

ASSESSING THE RISKS OF LAND USE CHANGES DUE TO TOURISM GROWTH: A CASE STUDY IN ELLA, SRI LANKA

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ABSTRACT

This study aims to analyze the land use change from 2010 to 2024 and to identify destination risk due to tourism growth. Secondary data were used to create maps of Landsat 8 and data were analyzed using unsupervised classification in Arc GIS Pro software. In 2010, there has been 2083.59 hectares of dense vegetation and it accounts 5736.15 hectares of vegetation in the same year. From 2016 to 2024, it has shown a clear decrease of vegetation cover in losing nearly 700 hectares. The area covered by dense vegetation has drastically decreased by -34.62% and vegetation cover has decreased - 26.12% from 2016-2024. It accounts a 66.26% increase in built-up areas. This growth is likely driven by the demand for tourist accommodations and facilities. The study has revealed that, annually the dense vegetation is decreased by -1213.50 hectares and vegetation cover is decreased by -3282.08 hectares. The increasing of built-up areas annually by +3068.18 hectares reflects the growth and expansion of this area. The considerable increase in built-up and bare land, combined with the decline in dense and overall vegetation, highlights the deforestation, soil erosion, landslides and forest fires. For future sustainability, it is critical to implement strategies that balance development with environmental conservation including strict the policy implications and protecting the natural beauty.

1. INTRODUCTION

Sri Lanka, which has been described as the "Pearl of the Indian Ocean," is a beautiful island nation that is filled with its rich tapestry of history, culture, or natural beauty, contributing to tourism's growth. The country has a wide range of sights, including blue beaches along its coast, green tea plantations in the hills, nature reserves, old ruins and vibrant cities such as Colombo and Kandy. Sri Lanka is known as a popular destination for tourists because of its warm tropical climate, pleasant people, and delicious cuisine. In order to preserve Sri Lanka's culture and heritage, tourism also has a crucial role to play. Furthermore, there is no argument regarding the importance of tourism in Sri Lanka. Not only is it a key source of foreign exchange income, but it also helps to create jobs and reduce poverty. In contrast, despite some ups and downs, Sri Lanka's tourist business has grown significantly in recent years. As a result, Sri Lanka's tourist industry has grown significantly, with the total number of visitors expected to reach 1.48 million by 2023. This indicates a huge growth over the previous year, with December being the most recent arrival (Shahuli, 2023). The growth of Ella as a tourism destination has been accompanied by impressive statistics that reflect its rise in popularity. However, the tourism industry was extensively affected with numerous disasters from 1960 until today. The 30 decades of war with terrorists and the tsunami disaster in 2004, substantially impacted the resources and capacities of the tourism industry in Sri Lanka. (Karunaratne et al., 2021) At the end of the civil war in 2009, the Sri Lankan tourism industry recorded a two-digit growth rate for both international

tourists' arrivals and tourism revenues. Tourism in Ella, Sri Lanka, has had several positive impacts, particularly on the socio-economic development of the area.

After the post-war boom in 2012, Ella experienced a considerable growth in tourism, which caused an increase in small-scale tourism and job opportunities, which may range from low-paying positions to high-paying professional roles in management, in order to generate more income and improve the standard of living. During this acceleration of the tourism industry, the Easter Terror Attack happened and completely reversed the tourism sector in many parts of the country, which caused a US\$1.5 billion loss in the tourism income of the country (Silva, 2019). Among the tourist destinations in Sri Lanka Ella, has faced numerous challenges so far due to various crises in Sri Lanka. But on each situation, the contribution of small-scale entrepreneurs in Ella was extensively admirable. When looking back on the journey, tourism often encourages increases in the price of goods and services, and increases the price of land and housing, as well as the cost of living. It improves investments and public utilities with well-developed road networks. Due to the acceleration of tourism, there are more opportunities to contribute to the income of the people; from 2012 to 2017, there was a rapid increase in the number of apartments, rooms, and workers in selected hotels and homestays in Ella. The growth of tourism in Ella is evident in the increasing number of hotels and guesthouses. In 2010, the town had only a handful of accommodation options, but by 2019, it boasted over 250 establishments, ranging from budget-friendly guesthouses to boutique hotels. Apart from

that, the individuals who engaged in agriculturally based opportunities, were fully converted into tourism-based livelihoods, providing a number of income opportunities to increase their standard of living.

After 2018, soon after the war, it caused a far-reaching growth in reference to the increase in the number of hotels and accommodations. The findings indicate that small-scale entrepreneurs play a vital role in catalyzing the growth of tourism in Ella. By establishing homestays, guesthouses, restaurants, cafes, and souvenir shops, these entrepreneurs diversified the tourist offer and strengthened the attractiveness of Ella as a destination. The number of visitors to Ella has increased significantly in the last decade. The Resource Profile of Ella Secretariat Division, 2019 data reveals that Ella was once a small tourist destination, but by 2019, it had grown to accommodate over 500,000 visitors annually. However, the rapid growth of tourism in the area has also brought about a set of challenges that need to be addressed in order to ensure the long-term sustainability of the industry. This study aims to study the land use change from 2010 to 2024 and to identify the destination risk due to the land use change over the time. This study further elaborates the negative impacts behind the unplanned tourism growth in Ella for the selected years of 2010, 2016 and 2024 and provides some recommendations to overcome risks of unplanned tourism growth and land use changes. This will provide a base for future research directions on land use changes and its impacts to Ella and the possible reasons of unplanned tourism growth.

2. LITERATURE REVIEW

2.1 Overview of the tourism industry- National Context

As in the rest of the world, tourism has traditionally been the third largest foreign exchange earner in the country and an important income generator for Sri Lanka over the years (Deshappriya & Nawarathna, 2020). The country offers a variety of tourism types, including ecotourism, wildlife tourism, coastal tourism, cultural and rural tourism, etc., which allow travelers to participate in tourism throughout the country. The country's tourism attractions include clean, whitish gold beaches, water spots, hill country with waterfalls and tea gardens, flora and fauna, modern shopping arcades, ancient cities, and cultural events as one of the fastest-growing sectors in Sri Lanka and a driving force of post-war economic development. There has been unprecedented growth in the tourism industry, especially since the civil war ended in 2009 due to the development plans and projects governed by the respective authorities (Deshappriya & Nawarathna, 2020). It has contributed more than \$2,980 million to the economy, second only to remittances and textiles and garments. According to the 2021 Travel & Tourism Competitiveness Report of the World Economic Forum, Sri Lanka ranked 74th out of 141 countries in terms of its passion for being a top tourist destination.

According to the annual statistical report of Sri Lanka Tourism Development Authority, 2010 tourism has surged to a new high record of 654,476 arrivals, surpassing the previous all-time highs due to the peaceful post conflict environment. The foreign exchange earnings increased by 62.0% from Rs. 40,133.00 million (US\$ 349.3 million) in 2009 to Rs. 65,018.00 million (US\$ 575.9 million) in

2010, showing the potential of economic contribution. According to the Sri Lanka Tourism Development Authority (SLTDA), in 2020, the total number of persons employed directly in the tourism sector increased by 1.5 percent from 2009 to 52,071 persons, compared with a decline of 15.2 percent in 2008, which has shown the number of direct and indirect employment opportunities it has provided and how it has contributed to the wealth of the local economy.

