that hampers drivers in maintaining their speed. The primary livelihood of the residents in the whole region is shifting agriculture, where various crops such as rice, corn, legumes, vegetables, and fruits are grown seasonally. Certain permanent crops like citrus and rubber trees are also brought in because of the advantageous climate and soil quality. The district showcases a varied and vibrant land use pattern shaped by its geographical characteristics, socio-economic aspects, and cultural traditions. Grasping its land use patterns is essential for efficient planning and sustainable development across different areas.

The area is blessed with abundant natural resources that are crucial for maximizing the economic potential of the land. Upon examining the whole district, it is discovered that, thankfully, the traditional land use system remains dominant, and land is utilized in all facets of life, whether in times of joy or sadness. The district is surrounded by several districts: Chandel and Kakching to the Northwest, Ukhrul to the Northeast, and Myanmar to the east. The significant rivers, such as Lokchao and Menal Rivers, originate from the Tengnoupal hill ranges and flow eastward, eventually entering the Myanmar landmass. The Taret River, found at the Northeastern edge of the district, flows down and joins other rivers in Myanmar.

Land-use pattern of Tengnoupal district

Tengnoupal District displays a varied land use pattern shaped by its geographical characteristics such as vegetation, soil types, topography, climate, socio-economic influences, and cultural practices. It is furthermore defined by its diverse characteristics, which play a vital role in enhancing its economy. Additionally, the terrain has provided a combination of farmland, wooded regions, urban expansion, and various other land utilizations. Agriculture is a significant undertaking in the Tengnoupal District, where a vast expanse of land is designated for farming activities. The farming methods in the district can be categorized as follows:

Jhum (shifting) cultivation: Shifting cultivation is an ancient technique and customary method of farming that has been employed since ancient times and persists in this digital era. Changing occupations hold a remote position in the tribal economy and have played an essential role in the socio-economic framework of the hills and tribal areas. In Manipur, especially in the tribal hills, shifting cultivation is as ancient as human settlement and represents the most basic method of growing crops for survival. It is the cyclical characteristic of farming where a piece of land is entirely devoid of trees and other plants to prepare for crop sowing. Jhum farming in the hilly regions of Manipur has served as a vital source of sustenance over the centuries, particularly for the entire Kuki community. Thus, in the Tengnoupal district, most of the population has also engaged in this traditional farming practice. This method includes the clearing of wooded regions for farming in a rotational manner. Shortly after they gathered the crops from the currently farmed lands, the village chief and his committee or subordinates inquired about the new site that would be the oldest and most densely populated next to the previously farmed region. The village chief and his power to protect the cultivated land rigorously uphold this rotational system. Additionally, the more established areas show enhanced soil richness and higher yield, while also generating fewer weeds in the crops. After the cultivation area was determined, they held a meeting to talk about the newly suggested farming sites and distributed the land through a lottery system. This is the method they would use to exchange the workplace each year. This culture and tradition have been maintained with unanimous consent by all members of the village committee for an extended period. It is confirmed that the majority of people still engage in this traditional farming technique across the district, which is exclusively meant for subsistence. Nevertheless, numerous individuals are oblivious to how significantly shifting cultivation has adversely affected the climate and biodiversity of the region. Altering farming practices has significantly impacted land use, leading to both beneficial and harmful environmental consequences. Its implementation reduces the intensity of land use and greatly lowers the rate of environmental deterioration. At the same time, its harmful consequences include the reduction of soil fertility and heightened deforestation. Despite its harmful impact on the environment, changing this cultural or traditional farming method in these regions is difficult unless a new agricultural system for growing crops is implemented in the area.

