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Geospatial Assessment of Land Cover Change and Development Transformation in a Semi-Urban Context: Evidence from Kuruwita Divisional Secretariat, Sri Lanka

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Abstract

This study investigates spatial and temporal land use and land cover changes in the Kuruwita Divisional Secretariat Division, Sri Lanka, over a ten-year period from 2013 to 2022 using Geographic Information System (GIS) and remote sensing techniques. Multi-temporal satellite images obtained from the United States Geological Survey were analyzed through supervised classification to identify five major land use categories: agriculture, forest, urban, water, and bare land. The classified data were processed in ArcGIS to generate land-use maps and calculate areal changes for each category. The results reveal a rapid expansion of urban land from 22 km² (8%) to 78 km² (30%), indicating accelerated semi-urban transformation, while agricultural land also showed notable growth. In contrast, forest cover declined sharply from 30% to 10% of the total land area, and water bodies were reduced by nearly half, reflecting increasing pressure on natural resources. Bare land exhibited a significant decrease, suggesting intensified land utilization driven by development activities. Overall, the findings demonstrate a clear shift from natural and semi-natural land uses toward urban and agricultural dominance in Kuruwita, highlighting the need for sustainable land use planning and environmental management to ensure balanced development in emerging semi-urban regions.

Keywords: Geographic Information System (GIS), Geospatial Analysis, Land Use and Land Cover Change, Remote Sensing, Urbanization, Semi-Urban Development

Introduction

Sri Lanka has been a developing country since its independence, and up to today, its income group has been classified as a lower-middle-income country (World Bank, 2026). For years, Sri Lanka has presented different levels of development strategies, development theories, and projects through different programs by various organizations and parties (Anulawathie Menike, 2016; Edwards, 2017). Even though no significant level of sustainable development has taken place in Sri Lanka recently in multiple facets. A stagnant development can be seen at the national level. There is also a question about regional sustainable development that is highly correlated with rural communities. According to the Sri Lankan administrative structure, it should be observed through the development of provinces, districts, and divisional secretariats (Election Commission, n.d.; Weeraratne, 2016). Divisional secretaries in regional spaces should be appointed in a planned manner. Regional and rural level development is an essential factor for the development of a country, and divisional secretariats play a crucial role in that process. No country can sustain the development of its economy depending on a city or a macro-level national economy. Regional disparities should be addressed. Development is a process of pulling the underdeveloped areas into development more inclusively (Fainstein & DeFilippis, 2016; Healey, 1997).

According to the United Nations, rural development has great potential to drive national development. The 17th session of the Commission on Sustainable Development states that sustainable rural development is vital to the economic, social, and environmental viability of nations (United Nations, 2009). Regional development also indicates a similar definition for rural development. The nature, focus, and characteristics of regional development align on an equal track of rural development. According to the Organization for Economic Co-operation and Development (OECD), regional development is a broad term, and it can be seen as a general effort to enhance well-being and living standards in all regional types. From cities to rural areas, regional development improve their contribution to national performance and more inclusive, resilient societies (OECD, 2018). Therefore, rural and regional development can be identified as two important factors in national development. In order to get an understanding of national development, rural and regional development have to be analysed.

Development varies both temporally and spatially. By studying the changes that take place in this movement, it is possible to study the fluctuations in development. In particular, development is often measured in terms of income and living standards. But many countries in the world are studying development based on spatial variations (Knieling, 2018; Wu &

Gopinath, 2008; Yang et al., 2022). With that, land space can be identified as a primary factor in determining development (Wu & Gopinath, 2008). Patterns of development can be inferred by identifying patterns in geospatial changes (Knieling, 2018; Yang et al., 2022). The pattern of land use of an area is strong enough that urban geographers are able to spatially express the development process from ruralization to urbanization (Jedwab et al., 2017; SIDA, 2018; Turok, 2017). Moreover, geospatial analysis supports understanding the reality of sustainable land use changes and variation over time.

According to Urban Development Authority (2023) explanation, Kuruwita is not fully a rural area, and for example, the Kuruwita regional secretariat does not show much rurality in comparison with rural areas in Mahiyanganaya, Hambantota, and Northern Province (Election Commission, n.d.; SIDA, 2018; Weeraratne, 2016). Similarly, districts like Colombo, Gampaha, and Kandy have not been urbanized as much as other areas in Sri Lanka (Election Commission, n.d.; Weeraratne, 2016). Kuruwita is a semi-urban area that is neither rural nor urban (Urban Development Authority, 2023). Due to this, the Kuruwita area is unique compared to other areas.

Understanding development spatially through changes in land use is an important transfer method. Likewise, the changes that can be observed in a semi-urban area like Kuruwita, fulfilling that requirement, are highly significant. Additionally, a semi-urban entity is rapidly growing than other geographical entities, and with a perspective in the Sri Lankan context, there are limited studies. This would also be an appropriate opportunity to study the spatial impact of regional and rural development to determine national development. Therefore, the study provides a specific scholarly contribution to existing literature.

Research Problem

In the subject of geography, land is a main concept, and without land, there is no geography and development (Knieling, 2018; Wu & Gopinath, 2008). At present, land resources are undergoing various changes due to human activities and natural disturbances (De Rosa et al., 2016). The research problem of the study is centred around the spatial change of land use in the Kuruwita area. Changes in the physical and human landscape can determine changes in the space in the world (De Rosa et al., 2016; Irwin & Geoghegan, 2001; Turok, 2017). It is possible to criticize development perspectives in terms of such differences that can be analyzed spatially (De Rosa et al., 2016; Irwin & Geoghegan, 2001; Knieling, 2018; Wu & Gopinath, 2008).

Mainly, any institution in Sri Lanka doesn't have a perfect idea about land use change in a semi-urban area such as Kuruwita. For the process of policy and planning, the land use mapping is an initial factor. The research questions that arise in the discussion related to the Kuruwita area is:

1. How has land use in the Kuruwita area changed in various land use types?
2. What are the significant development insights can be gathered from the land use change?

Research Objectives

In discussing the research objectives, it serves to fill the gaps aforementioned and lead to answering the specific research questions. Simply, objectives are organized to apply an insightful argument in scholarly use. The primary objective of the study can be interpreted as filling the gap of spatial identification in the study area. In summary, the following objectives can be aligned as the research objectives.

1. Assessing the key land use changes in the Kuruwita study area.
2. Synthesizing the spatial changes and development insights through the land use change.