2.2 Overview of the tourism industry- Ella as a tourist destination

Over the past ten years, Ella has grown in popularity as a travel destination in Sri Lanka. Ella sleepy town, which offers breath-taking views of tea estates, mountains, valleys, and waterfalls, welcomes 6% of all international visitors to Sri Lanka. Foreign visitors from European countries who are enthusiastic about rock climbing and the outdoors regularly come to Ella. China, India, France, Germany, Australia, and China are the main source markets for Ella's tourism industry. In general, Ella is regarded as a backpacker's dream come true (Ella Tourism Development Master Plan, 2020). Regarding the study, differences in language skills and problem-solving ability were the main issues affecting women's participation in Ella's hotel industry. Women's involvement in this sector, was also impacted by childcare responsibilities and inexperience. The results also showed that the majority of non-hospitality professionals, around 33%, are impacted by language barriers, a lack of industry knowledge accounts for 23%, and a lack of opportunities to work in the tourism sector accounts for about 13% (Rasanjali, Sivashankar, & Mahaliyanaarachchi, 2021). According to the study, 30 non-hospitality

workers were surveyed, and the results revealed that 53.3% of them considered working in the tourism and hospitality industries in the future, while 46.6% had no such thoughts (Rasanjali, Sivashankar, & Mahaliyanaarachchi, 2021).

Given that Ella's travel mode supports its tourism industry, the city's landscape presents a substantial possibility for the promotion of self-driving scooters, especially for its more isolated attractions. Travelers who want to visit far-off places are starting to take Ella's scooty journeys more often (Kumarasinghe & Damunupola, 2019). Ella is a destination that is largely utilized by the informal business community, with little involvement from the formal sector in long-term planning and development. Ella experienced a COVID-19 crisis as a result of this factor, which led to a reduction in all service offerings. The long-term survival of Ella's tourism industry is fully reliant on the planning activated by the government. Accordingly, lack of connection with domestic visitors, engagement, and visitor dissatisfaction are the main causes that were found during this pandemic (Pathirana et al., 2022).

2.2.1 Natural Attractions and Tourism Dynamics

Ella's tourism is highly dependent on its characteristics and beauty. The unique sights of the area, including the famous Ella Rock Bridge and the Nine Arches Bridge, play a major role in attracting tourists. Research shows that social media platforms are an important tool for promoting ecotourism, allowing visitors to share their experiences and increase the visibility of places like Ella (Wood et al., 2013). In addition, the concept of eco-tourism has been developed,

highlighting the contradictions within the neoliberal framework. Fernando & Kaluarachchi (2016) states that although eco-tourism provides economic opportunities, it often leads to environmental degradation and shows the need for sustainable in places like Ella that rely heavily on natural resources.

The social and economic impacts of tourism in Ella are manifold. Although tourism generates income and jobs, it also leads to challenges such as cultural heritage and an increase in the cost of living for local residents. Groups of tourist sites in Ella increase compatibility between different sites and promote a unique tourism experience. This cluster effect can attract more visitors and benefit businesses and society. However, there is a conflict between development and conservation. The influx of tourists can damage local infrastructure and resources and demand the implementation of effective tourism management strategies. Tourism development can be considered a double-edged sword. While it provides economic opportunities, it can also destroy the environment. It has shown that tourism development in Sri Lanka often causes environmental damage over time (Murshid et al., 2021). This finding was repeated by other researcher who suggested that international tourism development may contribute to increased carbon dioxide emissions, especially in regions with rapid economic growth (Katircioğlu et al., 2018). Residents' perception of tourism development plays an important role in determining the sustainability of tourism. Gannon et al (2020) emphasized the mediating role of residents' perceptions, suggesting that positive perceptions lead to sustainable tourism, while negative perceptions exacerbate environmental issues. In Ella, community

participation is important and it is important to understand these considerations in order to promote sustainable tourism.

Rapid urban growth associated with tourism often results in a decline in urban growth and an increase in urban heat islands, as Manesh et al. (2017). This urban sprawl affects local ecosystems, especially in sensitive areas like Ella, where biodiversity is rich but vulnerable. In addition, the impact of urbanization on the environment in Sri Lanka has been shown to be very positive, showing the relationship between urban growth and environmental problems (Baloch et al., 2022). This presents a major area of concern, because the natural beauty that attracts tourists is under threat due to lack of urbanization.

2.3 Destination risk and tourism growth-Global context

Documents show that the global travel and tourism sector is on track to recover from the setbacks of the Covid-19 pandemic and even surpass pre-pandemic peaks next year 2024. Tourism in the 21st century has destroyed places around the world that are not reported and are not understood by tourists (Wood et al., 2019). The country's problems also affect international tourism demand (Lee et al., 2021). Despite these challenges, tourism has generally recovered from disasters, with more than 100 million jobs lost in the sector during the pandemic (Tourism - An Opportunity for Sustainable Development, 2022). Travel and tourism's share of global GDP is expected to grow over the long term between 2022 and 2032. International political crisis in tourism development and post-pandemic travel behavior. International tourism is taught to develop a conceptual framework (Akram et al., 2023). Factors

affecting the growth of international tourism include demographic and social changes, economic and financial development, political and legal regulations, technological changes, business development, transport infrastructure and travel safety. Risks in the tourism industry include safety hazards such as slips, trips, falls, food shortages, fires, structural failure, natural disasters, theft, robbery, violence, persecution, and water and water sources (Parikka, 2023).

2.4 Destination risk and tourism growth- National context

The growth of tourism in Sri Lanka has brought both opportunities and risks. Prior to the COVID-19 pandemic, heavy tourist pressure was causing environmental degradation and wildlife disturbance in protected areas (Perera et al., 2023). The rush to develop and expand tourism has also been harmful to the natural environment and has excluded local communities. Economic risks include an increased debt and foreign exchange crisis, and high inflation (Fernando et al., 2024). The tourism sector also faces risks due to factors such as national security and political stability. Despite these challenges, tourism has been recognized as an important economic activity in Sri Lanka, especially since the end of the civil war in 2009 (Destination Risk and Resilience Manual, 2023.) In 2018, tourist arrivals peaked at 2.5 million, contributing US\$5.6 billion to the economy (Tourism in Sri Lanka, 2023). However, issues such as safety, harassment, and limited entertainment options pose significant challenges to the sector. Increased taxes and administrative changes may also raise costs for tourists, influencing their travel decisions and expenditure.

2.5 Land use change- National Context

Land use changes in Sri Lanka due to various reasons have significant implications for the environment, economy, and also local communities. But according to the literatures it has revealed that, the main reason for the land use changes is, tourism growth, population growth and development projects led by government. The development of tourist facilities often leads to habitat destruction, particularly in sensitive coastal and forest ecosystems. This can result in biodiversity loss and disruption of local wildlife habitats. For example, the conversion of wetlands for resort development can significantly alter local ecosystems, as seen in studies conducted in areas like the Kalametiya Lagoon where anthropogenic changes have affected bird diversity and feeding guilds (Bernard et al., 2023). Increased land use for tourism also can leads to soil erosion particularly in hilly or coastal areas. The removal of vegetation for construction projects leading to soil erosion and sedimentation in waterways. Research in different river basins in Sri Lanka has highlighted how land use changes associated with tourism can adversely affect vegetation and increase the risk of landslides (Jayasuriya et. al, 2024).