Terrace cultivation: Terrace farming, also known as terrace agriculture, is a method that involves cutting steps into hilly or mountainous areas to establish arable land for cultivating crops on the slopes. The core purpose of terracing or forming steps is not just the creation of fields but also allows farmers to capture water for intentional use and manage its movement effectively. This type of cultivation method for crops and land utilization in hilly or mountainous regions has been successfully implemented to optimize arable land spaces. Terracing the land contributed to minimizing soil erosion and preventing excessive water loss. Terrace farming resembles permanent or settled agriculture. The sole distinction lies in the geographical position. Settled or permanent agriculture is conducted in the flat or low-lying regions that have effective irrigation systems. Terrace farming occurs in elevated regions and relies entirely on rainfall for crop cultivation. Despite being labour-intensive, the technique is being utilized efficiently to optimize arable land in diverse terrains, which helps minimize soil erosion and water loss. It has been observed that in many systems and areas of the land, the terrace is a low, flat embankment of soil constructed along the slope, featuring a well-designed channel for runoff water located just above the ridge. Typically, terraces are constructed on a gentle slope to allow water in the channel to flow gradually towards the terrace outlet. This terrace farming has emerged as the latest and favored method of agriculture to manage the significant loss of soil erosion and its nutrient content. Consequently, this has been widely practiced in China, Japan, the Philippines, and various regions of Oceania and Southeast Asia; throughout the Mediterranean; in certain parts of Africa; and extensively in the Andes of South America.

In certain areas, individuals traditionally channel water from streams via pipelines to cultivate their fields year-round. At times, they grow the crops in a rotational manner by altering the crop varieties annually. It is also considered that because

of the irrigation capabilities of the terrace farming land, double cropping and triple cropping are being implemented widely. This has significantly boosted the economy for the people in those areas. However, these irrigation facilities can only be established where there is a river that provides water year-round. In certain areas, this resource is completely lacking, as individuals primarily rely on natural rainfall for farming. In Tengnoupal District, the areas designated for terrace farming lack sufficient irrigation facilities, as they are predominantly situated in high mountainous regions with limited water resources. Individuals can implement this to manage the gradual deterioration caused by overexploitation of land in the area. In spite of numerous challenges, farmers persist in their efforts and continue striving for success. Therefore, due to the continuous efforts of the residents in specific regions, the development of terrace fields in the district has proven successful. Occasionally, the delayed onset of the monsoon affects the usual starting time that must be observed throughout the cultivation process. Recognizing the importance of terracing farming in optimizing arable land and reducing soil erosion, farmers actively advocate for the expansion of the terrace farming system in the area. This technique enables farmers to grow paddies, grains, wheat, corn, and different seasonal crops or vegetables. In the whole Tengnoupal district within Machi Sub-Division, terrace farming was initiated a few years ago. It is hoped that this method of terrace farming can be expanded to a broader scale soon, as it can effectively optimize arable land and provide reliability for the family as well. This would aid in preventing the overexploitation of biodiversity in forest regions, while terrace farming remains the sole practical solution for the agricultural use of hilly land in relation to soil erosion and land degradation.

Permanent agriculture: Permanent Agriculture is a farming method that is established and maintained in a specific location indefinitely. In this system, the land is farmed with crops that grow for extended durations and do not require replanting once harvested. This is additionally referred to as a long-term agricultural system. Nevertheless, a reduced emphasis can be noted in this regard by most farmers. Due to the intricate nature of cultivating and planting the crops, numerous steps and procedures must be followed to ensure the crops reach maturity. Additionally, a significant investment is required in this instance for the development and processing of cultivation to ensure success. Consequently, many individuals struggle to afford this long-term farming in this area without financial support from any organization or agency to facilitate its introduction. Furthermore, farmers are certainly less experienced in this scenario; however, it is observed in certain small plots of land that are involved in this type of farming. Farmers are gradually introducing permanent crops like bananas, mangoes, lemons, oranges, and rubber plantations in many areas of the district. Concurrently, seasonal cash crops like ginger, stinky beans, and turmeric that offer improved income prospects are significantly cultivated in this district. The land use system is making progress to some degree in the region as they have begun placing slightly greater emphasis on the cultivation of cash crops or short-term crops.

However, since farmers rely exclusively on rainfall for irrigation, they occasionally encounter difficulties due to insufficient rainfall, resulting in crop decline or reduced yields. During our field survey in several villages, we found that a majority of the households were involved in the large-scale cultivation of cash crops. When some farmers were interviewed, their enthusiastic responses were both challenging and intriguing, as they expressed greater satisfaction with their work, which is more profitable than growing rice and other cereal crops. Regarding permanent crops, farmers primarily focus on ginger cultivation since the soil types and their fertility are more appropriate than for other cash crops in this area. Turmeric, conversely, is another cash crop that is widely cultivated in this area. It has been observed that numerous farmers have begun cultivating turmeric on both small and large scales in various areas of the district.