Limitations of the Study

It is common for any research to have inherent limitations. But the research must go beyond the limits to the extent that it does not distort the final answer. There are common limitations in performing Geospatial analysis. Similarly, the chosen research topic and study area are exposed to specific limitations of the study. The lack of spatial and temporal digitized data for the study area has led to a major limitation. The temporally reliable and updated data sources and spatial datasets are limited, which makes temporal novelty and technological smoothness of the study. Lack of quantitative data for verifying the field calculations is a primary issue that accounts for the inability to verify the spatial analysis. Unrealistic relational assumptions can be made with GIS classification, which may remain under-verified in this context.

Literature Review

The definition of space varies depending on the context. Especially, the word space generates different meanings in different subjects. For example, the word space is used in many fields

such as science, mathematics, geography, architecture, and development economics. In geography, space means place (Geographic Association, 2018). That is, the relative and absolute space with a longitude position located on geographical points (Mazúr, E., Urbanek, J., 1983).

This concept of geographic space can also be applied in advanced research using geographic information systems. The word space also has a developmental economic explanation. The concept of Space Economics tries to describe the relationship between the economy and space. Kumagi Satoru defines Spatial Economics as the interaction between 'agglomeration force,' which draws economic activity to a specific region. The term'dispersion force' defines the dispersal of economic activity throughout the surrounding area, and it determines the geographical distribution of economic activity (Satoru, n.d.). According to Francois Perroux (1950), Economic Space can be separated into three principles: Economic Space as defined by a plan, Economic Space as a field of forces, and Economic Space as a homogeneous aggregate. In addition, microeconomic issues in the spatial economy are concerned with how things operate spatially. Thus, the behavior of the geographical space of the Kuruwita area directly affects the behavior of the economic space. Sustainable development depends on how much economic space, determined by geographic space, supports expansion.

Development in spatial context is a term with a broad definition. Development is the process of any situation becoming better. Simply, development can be defined as a process in which someone or something grows or changes and becomes more advanced (Cambridge Dictionary, 2022). Citing Pearson (1992), Ream Abuiyada states that development cannot be defined only through economic, social, and political perspectives. He defines development as the result of the hybridization of economic, social, and political perspectives (Abuiyada, 2018). Criticizing the spatial land use change of the Kuruwita area from a developmental perspective is a study of the economic, social, and territorial development of the geographic space using geospatial techniques like GIS and RS.

The approach from spatial planning to development planning developed in the 1980s across the Europe (Knieling, 2018). After that, numerous studies focus on the geo-spatial techniques with development metrics, and United Nations (2012, 2021) established a considerable scholarly report ensuring the role of the geospatial techniques for development. Irwin & Geoghegan (2001) state that economic development can be portrayed through land use and spatial theories, data, and methods. In addition to that, Dritsas & Trigka (2025) conducted a

comprehensive systematic study, arguing multiple uses, the contribution of Remote Sensing and Geospatial Analysis in the big data era. As an extension of the scholarly works in a similar field, Kesamreddy et al. (2026) have used geo-spatial techniques for mapping, monitoring, and modelling for the cultivable soil. The studies that are conducted by Chen et al., 2023; Petja et al., 2014; Sangasumana P & Sivaruban S, 2019 ensure the geospatial techniques, including GIS and RS, to evaluate, assess and identify the rural development in rural spatial context.

Similar studies have been done in Sri Lanka using geospatial tools to assess the rural development. G.P.T.S. Hemakumara and W.A.S. Subhashini (2018) have done the Socioeconomic condition of the Siribopura resettlement housing scheme. They have basically used a Geographic Information System to evaluate the socioeconomic impacts of the resettlement housing. Several other researchers have conducted research using different regions of Sri Lanka as study areas. Bharathy et al. (2024) utilized geospatial analysis to monitor **deforestation**, **urbanization**, and **agricultural** expansion in the northern province. Sangasumana P & Sivaruban S (2019) conducted a geo-spatial analysis on rural road development to identify the **potential** in the Jaffna district. Wijesinghe et al. (2023) study application of GIS, multi-criteria decision-making techniques for mapping groundwater potential zones: a case study of Thalawa Division, Sri Lanka.

However, the present study focuses on semi-urban areas to perform more generalizable findings for developing a regional context. The previous studies highly rely on deforestation, urbanization, agricultural expansion, and potential analysis on the study areas in Sri Lanka. In this study, rather than directly using Spatial Economics, more attention has been given to factors of land use and land use change to untangle the development and policy insights that is regarding the land use change in Kuruwita Divisional Secretariat, Sri Lanka, which specifically has the rural and urban features (Urban Development Authority, 2023).

Research Methodology

Study Area

The Kuruwita divisional secretary's division is located in the Ratnapura administrative district of Sabaragamuwa province. The divisional secretary of Ratnapura district consists of 17 divisions. According to their size, the Kuruwita Divisional Secretariat occupies the 8th position (Divisional Secretariat Kuruwita, 2023). That is, according to the 1: 50 000 scale map

of the Survey Department, it has a size of 17,400 hectares (Divisional Secretariat Kuruwita, 2023). The relative location of the Study Area can be stated as follows (Divisional Secretariat Kuruwita, 2023):

Relative Location

North - Dehiowita and Deraniyagala divisional secretariat division of Kegalle district

South - Ratnapura and Kiriella divisional secretary divisions

East - Ratnapura divisional secretary division

West - Eheliyagoda and Kiriella divisional secretary division

The absolute position is also a very important factor, according to the geographical space, and the absolute position of Kuruwita divisional secretary division is mentioned below.

Absolute Location

Latitude and Longitude Location

North Latitude: 6° 41' - 6° 52'

East Longitude: 80° 15' – 80° 28'

Coordinates Location

North Coordinates: 167 – 185 Km

East Coordinates: 144 – 165 Km

Until 1997, there were 56 Grama Niladhari Divisions (GNDs) belonging to Kuruwita Divisional Secretary Division. In order to ensure efficiency and administration, 17 divisions have been established in Kiriella Division Secretary Division. Accordingly, as of today (Data available only by 2022), 116 villages have been owned under the Grama Niladhari Division 39 in the Kuruwita divisional secretary division (Divisional Secretariat Kuruwita, 2023).