2.6 Land use change- Regional Context in Ella

As tourism has flourished, agricultural land has been increasingly converted into hotels, guesthouses, and other tourist facilities. This shift not only reduces the area available for food production but also affects local farmers' livelihoods. Research indicates that the encroachment of tourism development into agricultural zones has been significant, leading to a decline in traditional farming

practices (Wijesundara et al., 2023). The expansion of tourism infrastructure often involves deforestation, particularly in areas surrounding Ella. The clearing of forests for hotels and roads has resulted in habitat loss for numerous species, impacting biodiversity. Studies show that the ecological balance in the region is threatened by the increased anthropogenic activities associated with tourism (Samarasinghe et al., 2022). The construction of tourist facilities and the associated increase in foot traffic contribute to soil erosion. Research highlights that the loss of vegetation cover due to land conversion leads to increased runoff and soil degradation, particularly on sloped terrains (Jayasuriya et al., 2024). This not only affects land productivity but also contributes to sedimentation in local water bodies, impacting water quality. The rise in tourist numbers has led to a significant increase in waste generation, which local infrastructure often struggles to manage. Inadequate waste disposal systems can result in pollution of the landscape and waterways, further harming the environment.

The cumulative effects of these land use changes raise concerns about the long-term sustainability of tourism in Ella. Without effective management and regulatory frameworks, the negative impacts could outweigh the economic benefits derived from tourism, leading to a decline in both environmental quality and tourist appeal (Jayasuriya et al., 2024). The literature has exposed that the several studies have contributed on destination risks in various aspects but limited to the Sri Lankan context. The few of studies have studied on unplanned tourism and the growth of tourism in Ella. This study provides a graphical idea how land use change has changed over the time due to

the tourism and how the unplanned tourism affects the livelihoods of the people in Ella and to the sustainability of the tourism industry.

3. METHODOLOGY

Ella, located in the picturesque hill country of Sri Lanka, is a renowned tourist destination known for its natural beauty, fully converted into a busy, vibrant city in the late after the war. In 2010, it had a handful of accommodations, and soon after the war, they ranged from small guesthouses to boutique hotels. The growth of tourism activities is still fully dependent on the number of small-scale entrepreneurs who contribute to the industry of tourism, lush green landscapes, and serene atmospheres. This small town has gained significant popularity among travelers and is often considered one of the top tourist destinations in Sri Lanka. According to the study by Bandusena, Dissanayake, & Silva (2023), 37.14% of respondents agreed that tourism brings increased opportunities to meet and socialize with world-wide tourists who are visiting the Ella destination. Tourism improves understanding of the image of different communities, more than 50% agreed that tourism helps boost international cultural exchange to get advice and develop homestays in Ella destinations in a more attractive way for tourists. Tourism leads to the development of opportunities and jobs for local businesses. 28% of respondents agreed that tourism leads to the development of opportunities and jobs for local businesses.

Tourism increases several recreation activities, which lead to job opportunities for residents in the homestays in Ella. 53.71% of respondents agreed that tourism increases the availability of recreation facilities, which

leads to job opportunities for residents of Ella. Further, most of them earn by providing accommodation, food, and other services. Employment & income opportunities and community participation on tourism development in Ella destination is positively correlated (Bandusena, Dissanayake, & Silva, 2023). However, along with its attraction, Ella has faced several challenges and witnessed notable developments in the field of tourism. Ella is blessed with breathtaking scenery that captivates visitors from around the world. The town is nestled within rolling hills, tea plantations, and cascading waterfalls,

offering panoramic views that are truly mesmerizing. The iconic Ella Rock, with its stunning hiking trails, attracts adventure enthusiasts seeking a memorable hiking experience. As a top tourist destination, Ella has faced certain challenges that come with increased visitor numbers. One of the primary challenges is managing the environmental impact of tourism. Infrastructure development has been a key area of focus in Ella's tourism sector. In recent years, there have been significant improvements in transportation and accommodation facilities.

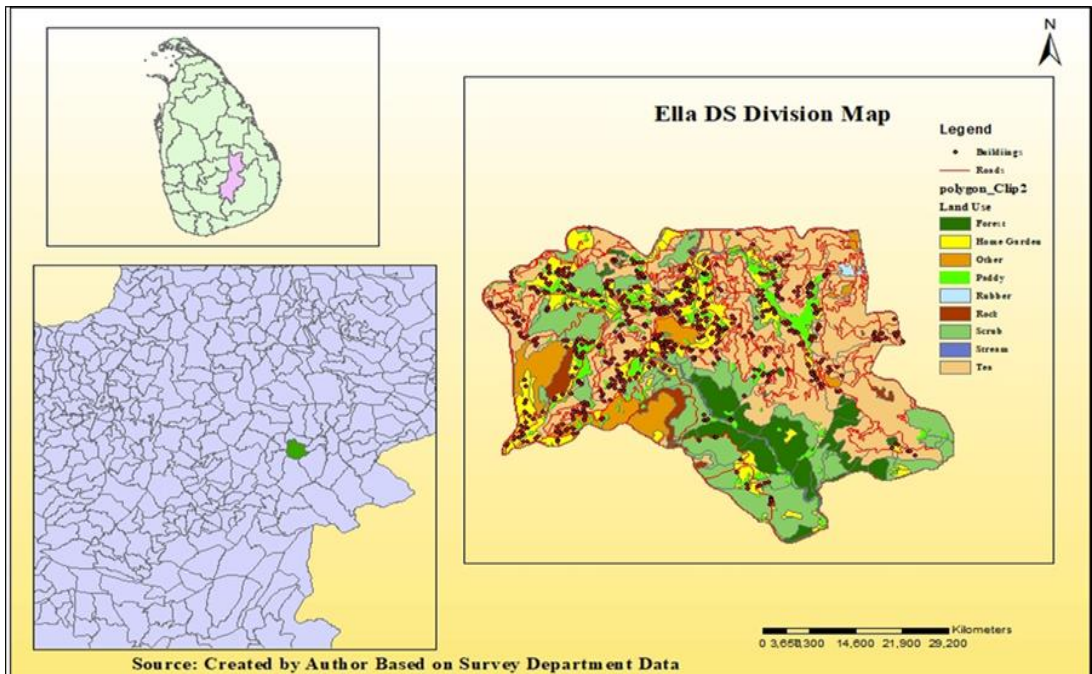


Figure 1: Ella Divisional Secretariat Map

Source: Prepared by author based on survey data, 2023

The accessibility of Ella has improved with better road networks, making it easier for tourists to reach the town. The availability of a range of accommodations, including boutique hotels, guesthouses, and eco-lodges, caters to the diverse needs and preferences of visitors. The development of tourism-related activities and services has also been significant in Ella. Local entrepreneurs have introduced various experiences to enhance visitors' engagement with the destination. From tea plantation tours and cooking classes to cultural performances and wellness retreats, there is a wide array of activities available to immerse oneself in the local culture and traditions of Ella. These developments have added value to the tourism experience and contributed to the local economy.

