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Urban Land Use/Land Cover Change Dynamics using RS and GIS Techniques in Addis Ababa City, Ethiopia

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Abstract. *The urban land cover has undergone significant changes due to rapid population growth. The aim of this research is to investigate the spatial extent and rate of LULC changes of the study area using remote sensing techniques by using tools: R-shiny, Collect Earth, QGIS, Arc GIS, GPS, Bing Maps, and the Google Earth Engine.The land use and land cover change (LULCC) analysis was conducted using four sets of satellite imagery; Key informant interviews (KII) and focus group discussions (FGD) were carried out to collect data on the drivers of land use and land cover changes, gather socioeconomic information, and cross-check the remote sensing data. The results showed significant LULC changes over the last 30 years. The built-up urban area has increased by 19,028.34 hectares, while agriculture, forest, and other land cover types have decreased by 11,460.42 hectares, 5,328.88 hectares, and 1,077.03 hectares, respectively. LULC Change in the study area has resulted from a combination of driving forces such as urbanization, industrialization, population pressure, it can be inferred that the city underwent a rapid Land Use and Land Cover Change (LULCC). To address the issue of LULC Changes Effective Land Use Planning is essential in managing or alleviating LULCC. The findings demonstrate that a rapid alteration in land use and land cover has occurred in the city. This modification was shaped by the interplay of immediate and fundamental driving forces.*

Keywords: *Addis Ababa City, Land Use Land Cover Change, LULCC Drivers, Land Use Plan, RS*

1. Introduction

Land use/cover (LULC) is the most prominent form of the global environmental change phenomenon occurring at spatial and temporal scales (1). Land cover is the physical and biological cover of the surface of the land , whereas land use is the indicator of complex human activities that alter land surface processes . The conversion of land use and land cover (LULC) from forests to agricultural land disrupts the flow of ecosystem services provided by forests These services include food supply, fodder for livestock, pharmaceuticals, firewood and timber, filtered water supply, erosion and flood mitigation, biodiversity conservation, climate regulation, and recreational values (2). The far-reaching effects of climate change are notably altering biodiversity, jeopardizing food security, diminishing water availability, and curbing productivity levels in Africa . Multiple socio-economic, demographic, and bio-physical factors have driven such transformations. Nevertheless, recent expansion of urban settlements and infrastructural development could have accelerated the rate at which land cover transformations preceded Accelerated population growth in developing countries, accompanied by unprecedented rates of

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urbanization, has placed tremendous pressure on the surrounding land and its biotic and abiotic resources (3). It is claimed by many that this pressure is responsible for the increasing rate of landscape change in these regions. Numerous studies have shown that urbanization, resulting in land cover change, has an enormous impact on the radiative, thermodynamic, and hydrological processes that can lead to a change in the local climate Changes in population size, distribution, and associated demographic characteristics are often considered the most important factors affecting land use distribution and change (4).

Ethiopia is witnessing substantial LULC transformations attributed to rapid population growth, land tenure disputes, widespread poverty, and political instability (5). The relentless population surge is driving unnecessary exploitation of natural resources like deforestation for agriculture and settlements, shortened fallow periods, and land fragmentation all negatively impacting agricultural output (6). The prevalent environmental issue globally stems from the conversion of LULC types due to rapid urbanization. As the population of Addis Ababa City has increased dramatically, the vegetation cover and other land cover classes have been converted into built-up areas Previous remote sensing studies conducted in the city have faced challenges due to either being too specific or too broad in scope, often failing to accurately capture the actual boundaries of Addis Ababa (7).

The rapid urban growth of Addis Ababa has triggered significant environmental degradation by destroying green infrastructure, such as fragmented riparian vegetation and highland forests, which weakens the city's natural defenses (8). The substantial alteration of LULC severely diminishes the region's localized carbon storage potential and irreparably harms the adjacent watershed by replacing essential carbon-sequestering biomass and open grasslands with uninterrupted impermeable surfaces. Rainwater creates significant surface runoff without permeable soil to absorb it, worsening downstream flooding, polluting the Akaki River basin, and depleting local aquifers that sustain baseflows in the dry season (9). Urbanization and habitat fragmentation have disrupted ecosystems, significantly reducing regional biodiversity and essential ecosystem services for environmental resilience.

Comprehending Land Use/Land Cover dynamics is crucial for alleviating environmental degradation, safeguarding important ecosystem services, and fostering climate-resilient urban development in swiftly expanding African cities (10). The fast expansion of metropolitan areas necessitates the monitoring of spatial changes to ensure a balance between development and conservation, safeguarding biological systems such as forests and wetlands from irreversible damage (11). Analyzing temporal trends enables urban planners to implement targeted interventions that mitigate local environmental effects, promote Sustainable Development Goals 11 and 15, and enhance urban livability and regional biodiversity. The study of land use and land cover changes converts essential spatial data into implementable policy, thus preserving urban liveability and regional biodiversity for sustainable future development (12).