Forested areas

A considerable portion of the Tengnoupal District is covered by forest. These woodlands are vital for preserving biodiversity and offer resources like timber, firewood, and non-timber forest products (NTFPs). These forests are essential for sustaining local livelihoods via collection activities, and they also aid in biodiversity conservation. The woodlands host a variety of plants and animals throughout the entire region. The village leader and his subordinate or committee are actively engaged in managing the forest. For example, the village maintained the forest that encircles it, locally referred to as ‘Khutu’. This forest is a shared asset and is thoroughly managed by the village Authority. Thus, anyone who fells trees or exploits the forest and violates the regulations established by the village Authority is imposed a fair fine. Thus, the safeguarding of village forests has been traditionally practiced since the establishment of settlements and continues to this day. The forest is maintained for various purposes; for example, firewood, which is often used for cooking in the village, is gathered from this forest. It is also utilized for gathering materials for house construction. The forest is rich in various plant species, including medicinal plants, prompting people to gather medicinal leaves and roots from the jungle for first aid whenever an accident happens in the village. These have rescued numerous lives from perilous conditions.

The yangngoupokpi-Lockchao Wildlife Sanctuary is an Indo-Myanmar refuge for animals located in the Tengnoupal District, designated as Government Reserved Forest. The Indo-Myanmar boundary is located approximately 110 kilometers from Imphal. It covers an area of 184.80 square kilometers. The ecosystem within this wildlife sanctuary is distinct and lively. Various animals from different families established themselves in this forest. It signifies the biological diversity of Indo-Myanmar. The wildlife sanctuary's strategic position at the intersection of the two geographical zones, India and Myanmar, is the reason. The forest provides numerous species of trees. The teak and Khangara trees are primarily tree species found in these two natural regions of India and Myanmar. The department of Wildlife Sanctuary's regional office is situated in the town of Moreh. Certain office personnel are assigned to this location for the management of the office. When we met with the officials and inquired about how the wildlife in this forest is managed and protected. They openly revealed the reality that exists in this area, where hunters continue to kill wildlife such as deer, monkeys, tigers, and elephants,

despite the penalties enforced for animal killing. Residents previously engaged in secret killings, but when apprehended, they face fines of suitable amounts and receive gentle warnings to refrain from further hunting. The use of forest land is also affected by variations in weather and climate. For instance, the recent drought in California's history has led to a notable event of forest die-off. Besides, the quantity of standing forest timber diminishes annually due to excessive land utilization. Individuals tend to fill trees for various purposes such as creating pillars and charcoal. Occasionally, extensive forest fires are observed in March, April, and May, resulting in significant destruction of plant life. Therefore, if no protective measures are taken for the forest reserved area, the outlook will be at risk. Simultaneously, the public's perception of the land use system needs to shift away from outdated views.

Construction of roads and national highway

Road and highway systems are essential in contemporary society as they link individuals and products throughout the nation and over great distances. The development of the India-Myanmar-Thailand Trilateral Highway (IMT), which spans 1,360 km, is a four-lane road that falls under India's Look East Policy initiative. This route travels through the central area of the district from Pallel to the border town of Moreh. The road is anticipated to enhance trade and commerce within the Asean – India Free Trade Area and with the broader Southeast Asia region. The 160 km India-Myanmar Friendship Road, officially opened on 13 February 2001, links Moreh-Tamu-Kalemyo and has become a trilateral highway. This has expedited trade and commerce with the Southeast ASEAN international nations. Additionally, the finishing of this road has created a significant opportunity for utilizing time effectively. Previously, it required three and a half hours to travel from Moreh town to Imphal, but now it only takes two and a half hours. Thus, the enlargement of this national highway provided a significant boost to business and various trade activities between far-off locations.