In recent years, community-based tourism initiatives have emerged in Ella, aiming to empower local communities and provide authentic experiences for travelers. Further, these initiatives involve the participation of individuals in tourism activities, such as homestays, cultural exchanges, and handicraft workshops. Such developments help distribute the benefits of tourism more equitably and promote a deeper understanding of the local culture. The fascinating views, blessed with green valleys, mountains, waterfalls, and tea estates, of Ella misty valley have resulted in 6% of foreign tourist attractions out of total tourist arrivals in Sri Lanka. Little Adam's Peak, Ella Rock, Diyaluma Falls, Ravana Waterfall, Dowa Temple, Demodara Nine Arch Bridge, and Ravana Caves are the most attractive tourist attractions in this green, misty valley. On the other hand, the train from Ella to Nanu Oya, higher up in the mountains, is known to be one of the most scenic train rides in the world.

Ella is quite occupied by foreign tourists from European countries who are fascinated with rock climbing and nature. During July–September and November - February an approximate number of 450 visitors visit Ella town daily, 280–300 visitors trot in the area during January - June and October–November. France, Germany, Australia, China, and India are the main source markets for the Ella tourism industry (Ella Tourism Development Master Plan 2020-2023, 2020). By embracing sustainable practices and involving the local community, Ella can continue to thrive as a sought-after destination while preserving its natural heritage for generations to come. For the study, Ella Divisional Secretariat Division will be used to gather samples and data.

The study employed quantitative research methods to collect data and information. Secondary data was gathered using Landsat images of 2010, 2016 and 2024 in order to analyze the destination risk of unplanned tourism industry and to identify possible impacts of land use changes in Ella, Sri Lanka. The reason for the selected years is, the lack of quality images for the other years and have to select the images without cloud coverage. The other reason for the selected years is, to make a coverage on soon after the post-war development, mid of the post-war development and present. Research articles, reports and books were used to gather information related to the study. Collected data were analyzed using unsupervised classification in Arc GIS Pro Software and using Excel application. In Excel the below mathematical formula was used to calculate the land use change in hectares, calculate the annual change of land use and compare the three years. Analyzed data is presented using maps, figures and tables.

Example:

1. Dense Vegetation Count Value*900= Dense Vegetation in Square Meters
2. Dense Vegetation in Square Meters*0.0001= Dense Vegetation in Ha
3. Percentage of Dense Vegetation = ((Hectares value of dense vegetation in 2024- Hectares value of dense vegetation in 2010)/ Hectares value of dense vegetation in 2010*100)
4. Annual Change of Dense Vegetation= (Hectares value of dense vegetation in 2024- Hectares value of dense vegetation in 2010)/ 14

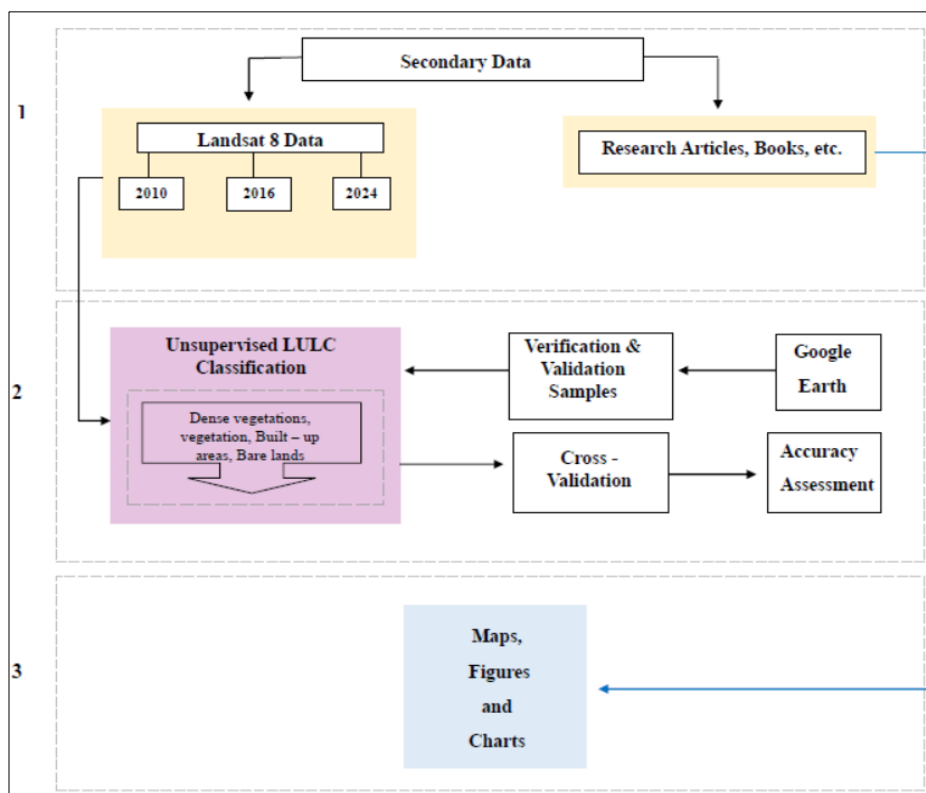


Figure 2: Methodology Flow Chart

Source: Author's work, 2024

3.1 Research Objectives

Main Objective

- To analyze the change of land use in 2010, 2016 and 2024 in Ella DS Division, Sri Lanka

Sub Objectives

- To analyze the annual change of land use change in 2010, 2016 and 2014 in Ella DS Division, Sri Lanka
- To identify the possible impacts of land use, change due to tourism in Ella DS Division, Sri Lanka
- To identify the destination risk of land use, change due to the unplanned tourism growth in Ella DS Division, Sri Lanka and to provide possible suggestions to overcome the risks

3.2 Research Questions

1. How the land use has changed in 2010, 2016 and 2024 in Ella?
2. How the land has changed annually?
3. What are the possible impacts of land use change?
4. How is the destination risk due to unplanned tourism in Ella?
5. What are the possible suggestions that can be provide to overcome the risks?

4. RESULTS AND DISCUSSION

4.1 Analyzing the Land Use Change From 2010-2024

Tourism in Ella was not a that much popular destination prior to the war period and it was seeming like a tiny sleepy town. Soon after

the post-war development, the government had implemented several development projects to enhance the livelihoods of the communities. Due to the high growth and expanding demands in the tourism industry, the tourism in Ella, Sri Lanka, has led to significant environmental changes. The natural land cover has been disturbed and reduced due to tourism-based projects, leading to land degradation, excessive tree cutting, soil erosion, and natural hazards (Niluksha, 2021). Unchecked development of hotels and infrastructure for tourism has resulted in forest fires especially in Little Adam’s Peak and Ella rock, land grabbing, and destroying the forests in Ella (Niluksha, 2021). Series of forest fires had occurred in 2019, 2023 and 2024 which caused a severe threat to the fauna and flora in Ella. Accordingly, the below maps are shown how the land use has changed over the years till 2024 from 2010.