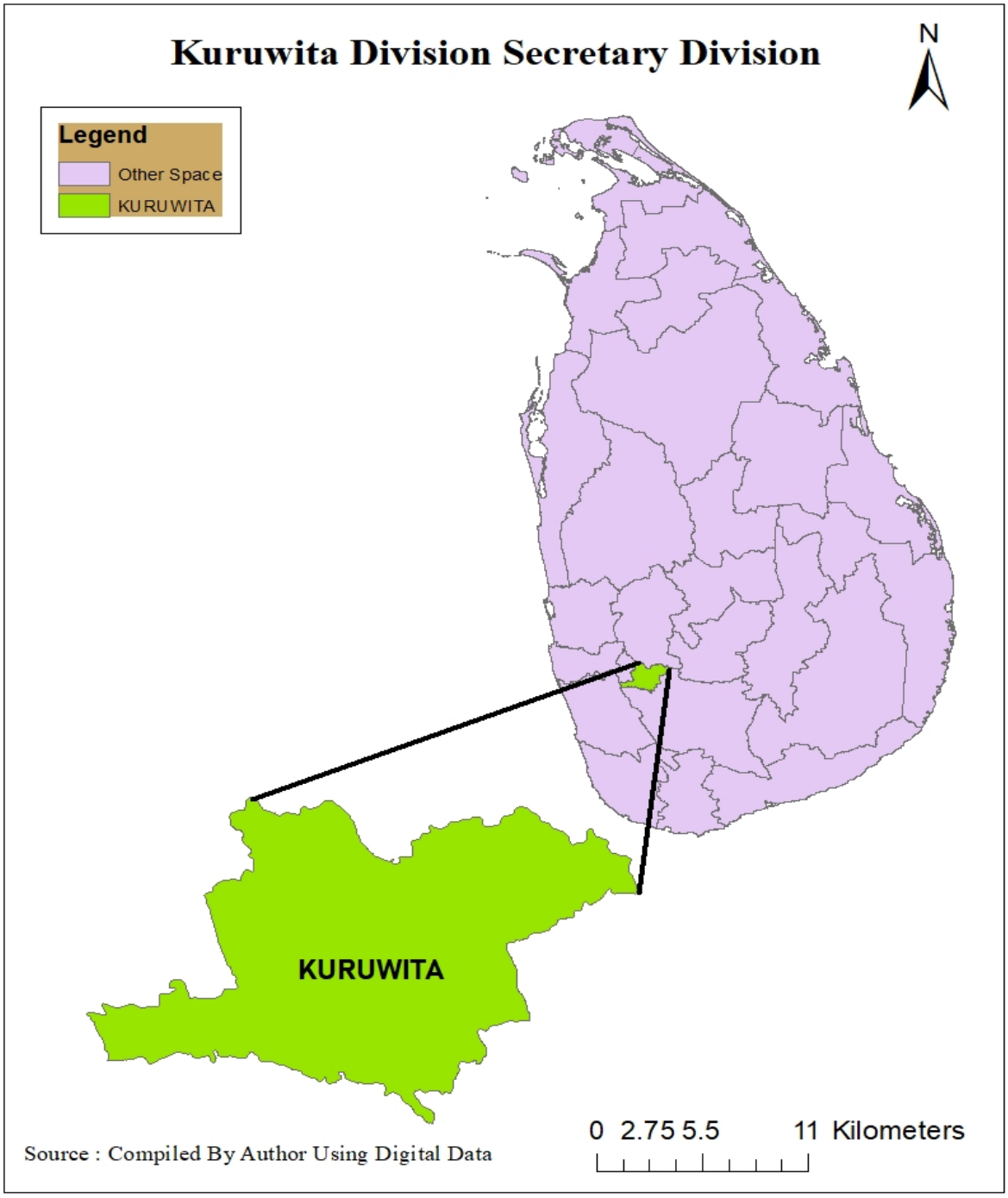


Figure 1: Study Area Map

Data Collection

Data held by government offices is specifically expected to be available. A program should be made to obtain resource profiles by the Divisional Secretary divisions and to obtain secondary data through the planning section of that office. The necessary secondary data should be

obtained by contacting the Census and Statistics Department. It is imperative to obtain the data held by the Kuruwita Municipal Council, as a more effective analysis can be done by obtaining data from many years. Data collected through Grama Niladhari offices is also aggregated to the resource profiles that were provided by the Divisional Secretariat (Due to the inefficiency of reporting and data collection of the government, no updated data for recent years).

Secondary data can be obtained from several sources, such as journal papers, books, magazines, and reports. Mainly, secondary data are published documents. ArcGIS Software was used to analyze geospatial data. The study of geo-spatial land use change has been conducted using satellite images from the United States Geological Survey (USGS). Hence, the main secondary data source is the USGS Earth Explorer. The satellite image that was downloaded from the website has been used for mapping and image classification.

Data Analysis

The collected data from the reliable sources are systematized and used for analysis. Data analysis was performed using several techniques. This study mainly used ArcGIS software for image classification in mapping. All the geo-spatial data collected from the USGS Earth Explorer were analyzed using the Geographic Information System (GIS) under major data analysis. In ArcGIS Software, the supervised classification has been used for the main mapping analysis. In this research, the Kuruwita as the study area, has been classified into mainly five land use classes from supervised classification techniques. Then, the main techniques that are used for classifying satellite images have been done by an image classification tool in the ArcGIS software. The field calculation tool was used for the land use change mathematical assessment. Two land use maps in 2013 and 2022 were classified to capture the temporal analysis of land use over a decade. Preliminary data presentation was done using the MS Excel application software, and the required charts and tables were created.