However, building roads and highways has significantly contributed to the clearing of natural habitats, resulting in deforestation and a decrease in biodiversity. The destruction of ecosystems can greatly affect the environment, leading to habitat loss for many wildlife species that have sought refuge in the forest for a long time. Ehsan Ashouri (2023) noted in his writing that the greatest effect of road and highway infrastructure on the environment is the release of greenhouse gases, especially carbon dioxide. Worldwide, the transportation industry accounts for about 14% of global greenhouse gas emissions. This implies that as we enhance road connectivity and significantly expand it, there's a greater likelihood of disturbances in the existing ecosystem, which ultimately disrupts the normal cycle of the region's micro atmosphere. Additionally, the introduction and establishment of new cutting roads is the most damaging process of removal and deforestation of the region's primary natural resources, which continuously harms the ecosystem. Moreover, the ecological imbalance negatively impacts biota, leading to disturbances in the healthy environment on Earth and potentially making human survival more complicated and endangered. It leads to the destruction and degradation of natural habitats, climate change, and global warming.

For example, the centrally sponsored Inter Village Road (IVR) scheme and district road, initiated in 2000 under the guidance of then Prime Minister Atal Bihari Vajpayee as part of the Pradhan Mantri Gram Sadak Yojana (PMSY), has been significantly executed to alleviate the critical communication issues in the hill district of Manipur and other regions of the nation. The program has proven to be very effective and advantageous, as it has greatly benefited the hill areas of Manipur, especially in the Tengnoupal district, alleviating and eliminating the difficulties people previously encountered regarding transportation and communication. Previously, the main method of communication between the villages relied solely on footpaths. However, the situation has entirely transformed, as the majority of people now travel by bike and other four-wheel vehicles throughout various areas of the district. Conversely, the geographical assessment in this regard cannot be overlooked, as this road construction and expansion have led to the destruction and removal of countless pre-existing natural resources such as plant species and habitats of wild animals. During physical inspections of the roadside locations, numerous areas experience landslides annually, both small and large, which are beyond any control measures. Indeed, this is the effect that emerged following the advancement of transportation and communication throughout the district. Simultaneously, there remain numerous areas along the highways that are susceptible to mudflows and landslides, potentially leading to significant devastation of natural resources.

Urban settlement

The role of a settlement relates to the main economic or social activities taking place in the region. This is commonly referred to as land usage. Typically, the city or town serves as the primary center of activity where numerous business and government services can be located. The state capital and district headquarters are locations where people congregate more compared to other remote areas from the town or city. Simultaneously, government facilities such as hospitals, schools, colleges, clinics, departmental offices, and public services are prevalent. These amenities encourage individuals to migrate to urban areas to access these services promptly. Thus, while establishing a new settlement in and around urban regions, the land use and land cover change significantly. The planning for development by the state and Central Government is vital for the expansion of settlement. Any party that formed and governed at the Centre and state prioritized introducing new plans for the benefit of the people. Thus, all these developmental activities for the new land extension also led to a decrease in land use and land cover in the district, which ultimately influences the micro-ecosystem of the regions.

The Land Port Authority of India has been set up to ensure improved governance and integrated management of the cross-border transit of goods and travelers along India's land border. The Moreh Integrated Check Post is one of the most significant transit locations for advancing trade and commerce. The town is already regarded as the commercial hub of Manipur and India's entry point to South-East Asia. The land ports situated between India and Myanmar are approximately 110 Kms away from Imphal, designed to enhance cross-border trade and the transit of passengers and goods. The land area of this Moreh Integrated Check post is

approximately 45.5 acres, and the projected cost of the land Port project is nearly Rs. 72.67 crore. (Land Port Authority of India.) Considering the importance of border trade and commerce, the Land Port Authority of India does not concern itself with the adverse effects of climate change. Prior to the establishment of the Integrated Check Post, all the vegetated land cover had been entirely depleted, leaving no remnants of even a single blade of grass in these regions. Currently, all these areas have been transformed into urban settlements with completed Integrated Check Post buildings, while some buildings remain under construction. The war is yet another element that alters the arrangement of the district. For example, the recent ethnic conflict occurring since May 3, 2024, involves displacement that has occurred in different areas of the state. This unexpected ethnic conflict also impacts the land use and land cover system of the settlement. It is observed that certain areas are growing in population, while the abandoned locations stay desolate, leaving uncertainty about when to initiate resettlement in their original communities.