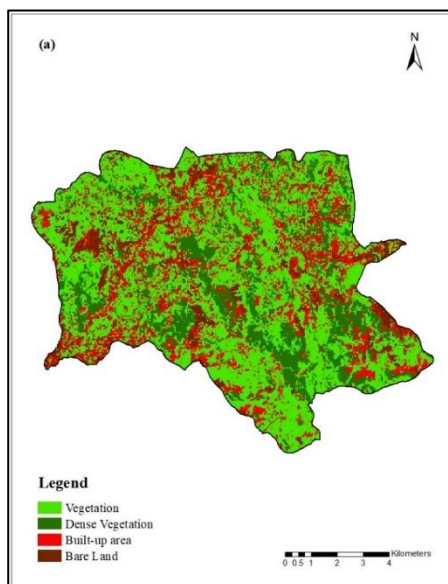


Figure 3: Land Use Change in Ella DS Division- 2010

Source: Prepared by Author based on Landsat data, 2010 (2024)

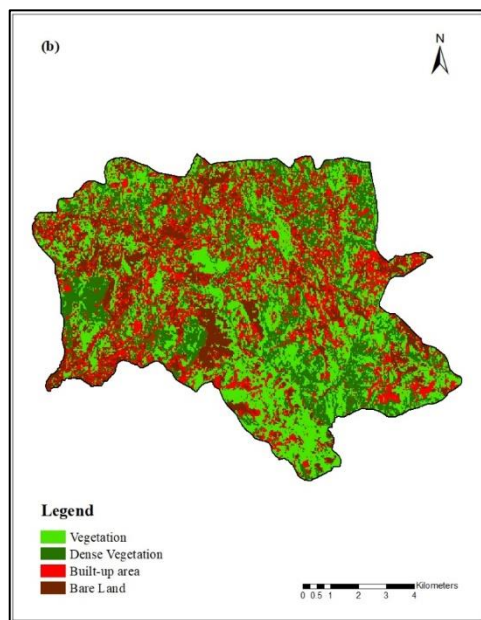


Figure 4: Land Use Change in Ella DS Division- 2016

Source: Prepared by Author based on Landsat data, 2016 (2024)

According to the above figures, (Figure 3 & Figure 4), the town, situated in an environmentally sensitive zone, has become vulnerable due to the unplanned tourism development. Despite being one of the most popular ecological tourist destinations in Sri Lanka, Ella has witnessed a reduction in green cover over time (Wijesena, 2020). The emerging unplanned tourism activities pose risks to the natural environment. With the end of 30-year war, tourism was gradually increased from 2009 to 2016. Even 2011, these locations; Nine arch bridge, Little Adam's Peak, and Ella Rock were hidden by the wilderness and started to pop up after the post-war development in 2016. After 2018, soon after the war it caused to a far-reaching growth reference to the increase of number of hotels, accommodations and the findings indicate that small-scale entrepreneurs play a vital role in catalyzing the growth of tourism

in Ella. Through the establishment of homestays, guesthouses, restaurants, cafes, and souvenir shops, these entrepreneurs have diversified the range of tourism offerings, bolstering Ella's appeal as a destination. Ella has experienced a substantial increase in visitor arrivals over the past decade. In 2010, Ella attracted a modest number of tourists, but by 2019, the number had risen to over 500,000 visitors annually according to the resource profile of Ella Divisional Secretariat Division statistics, 2019. The growth of tourism in Ella is evident in the increasing number of hotels and guesthouses. In 2010, the town had only a handful of accommodation options, but by 2019, it boasted over 250 establishments, ranging from budget-friendly guesthouses to boutique hotels. Apart from that, the traditional employees who engaged in agriculturally based opportunities, were fully converted into tourism-based livelihoods supplying number of income opportunities to increase their standard of living in a way. At the same to expand the needs for the excessive growth of tourists in Ella, the number of vegetation cover has decreased over the time including forest clears, land grabbing, and losing thousands of habitats for fauna and flora.

After 2016, the Ella tourism is gradually increased by implementing thousands of guesthouses, hotels, homestays, restaurants and shops. It has led to loss of vegetation cover and increased the number of built-up areas in order to provide essentials for tourists and visitors. The findings indicate that Ella, a town in Sri Lanka, is facing

environmental challenges due to unplanned tourism development.

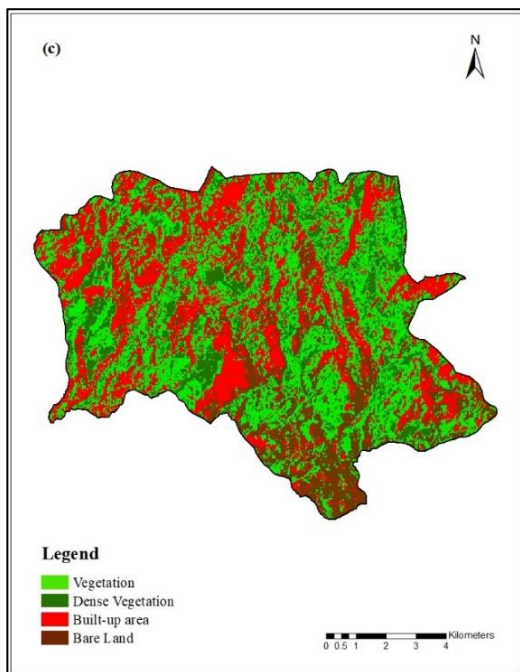


Figure 5: Land Use Change in Ella DS Division- 2024

Source: Prepared by Author based on Landsat data, 2024 (2024)

The town, which is located in an environmentally sensitive zone, has seen a surge in infrastructure for tourism, leading to a grave vulnerability. The negative environmental impacts, including those on food, forests, mountains, rivers, and tributaries, reportedly outweigh the benefits. Ella has been designated as a mini tourist zone, but the unplanned tourism activities pose risks to the natural environment. There have been instances of forest fires, such as the one in Mini Adam’s Peak, which resulted in the destruction of over 150 acres of rainforest in 2024. The town is also known for its rich biodiversity, including montane rain forests, grasslands, tea, paddy, and a mix of dry

evergreen forests and lowland rainforests. However, the pressure from tourism could lead to the overharvesting of these vital forest resources for fuel, furniture, or construction materials.

Table 1: Comparison of land use change from 2010-2024

	2010 (Ha)	2016 (Ha)	2024 (Ha)
Dense vegetation	2083.59	1356.3	1362.33
Vegetation	5736.15	5234.31	4238.1
Built-up	2051.01	2664	3410.01
Bare land	1058.4	1764.36	1918.71

Source: Prepared by Author based on

In 2010, was the year which started to grow the tourism industry in Ella and according to the statistics it shows that, there has been 2083.59 hectares of dense vegetation in 2010 and it accounts 5736.15 hectares of vegetation. Most importantly it can be seen a considerable number of built-up areas as well in 2010. Both dense vegetation and vegetation cover have been decreased gradually when it comes to the year of 2016 which made a significant loss of forest covers to Ella. The literature has found that, from 1999 to 2017 the total forest cover has changed, which accounts reduction of 1000 acres to nearly 300 acres. Conversion of forest covers into tea plantations and other crops was the main reason behind this reduction of forest covers in Ella. Apart from that, the increasing number of residential populations was reasoned to this gradual decrease of vegetation cover (Urban Development Authority of Sri Lanka, 2020). After 2018, the main reason for the reduction of forest covers, was the development of accommodation facilities for the visitors in

Ella. From 2012 to 2018 it has shown a clear increase in volume of tourists in Ella (Figure 4) which caused to loss of forest covers.