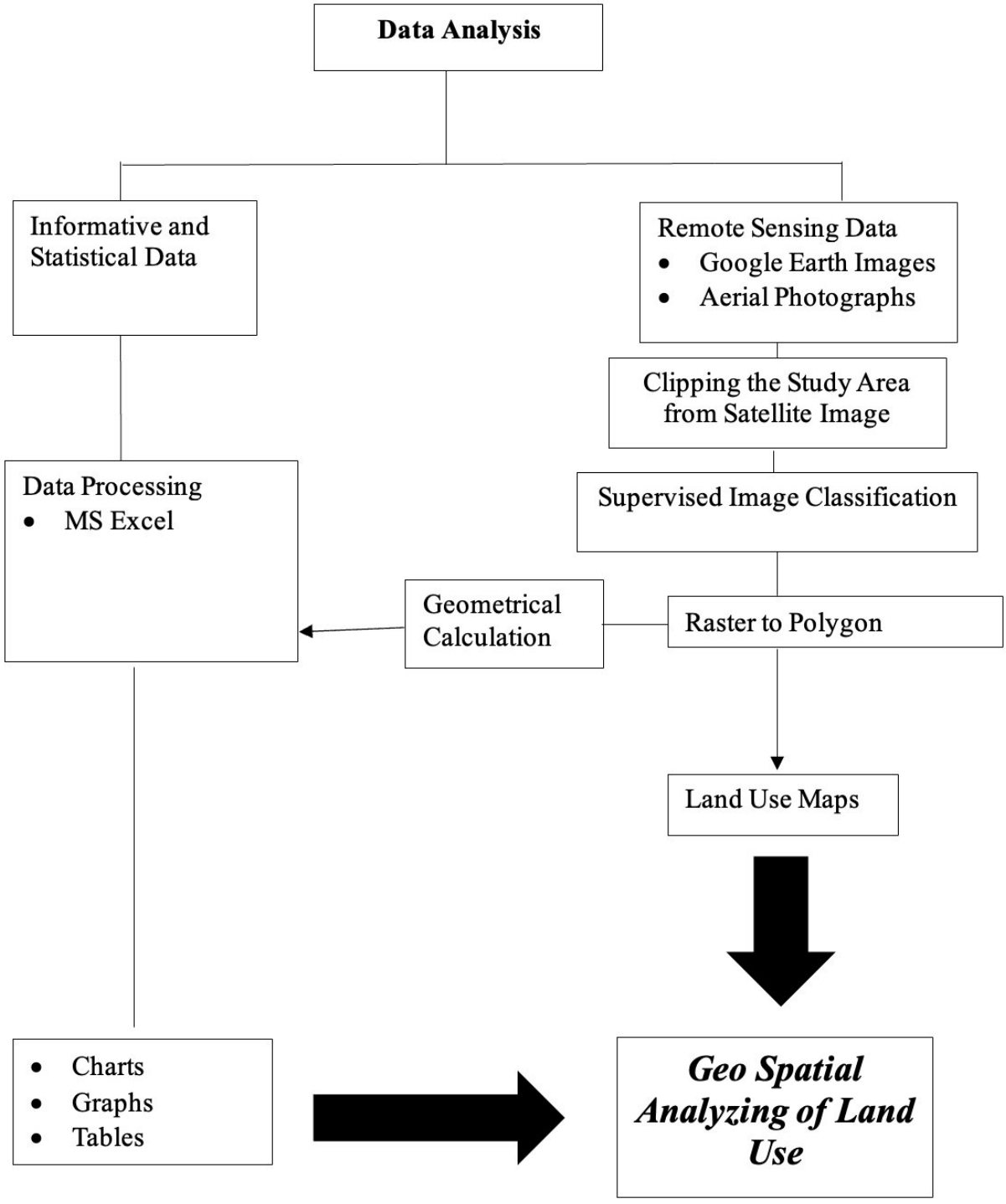


Figure 2: Data Analyzing Flow Chart

Source: Compiled By Author

Results

The land use change shown by the map is most suitable for doing the geospatial analysis through it. The research is mainly based on two years that has one decade gap. The study focusses to study the land use change over the past ten years. Therefore, using supervised

classification and satellite image of two years, the two land use maps have been created for the geo-spatial analysis through the land use of Kuruwita. Mainly, five classes have been classified from supervised classification in ArcGIS. There is agriculture, bare land, forest, urban, and water sources. The first satellite image was in 2013. It is used for studying the land use change in Kuruwita over the past ten years. The satellite image supervisely classified, and the area has been calculated among the five land use classes (Figure 3).

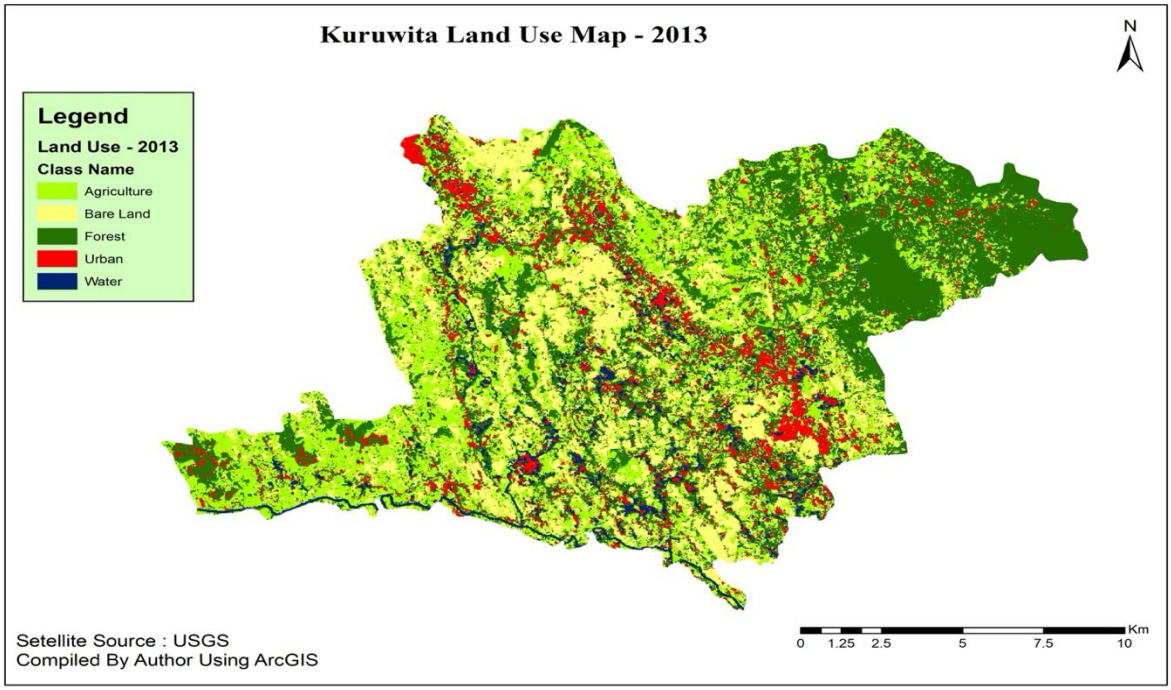


Figure 3: Land Use Map Kuruwita - 2013

The area has been calculated by geometrical calculations. The area of the five land use classes was calculated from the attribute tables data that came from the supervised classification and the conversion of the raster to the vector format by using the raster polygon tool in ArcGIS. The calculated result of the land use areas is mentioned below (Table 1). The total area of the Kuruwita is the 260km^2. The result was shown by five classes in the area that was occupied by the total area of the study field.

Table 1: Land Use in Kuruwita - 2013

Class Name	**Area (Km^2)**
Agriculture	87

Bare Land	52
Forest	79
Urban	22
Water	20
Total	**260**

The same process has been used for the mapping and calculation in the 2022 satellite image classification. The satellite image was in 2022. It is used for studying the land use in Kuruwita in the contemporary context. It is latest satellite image that has been found related to the study area. Under supervised classification, the area has been calculated among the five land use classes using the Landsat 8 images (Figure 4).