Border fencing construction

Fencing is being constructed on the Indo-Pakistan border, Indo-Bangladesh border, and Indo-Myanmar border. To date, a total of 5187 km of India's international border has been fenced to manage and control any external disturbances along the border. As part of this, the building of border fencing along the Indo-Myanmar border, intended to secure the border and reduce cross-border crime such as smuggling of goods, arms, counterfeit currency, and drug trafficking, has only reached 30kms completion by September 2024, out of an estimated 1,624 km that will be constructed along the Indo-Myanmar border. This was initiated after the governments of Myanmar and India reached an agreement to carry out a joint survey prior to constructing the fence.

The building of fences leads to significant harm and loss of land cover in this border area. In addition, this has posed a significant risk to large mammals in the border regions. For example, in the 1980s, wild elephants, tigers, leopards, and wild mithun inhabited this area, but currently, no large mammal species are found in this region. The primary cause for the relocation of these large mammals to these regions is human threats posed by various activities. Border fencing is another factor that posed a significant threat to them, as the fencing has deteriorated and disrupted their regular habitation in these regions. For migratory species, it can be a significant issue since many must cover vast distances for breeding and reproduction. Walls and structures built to secure national and international borders may hinder the ability of nearly 700 mammal species to adjust to climate change, according to new global research. Additionally, the total loss of forested land cover for construction obstructs their movement, and the removal of trees and vegetation could have lasting impacts on weather and climate. Consequently, humans are changing the makeup of biological communities through various activities that elevate the rates of species invasions and extinctions, ranging from local to global scales.

Conclusion

The land use system of the district shows many changes that negatively impact all aspects. The district is primarily inhabited by tribal communities that participate in various economic activities. For example, shifting cultivation, recognized as the most common and traditional agricultural method and the leading practice in the whole district, has yet to fully transition to other more profitable and scientific farming types. This has significantly impacted land use and land cover, gradually reducing the land to a certain degree. Moreover, the tribal communities have a strong attachment to this age-old cultivation technique, as it provides their primary staple food. Luckily, in certain areas, individuals are beginning to implement terrace farming effectively. The implementation of this farming method establishes a solid basis for the development of the agricultural system in the district, aiding in the reduction of land use in the future. The long-term agricultural practice of cultivating rubber trees in the easternmost areas of the district has significantly contributed to controlling soil erosion and maintaining balance in the ecosystem. This land use system appears to be growing in the district, as many individuals show a strong inclination to engage in extensive practices when questioned during the survey. In this context, the involvement of the relevant authorities is essential, and simultaneously, support in every aspect of these cultivation processes is eagerly anticipated by the people.

The city is growing because of the lack of government services. For example, those living far from government facilities do not have access to schools, higher secondary education, colleges, hospitals, and other departmental offices. Consequently, individuals migrate to towns and cities to take advantage of these amenities promptly. Thus, the government must implement measures that can be beneficial for the citizens. Thus, it will reduce the growth of urban development in the area. The building of the border fence is beneficial from a strategic perspective to manage the illegal crossing of weapons, ammunition, and foes across the border. Nonetheless, this operational process significantly damaged the vegetation cover, potentially impacting and jeopardizing the natural ecological balance in the area.

References

1. Eshan Ashouri. The Impact of Highway Infrastructure on The Environment and Climate Change, 2023.
2. Karina Winkler, Richard Funch et al. Global Land Use Changes Are Four Times Greater Than Previously Estimated, 2021.
3. Azadi Amrit Mahotsav. Central Government Develops Integrated Check Post at International Land Borders of The Country with The Aim to Facilitate Cross-Border Movement of Passengers and Goods, 2023.
4. Sonam wangyel wang, Lamchin Munkhnasan et al. Land Use and Land Cover Change Detection and Prediction in Bhutan's High-Altitude City of Thimphu, Using Cellular Automata and Markov Chain, Environmental Challenges, 2021, 2.
5. Vishwambhar Prasad Pati. Shifting Cultivation in Mizoram, India: An Imperial Study of Its Economic Implications, 2019.
6. E-Pao. Jhum Cultivation and the Hill of Manipur, 2024.
7. Ashok Kumar verma. Ecological Balance; An Indispensable Need for Human Survival, 2018.
8. Ashok Kumar Verma Department of Zoology, Government Post Graduate College, Saidabad, Allahabad - 221 508, India