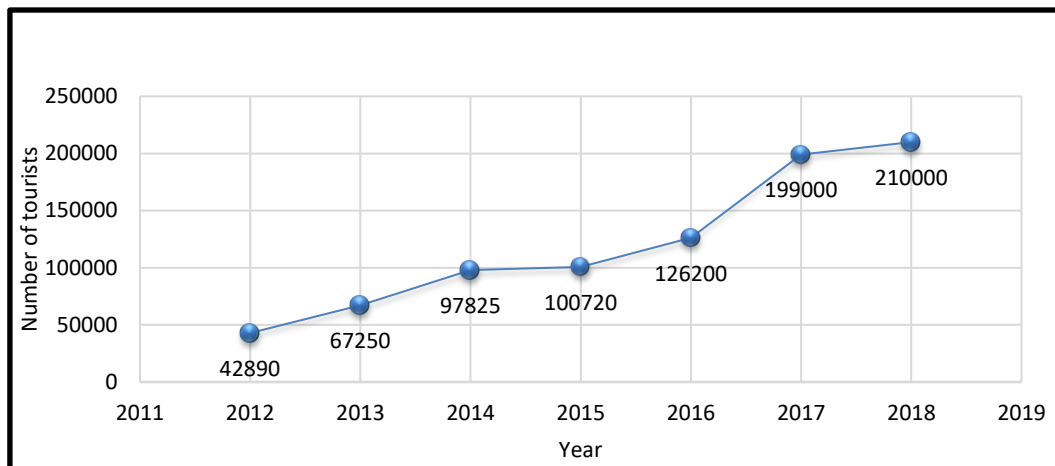


Figure 6: Increasing the volume of tourists from 2012 to 2018

Source: Prepared by author based on Tourism Development Master Plan, 2021 (2024)

From 2016 to 2024, it has shown a clear decrease of dense vegetation cover in losing nearly 700 hectares. The statistics of 2024 is showing only up to March but at that point also can see a considerable amount of loss in

dense vegetation. Same as that, it has decreased the vegetation cover up to 4238 hectares in 2024 which means loss of 1000 hectares from 2016 to 2024 (Figure 5)

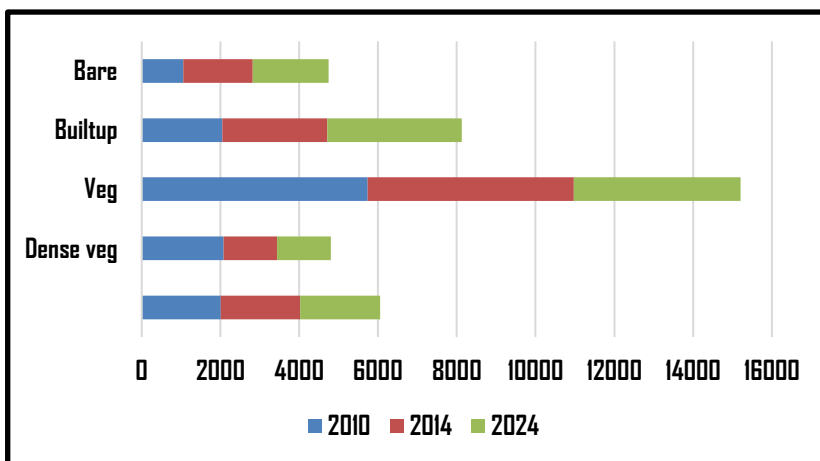


Figure 7: Land Use Change in Ella DS Division 2010-2024

Source: Prepared by Author based on Landsat data, 2010, 2016 and 2024 (2024)

According to the findings, it shows notable changes in the categories of land use types between 2010 to 2024. Below discussion provides a detailed information the percentage of land use change and possible reasons for the increase or decrease of the particular land use type.

4.1.1 Land use change as a percentage from 2010- 2024

4.1.1.1 Dense Vegetation

The area covered by dense vegetation has drastically decreased by -34.62%. this significant decrease or loss of dense vegetation implies that there has been a decrease in vegetation in areas that were formerly covered in dense greenery or deep forests. The main reasons for the decrease of vegetation cover as result of land-use changes, urbanization, deforestation and due to expand the accommodations for travelers in tourism industry in Ella. As tourism industry plays a major role in providing benefits, these areas might be cleared to make; hotels, resorts and recreational facilities. This decrease of dense vegetation

can boost local economies but also pose challenges like increased pollution, strain on local resources, and potential changes in the area's character. Ella is a hilly mountain area which usually not easier to build high rise buildings. But when it comes to Ella, it is

that, most of the buildings are constructed in hilly mountain areas. Apart from that, most of the unplanned accommodations and restaurants were

can lead to habitat loss, reduced biodiversity and risk for natural hazards including soil erosion and landslides.

4.1.1.2 Vegetation

From 2010 to 2024, vegetation cover has decreased - 26.12%, including forest covers with high diversity. This is a serious threat to the ecology of the Ella area and reduces the tourist attraction. As with the dense vegetation, this decline is due to the increased development of infrastructure to accommodate tourism. In addition, activities related to tourism such as off-road driving and hiking destroy this unique beauty of green spaces.

4.1.1.3 Built-up Areas

Most significantly, it has shown that built-up areas highlight a substantial rise in constructed environments, such as buildings, roads and other infrastructure. It accounts a 66.26% increase in built-up areas. This growth is likely driven by the demand for tourist accommodations, amenities, and facilities. Such expansion

clearly shown that, most of the buildings are constructed in hilly mountain areas. Apart from that, most of the unplanned accommodations and restaurants were constructed in attractive zones like Nine Arch Bridge.

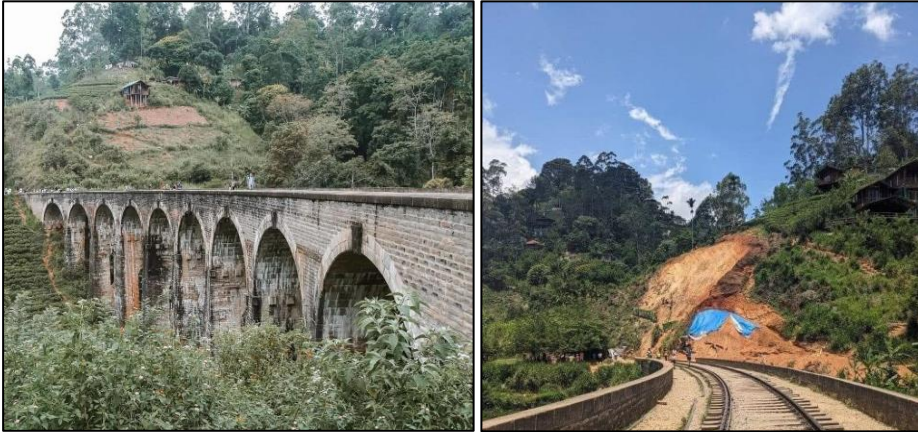


Figure 8: Unplanned tourism activities and landslides in mountains close to nine Arch Bridge

Source: Pauly, 2024

4.1.1.4 Bare Land

An 81.28% increase in bare land points to a significant rise in areas without vegetation or significant development. This increase in bare land might result from land clearing for new constructions or from areas where vegetation has been removed and not yet replaced. It could also indicate erosion or degradation of land due to increased human activity.