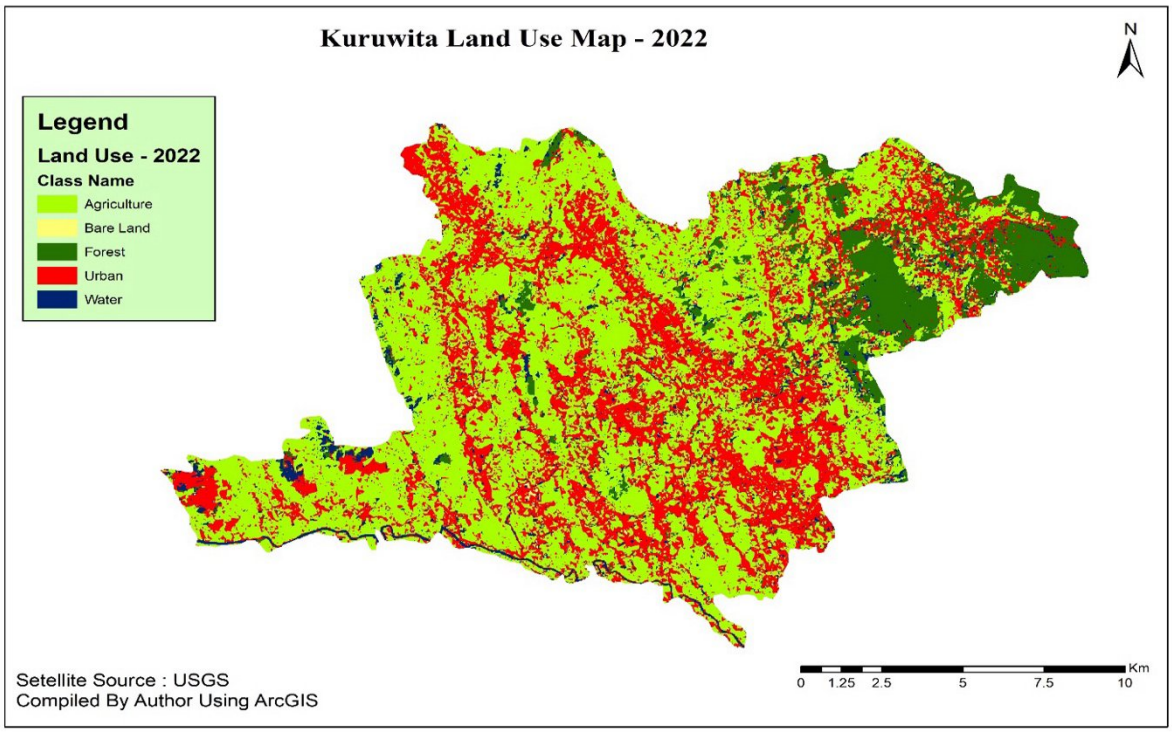


Figure 4: Land Use Map Kuruwita - 2022

The area in the land use map in 2022 has been calculated by the geometrical calculations as well. The area of the five land use classes was calculated one by one from the attribute tables data that came from the supervised classification and the conversion of the raster to the vector format by using the raster polygon tool in ArcGIS. The calculated result of the land use areas

has been mentioned below, and the proportions of the total area of the Kuruwita, which is 260 km^2, will be discussed in the next section (Table 2). The result was shown by five classes in the area that was occupied by the total area of the study field.

Table 2: Land Use in Kuruwita - 2022

Class Name	Area (Km^2)
Agriculture	145
Bare Land	1
Forest	25
Urban	78
Water	12
Total	**260**

Discussion

Land use change is the process through which human activities alter the natural landscape, referring to how land has been utilized, with an emphasis on the functional use of land for economic activity (Dritsas & Trigka, 2025; Irwin & Geoghegan, 2001; Kesamreddy et al., 2026). Land use is not a regular or unchangeable thing. It is changing relative to space and time (Irwin & Geoghegan, 2001; Jedwab et al., 2017; Knieling, 2018). Then, the temporal and spatial changes should be studied from the geospatial analysis. The study of Kuruwita has been done as both spatial and temporal geospatial analysis. For that, the study has been developed over ten years and has changed. According to the satellite image supervised classification result, in 2013, most of the land cover was agricultural land. On the other hand, it cannot be an unnatural thing since Kuruwita is a suburban area in Sri Lanka, and the agricultural sector may play a major role. Therefore, still considerable land should be covered by agriculture. The GIS-created bar chart outlines the land use status in 2013 (Figure 5).