While tourism is a major factor, several other reasons might contribute to these changes in land use. If there is a shift towards agriculture to support local food needs or cash crops, this could also reduce natural vegetation and increase bare land. Apart from that, broader trends in urban expansion beyond tourism, including local population growth and economic development, could contribute to increased built-up areas and decreased natural land cover. Besides tourism, infrastructure projects such as roads, utilities, and commercial buildings could lead to land clearing and increased built-up areas. Illegal logging or deforestation for various purposes, including agriculture and construction, can lead to reductions in both dense and general vegetation. In contrast, overuse of land, especially in areas where tourism activities are intense, can lead to soil degradation, erosion, and loss of vegetation. The annual change of these land use types showcases a significant point about Ella which cause to reduces its' unique fauna and flora due to the tourism industry and other development activities.

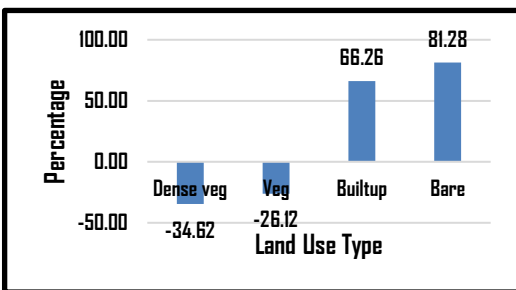


Figure 9: Land use change as a percentage 2010-2024

Source: Prepared by Author based on Landsat data, 2010, 2016 and 2024 (2024)

4.1.2 Annual Land Use Change from 2010-2024

4.1.2.1 Dense Vegetation

Annual Change: -1213.50 hectares

The loss of dense vegetation by the amount of 1,213.50 hectares per year presents a significant reduction in dense vegetation. Dense vegetation, which includes forests and dense woodland, is important for biodiversity, carbon sequestration, and especially for the soil protection. The decline of dense vegetation in Ella, indicates that these lands have been cleared or degraded, potentially for the development of tourism infrastructure, such as hotels, resorts, and recreational facilities with creating a high pressure on the dense vegetation. The decrease in dense vegetation often results from direct land conversion for agricultural purposes and might also reflect logging, land clearing for new developments, or infrastructure expansion to cater to the growing tourism industry.

4.1.2.2 Vegetation

Annual Change: -3282.08 hectares

The decrease in general vegetation by 3,282.08 hectares per year suggests that the overall vegetation cover is getting declined due to the development activities of tourism industry. IN Ella from 2010 to 2024 it shows a massive increase in tourists' arrivals and the little town is getting more bigger to provide facilities to the travelers who visit Ella and to promote it as a top tourists' destination in Sri Lanka. This declined might be cause by due to the expansion of infrastructure development and road networks especially. Further this

mountainous town is converted to a busy town with clearing all the green cover is impacted to the destination itself occurring number of landslides, soil erosion, forest fires and deforestation.

4.1.2.3 Built-up Areas

Annual Change: +3068.18 hectares

The rise in built-up areas by 3,068.18 hectares per year significantly indicates that the town is experiencing a substantial urban and infrastructural development. This growth is closely linked to the expansion of the tourism industry, which typically drives the construction of new hotels, resorts, restaurants, entertainment facilities, and transportation infrastructure. This expansion often results in the conversion of natural or agricultural lands into built environments to accommodate increasing numbers of tourists.

4.1.2.4 Bare Land

Annual Change: +1742.31 hectares

The increase in bare land by 1,742.31 hectares per year reflects areas that are either newly exposed or not currently used for vegetation or built-up purposes. This can be a result of land clearing processes, where land is stripped of vegetation to make way for construction or development, or it may be indicative of land that has been abandoned or left fallow. In tourism development contexts, bare land often precedes construction activities, where land is prepared before the actual building begins. This also points to potential land degradation or areas undergoing transformation.

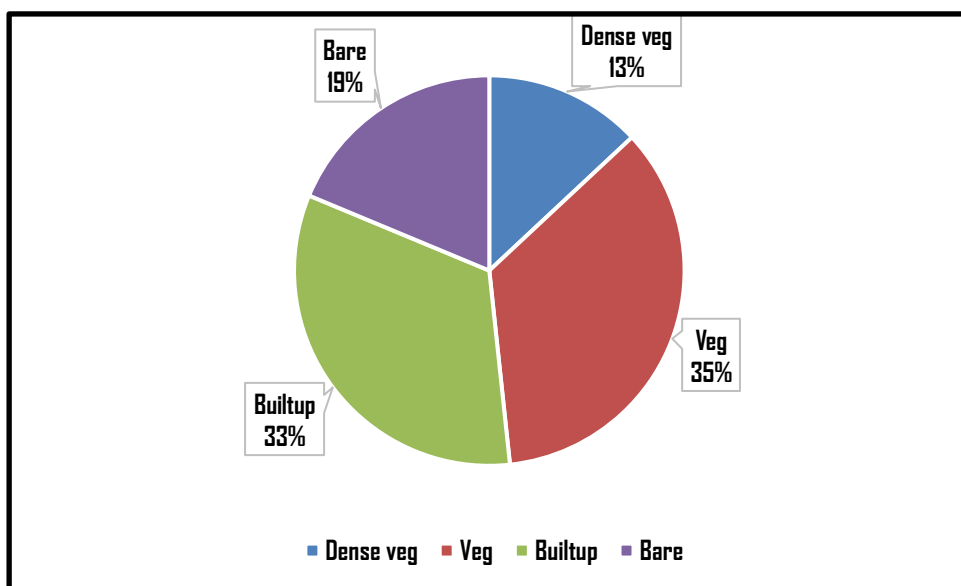


Figure 10: Annual Change of Land Use

Source: Prepared by Author based on Landsat data, 2010, 2016 and 2024 (2024)

A significant loss of dense vegetation suggests significant environmental impacts, such as habitat loss, biodiversity reduction and changes in local climate conditions. This can affect the ecological balance and ecosystem services of the region. The increase in built-up areas and bare land coincides with the increase in tourism development, indicating that more land is being converted into tourism infrastructure. This transformation can lead to economic growth, but it also puts pressure on the natural environment. The increase in general vegetation may reflect efforts to offset some of the environmental impacts of tourism development, for example through landscaping or reforestation initiatives. However, this does not fully compensate for the loss of dense vegetation. The data highlight significant changes in land use driven by tourism, highlighting the need for balanced development approaches that

consider economic benefits and environmental sustainability.

4.2 Impacts of land use changes due to tourism growth

Ella, is a sleepy mountain hill town located in the heart of the mountainous region of Sri Lanka, has become a prime destination for travelers who love to engage in adventurous activities and love nature, attracting a large number of tourists every year. However, this influx of visitors is not without a price, as the environmental impact of tourism in the region has become increasingly apparent (Bultjens et al., 2005). One of the main concerns is the pressure placed on the local ecosystem by the increase in tourist activity. The disposal and management of waste, both solid and liquid, has become a significant challenge, with inadequate sewage systems struggling to cope with the increased load. This has led to water pollution problems,

which pose a threat to the biodiversity of the region and the general environmental health of the area (Yusnita et al., 2018) (Buultjens et al., 2005). In addition, the increasing demand for water resources from hotels and other tourist facilities has exacerbated the existing water scarcity problems, with the local community sometimes facing a shortage. The rapid growth of tourism has also contributed to the degradation of natural habitats and the displacement of local wildlife.

However, the town faces challenges due to natural hazards and the impact of tourism. Landslides are the main natural disaster that could affect the Ella area due to the many mountains located around Badulla and Ella. Most significantly, illegal and improper construction and activities related to the tourism industry in the Ella area help to generate natural disasters and environmental negative impacts. (Niluksha, 2021) For example, there can be seen massive and unsafe construction like tourist hotels, restaurants, as well as improper tourism, adventure activities can be seen on time. Mountain taps, even the mountain can't hold such a massive weight on top. Because of that, it causes soil erosion and severe slides. (Niluksha, 2021)

Unplanned tourism activities also pose risks, disturbing the natural environment and creating vulnerabilities. Ella's environment has been destroyed of its natural vegetation during the last decade of 2010 to 2022 and put over pressure on the natural vegetation. (Wijesena, 2020) There is a need for collaboration among authorities, policymakers, and planners to protect Ella's natural heritage and promote sustainable tourism. (Silva et al., 2023) The Ella Urban Development Plan 2021-2030 aims to create

a resilient and sustainable tourism destination, considering natural disasters and unique environmental features. However, the resilience of the tourism industry to natural disasters has been compromised due to insufficient hazard identification.

5. CONCLUSION

The research highlights a significant transformation from a post-war recovery phase in 2010 to a period of tourism-driven development by 2024 with declining 1000 of hectares per every 6 six years. The expansion of built-up areas and bare land, coupled with the decline in vegetation, underscores the need for sustainable development practices to mitigate environmental impacts while take advantage of on economic opportunities. Effective planning and management strategies will be crucial to ensure that the benefits of tourism and urban development are maximized while minimizing adverse effects on the natural environment. In Ella, where informal sector runs the tourism, caused to the unplanned and illegal tourism activities. The land use data from 2010 to 2024 discloses significant changes in the region's landscape, reflecting a significant shift from post-war recovery to tourism-driven development. There has been a significant reduction of 34.62% in dense vegetation. This decline highlights the impact of initial reconstruction efforts and subsequent changes in land use. Total vegetative cover decreased by 26.12%, indicating that not only dense vegetation but also general vegetative areas have been reduced. This suggests a broad trend of habitat loss and diminished green space. Built-up areas have increased by 66.26%, reflecting a substantial expansion of urban and infrastructure development. This growth

correlates with the region's development focus on tourism, which has likely driven the construction of new facilities and amenities. The bare land area has grown by 81.28%, a significant increase that reflects the conversion of previously vegetated or undeveloped land into bare or cleared spaces. This trend is consistent with increased construction and land preparation activities.

The land use change from 2010 to 2024 reveals a clear change towards urbanization and tourism development. While this change has adopted economic growth and infrastructure improvements, it has come at the declining natural vegetation and green spaces. The considerable increase in built-up and bare land, combined with the decline in dense and overall vegetation, highlights the environmental challenges associated with rapid development due to the tourism development. For future sustainability, it is critical to implement strategies that balance development with environmental conservation. This includes integrating green spaces into urban planning, promoting sustainable construction practices, and investing in ecological restoration efforts. By doing so, the region can continue to develop economically while preserving its natural heritage for future generations.

6. RECOMMENDATIONS

Recognizing the growing pressures from tourism, local authorities have to consider a sustainable tourism development framework. This framework can be regulating the construction of new hotels and resorts, ensuring that they adhere to environmental standards and do not encroach on ecologically sensitive areas. Studies suggest that implementing eco-friendly practices in the tourism sector can

mitigate negative environmental impacts and enhance visitor experiences (Bernard et al., 2023). Providing a sustainable framework will ensure that each individual follows the guidelines when implementing their new projects. Apart from that, the establishment of an integrated land use planning approach is critical for balancing tourism, agriculture, and conservation efforts. This plan would involve stakeholders, including local communities, environmentalists, and government agencies, to collaboratively develop land use strategies that prioritize ecological sustainability while accommodating economic growth.

The main recommendation is to propose biodiversity conservation initiatives focus on protecting endemic species and restoring habitats that have been degraded due to land use changes. Because Ella has recognized as an environmentally sensitive zone. The establishment of protected areas and wildlife corridors is essential for maintaining ecological integrity. Studies indicate that such initiatives can significantly enhance biodiversity and contribute to ecosystem services (Samarasinghe et al., 2022). Given the increasing strain on local water resources, comprehensive water resource management plans are being proposed. These plans would include measures for sustainable water use in both agricultural and tourist sectors, promoting rainwater harvesting and efficient irrigation techniques. By implementing measures to protect water resources would improve the maintaining the quality of water around the tourists' zone and to restrict the unplanned developments near to the water ways. Research emphasizes the need for integrated water management to ensure long-term sustainability of water resources in tourist-heavy regions

(Gunathilaka et al., 2022). To address the challenges posed by increased waste generation from tourism, local authorities are proposing enhanced waste management strategies. This includes the implementation of recycling programs, composting initiatives, and the establishment of waste segregation at source. Effective waste management is crucial to maintaining the cleanliness of Ella's natural environment and preventing pollution (Dahanayake et al., 2024). But there is a lack of maintaining the waste dumping issues around Ella due to high growth of tourist arrivals and places to put all the waste.

Engaging local communities in conservation efforts is vital for the success of land use planning measures. Proposed community-based programs would involve local residents in monitoring and managing natural resources, fostering a sense of ownership and responsibility. Studies suggest that community engagement can lead to more effective conservation outcomes and enhance local livelihoods. Some of the proposed regulations for infrastructure development aim to limit the environmental impact of new roads and buildings. This includes conducting environmental impact assessments (EIAs) before any major project is approved, ensuring that potential negative effects on the landscape and ecosystems are adequately addressed (Jayasuriya et al., 2024).

The proposed plans and land use planning measures in Ella, Sri Lanka, reflect a growing development with environmental and social sustainability. By integrating sustainable tourism practices, engaging local communities, and implementing effective resource management strategies, Ella can work towards preserving its unique natural

and cultural heritage while accommodating growth. Collaborative efforts among stakeholders will be essential in achieving these objectives and ensuring a sustainable future for the region.

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