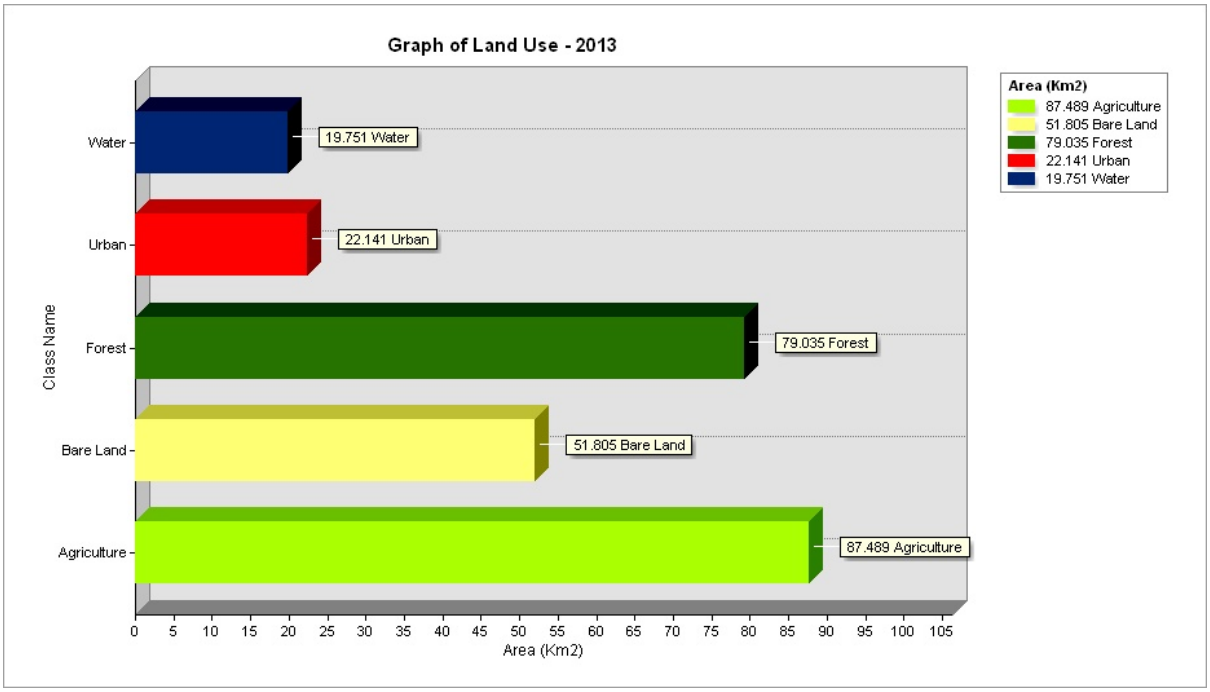


Figure 5: Land Use Area Chart of Kuruwita Using GIS - 2013

Out of the total of 260km^2 land, 87 km^2 of land was taken from the agricultural sector of the Kuruwita DS. In Kuruwita, the main agricultural livelihood is paddy (Secretariat Kuruwita, 2023). In addition to that, tea, coconut, and rubber can be seen as commercial crops in the Divisional Secretariat Division and may cover the major agricultural land (Secretariat Kuruwita, 2023). However, the main land cover is from agriculture, and secondly, forest areas can be seen. Kuruwita is a region of the wet zone, and a small wet rain forest has shown

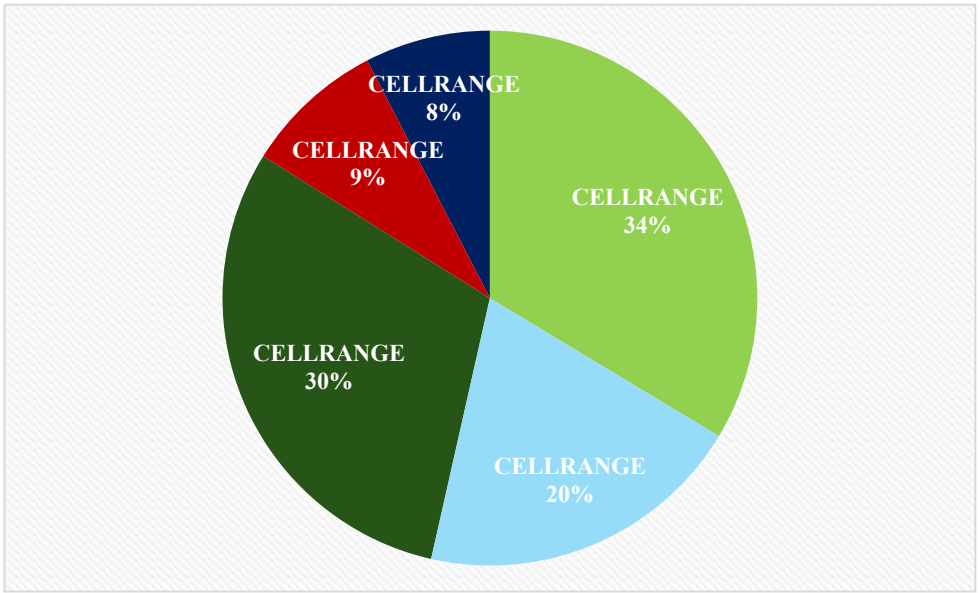


Figure 6: Land Use Area Proportion Chart of Kuruwita - 2013

significant coverage for its land use, with an area of 79 km^2. The proportion of land use has been calculated from the ArcGIS Attribute calculation and pie-chart tools below (Figure 6).

According to the chart, 34% of the land use is covered by agriculture. Forest areas were 30% of the total land. The next significant factor that can be stated is the proportion of bare land. It has covered 20% of the area. It is important since bare land is a land area that is not the main occupied crop or economic activity (Pagano & Bowman, 2000). Most of the time, it is empty land. Therefore, it is most of the time economically inactive (economically underutilized) (Song et al., 2020). From an economic perspective, it has been an economically inactive and unutilized resource. 9% of water coverage is a good percentage of the land. Water is the most important resource for living beings. But urban land had a limited 9% in 2013. Therefore, the uneconomic area and bare land proportion creates a significant hypothesis (Irwin & Geoghegan, 2001; Pagano & Bowman, 2000; Sangasumana P & Sivaruban S, 2019; Song et al., 2020). Unutilized resources make rural growth slow. This slowdown can be attributed to the unused land. Whatever, the land use of Kuruwita in 2013 shows the unutilized and the developing region with high rural features in the land use.

This geospatial analysis revealed that the main point is land use change over the ten years, and in the 2022 land use map, after one decade, the land use change shows a remarkable change. It is the most important thing about this GIS-based research discussion of the present study. According to the satellite image supervised classification result, in 2013, most of the land cover was agricultural land. It shows an unchanged and similar condition in 2013 has repeated. On the other hand, it shows the transformation of rapidly urbanizing divisions by urban land cover; agriculture remains as a major land cover (Turok, 2017). The land use in 2013 already proved the rural features in the study area, and the Urban Development Authority (2023) confirmed this through their literature. The study verified the secondary literature empirically. Therefore, still considerable land should be covered by agriculture, and urbanization may proceed slowly. The GIS-created bar chart outlines the land use status in 2022 (Figure 7).

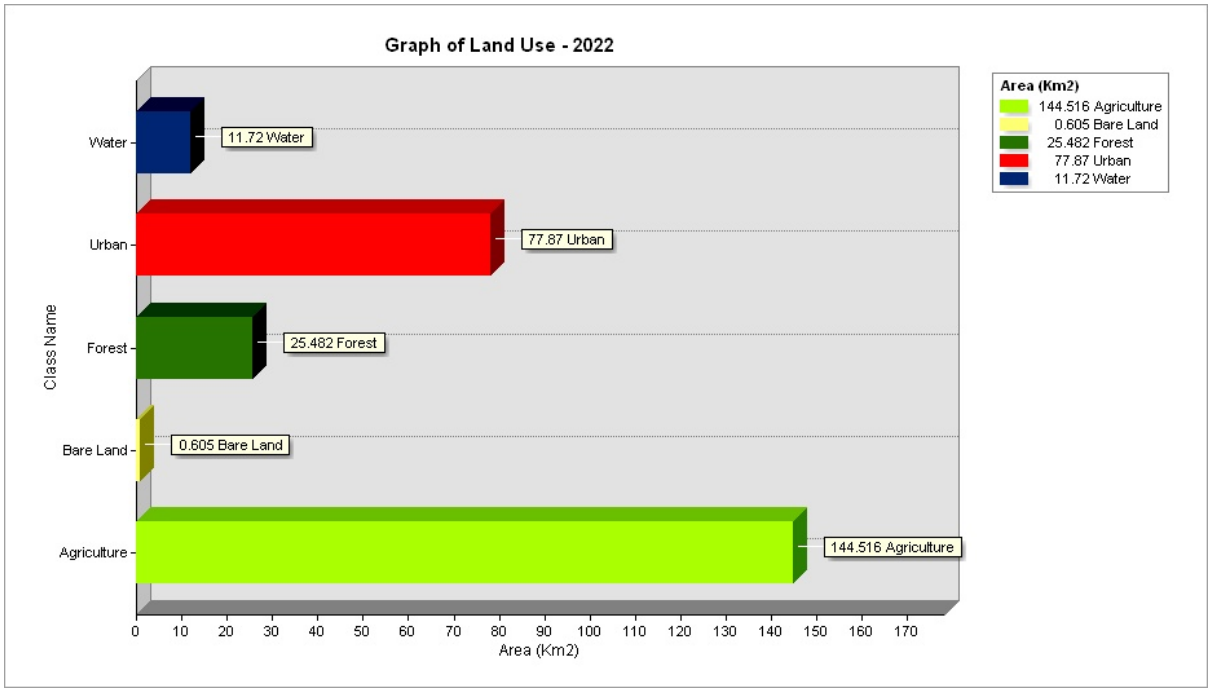
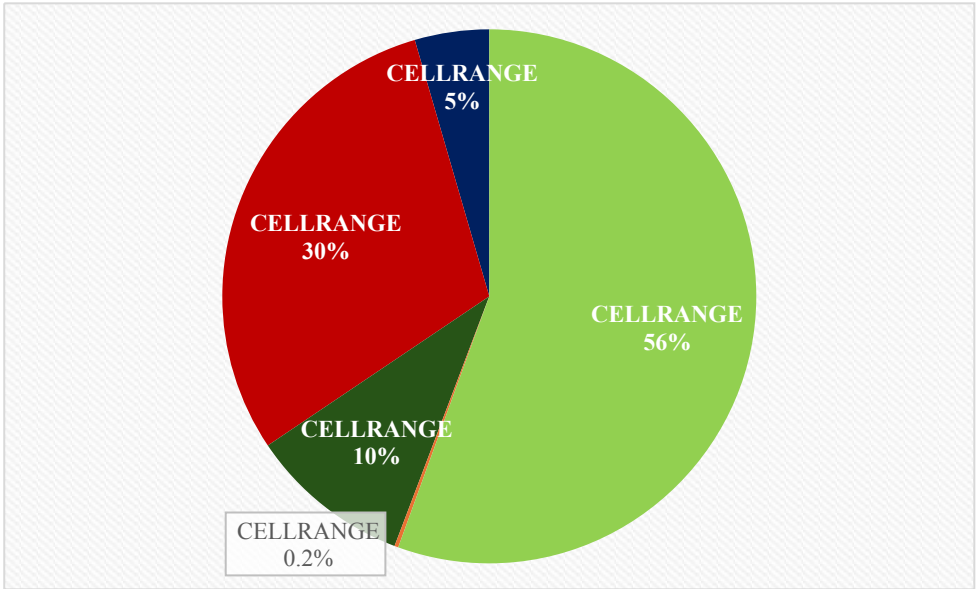


Figure 7: Land Use Area Chart of Kuruwita Using GIS - 2022

Out of the total of 260km^2 land, 145km^2 land was taken from the agricultural sector of the Kuruwita DS. In Kuruwita, agriculture remains a main livelihood. However, the main land cover is from agriculture, and secondly, urban areas can be seen as a remarkable increase in



land use. As the proportion of land use has been calculated from the ArcGIS Attribute calculation and pie-chart tools given below, to show a clearer proportionate of the land use

Figure 8: Land Use Area Proportion Chart of Kuruwita - 2022

(Figure 8).

According to the chart, 56% of the land use is covered by agriculture. It is more than half of the total land use. Forest areas have been 10% of the total land. The percentage of the total has reduced, specifically in water resources. Kuruwita is a region of the wet zone (Secretariat Kuruwita, 2023), and a small wet rain forest has shown a significant impact for its sustainable land use, which has been collapsed into a 26 km^2 area. The next significant factor that can be seen here is the proportion of bare land. In 2013, it has been 20% of the area was covered, and that high percentage is a special feature of that land use. In 2022, land use also, the bare land shows a large reduction in its total area. It is a crucial situation in contemporary land use in Kuruwita. As aforementioned, from an economic perspective, it has been an economically inactive and unutilized resource, and an urban development indicator in land encroachment by the reduction of bare lands (Pagano & Bowman, 2000; Song et al., 2020; Turok, 2017). In this perspective, land use change shows the dramatic development of economic activation and resource utilization.

4% of water coverage is a good percentage of the land. Even though water is the most important resource for living beings, land use in 2022 has largely reduced from the total land cover. This is a critical issue in the land use change that can be identified. Environmental sustainability and water reserves can be a massive crisis in the future. Especially, the regional climate changes over the last few years may have an impact on this transformation. Even though Urban land has limited 9% in 2013, there are 30% of the land area is occupied by urbanization.

Although urbanization is frequently considered in terms of countries that are now industrializing and urbanizing, all industrialized nations have undergone urbanization at some point in their history. Furthermore, urbanization is on the rise all across the world (Davis, 1965; United Nations, 2019). During the last few hundred years, the world's population has risen dramatically, and economies have gotten more industrialized, resulting in a huge increase in urbanization (Turok, 2017). This is referred to as urbanization. However, in the third world, the global south, urbanization is a gradual process of development of their economies and trade. In the land use of Kuruwita, there is an important change in urbanization that can be probed. In a comparative geospatial study, the land use change that occurs in one decade can be measured through the attribute table and field calculation, and the chart below has been compiled by the field calculation from ArcGIS for comparative statistical observation of the land use.

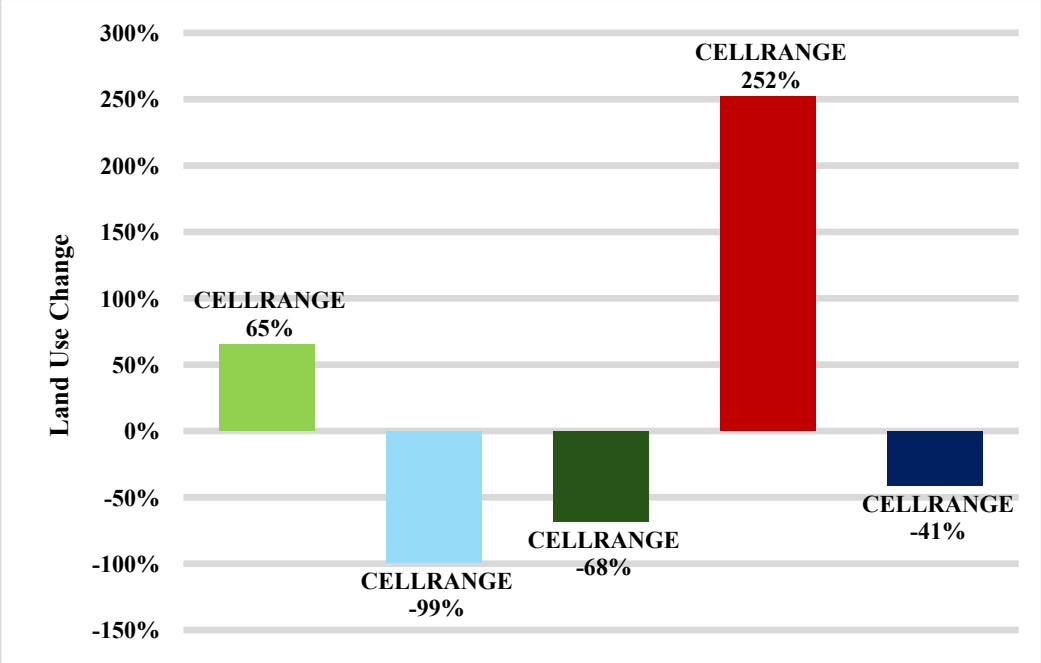


Figure 9: Land Use Change across the Previous 10 Years in Kuruwita

When considering all five land use classes, the total figure can be depicted by the bar graph, and it can be demonstrated as the overall summary of the land use change study. Three components of land use have changed through time period of the ten years (One decade). Basically, three components are in the decrease in land use. Those are the Bare land, forest, and water. The most critical change has happened in bare land use. 99% of quantitative depletion can be seen in the bare land. It is the most changed land class in the previous ten years. Most environmentally effective land use change occurred in the forest and water structure. Forest cover has been removed from the land by 68% as percentage. The land use map (Figure 9) also shows the effect of diminishing land use. In addition to that, water resources have been depleted as valuable resources. 41% of the water proportion has been alleviated from the total land in the past 10 years.

The significant land use improvement can be realized by the two components of land use, namely the urban lands and the agricultural lands. The vast range of improvement can be confronted by the urban lands. It is a very large amount of land use, as 252%. That is a change of land use by more than double. In the spatial development view (Amarasinghe et al., 2005; Knieling, 2018; Vista & Murayama, 2011) and economic development view (Irwin & Geoghegan, 2001; Pacillo, 2022; Wu & Gopinath, 2008), Kuruwita indicates a significant growth quantitatively.

Conclusion

This study has conducted a multidimensional geospatial analysis of land use and land cover change in the Kuruwita Divisional Secretariat Division over the decade spanning 2013 to 2022, employing supervised image classification in ArcGIS to examine five distinct land use categories. The analysis was structured across five interrelated dimensions: a spatial dimension, which traced how land use has been distributed and reconfigured across the study area; a temporal dimension, which captured the trajectory of change over a ten-year period; a geographical dimension, which considered the physical and locational characteristics that have shaped land use patterns; a statistical dimension, which quantified the magnitude of change in each land use category through field calculation; and a geo-imagery dimension, which underpinned the entire investigation through the interpretation and classification of multi-temporal satellite imagery.

The findings reveal a pronounced and accelerating semi-urban transformation in Kuruwita, evidenced by a 252% increase in urban land cover over the study period. Agricultural land also expanded substantially, consolidating its dominance as the primary land use category by 2022. These gains, however, have come at considerable environmental cost. Forest cover declined by 68%, representing a severe loss of ecologically significant vegetation in a region situated within Sri Lanka's wet zone. Water bodies diminished by 41%, raising serious concerns regarding the long-term availability of freshwater resources in the area. Bare land, which constituted 20% of total land cover in 2013, was reduced to near-negligible levels by 2022, indicating intensive and largely unregulated land conversion driven by both agricultural expansion and urbanization pressures. Collectively, these transformations reflect a fundamental restructuring of the landscape, in which natural land cover types have been systematically displaced by anthropogenic land uses.

The geospatial evidence produced through this study provides an empirical foundation for anticipating and managing future land use trajectories in Kuruwita. The satellite-derived land use maps and associated statistical outputs constitute a reproducible monitoring framework that can inform geographically and economically grounded policy decisions at both the divisional and district levels. While the rapid urbanization documented here reflects a broader pattern of development, it simultaneously underscores an urgent need for integrated land use planning that reconciles economic growth with environmental sustainability.

Policy Implications and Future Directions

In light of the observed spatial and temporal transformations in land use and land cover within the Kuruwita Divisional Secretariat Division, this study underscores the urgent need for evidence-based and spatially informed policy interventions to guide future development. The rapid expansion of urban land and agricultural activities, alongside the significant depletion of forest cover and water bodies, highlights an imbalance between development-driven land utilization and environmental sustainability. Therefore, future policy directions should prioritize integrated land use planning that incorporates geospatial monitoring into regional decision-making processes, ensuring the protection of critical ecological assets while accommodating necessary urban growth. Strengthening land zoning regulations, promoting vertical and compact urban development, conserving forest and water resources through legally enforced environmental buffers, and encouraging sustainable agricultural intensification are essential strategies for mitigating adverse environmental impacts. Moreover, institutionalizing the use of GIS and remote sensing at divisional and district planning levels would enhance the capacity for continuous land use monitoring, early detection of unsustainable trends, and informed policy formulation. Ultimately, adopting a spatially balanced and environmentally conscious development framework is crucial for steering Kuruwita's semi-urban transformation toward long-term sustainability, resilience, and inclusive regional development.

Conflict of Interest declaration

The authors declares that there is no conflict of interest regarding this journal article's content, data, or insights.

Availability of data and materials

Data sets are available on request.

Funding details

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Author contributions

Isuru Udakara Yakandawala contributed to the conception and design of the study. Material preparation, data collection, and geospatial analysis were performed by Isuru Udakara Yakandawala, with support from W.O.K.P.L. Wijesinghe. The first draft of the manuscript was written by Isuru Udakara Yakandawala, and both authors commented on and revised previous versions of the manuscript. All authors read and approved the final manuscript.

Ethics and Consent statement

The study didn't use any sensitive data.

Declaration of AI Use

Generative AI was not used for the language edition, and the author solely wrote the article.

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