Despite numerous studies conducted across various parts of the city and its environments, they have fallen short in addressing the aforementioned gaps (13). Consequently, there remains a substantial absence of comprehensive urban coverage and long-term historical geospatial data, particularly for recent years, essential for accurately gauging the scale and pace of change within the city. Decision-makers are confronted with the intricate task of navigating a dynamic and multifaceted landscape when devising extensive urban development plans that could detrimentally affect the environment and natural resources due to LULC change. Tackling these challenges requires access to comprehensive coverage and long-term historical geospatial data gleaned through effective data mining techniques. The primary objective of this study is to acquire a holistic understanding of the drivers, impacts, and dynamics of land use changes in Addis Ababa. Detecting and analyzing land use changes will provide valuable insights for sustainable land management and environmental planning, using remote sensing data from 1992, 2002, 2012, and 2022.

2. Methods

2.1. Description of Study Area

Addis Ababa, the capital city of Ethiopia, is located in the heart of the country and is the most important commercial, political, and industrial city of Ethiopia 14). The city also serves as the seat of the African Union in addition to the Oromia Regional State . The city lies north of the equator, /between 8° 51′ 15″ and 9° 4′ 15″ N latitude and between 38° 38′ 0″ and 38° 55′ 30″ E longitude (15). The physical landscape of Addis Ababa is characterized by rugged topography, particularly in the mountainous area in the north called Entoto Mountain, while the central, eastern, western, and southern parts of the city are predominantly flat (16).

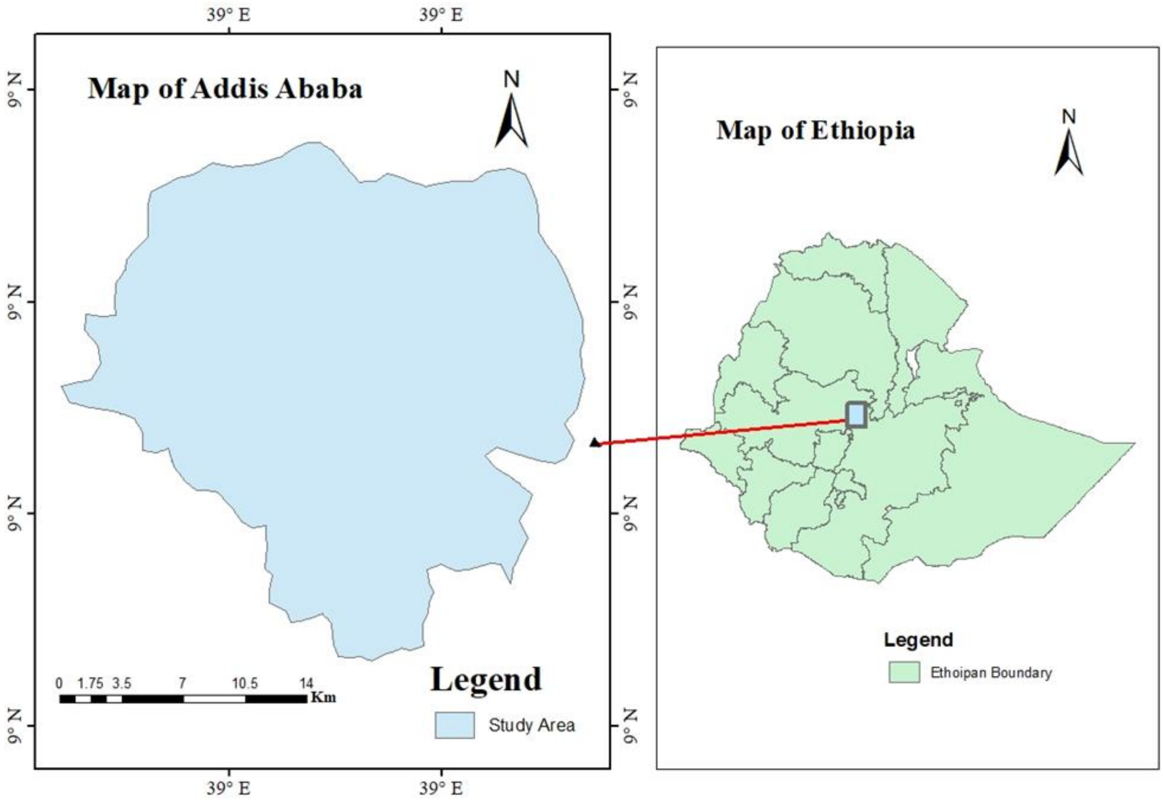

Figure 1. Locatin map of study area

Source:researcher

Figure 1 illustrates the geographic location map of study area, prepared by the researcher, According to the 2007 census, the city have a total population of 2,739,551 inhabitants with a minimum elevation of 2200 m above sea level at Akaki in the southern boundary and a maximum elevation of 3000 m in the Entoto Mountains to the north of the city (17).

2.2. Site selection

Addis Ababa has been designated as a research site due to its notable urbanization and remarkable growth in the urban population. These factors have significantly influenced the city's LULC. As a result, local farmers in the surrounding areas have raised concerns about the conversion of their agricultural land for urban development. It is well-known that residents in these residential colonies have expressed their grievances to the government through various media channels regarding the demolition of their homes

The rapid urban expansion in Addis Ababa has resulted in the encroachment of fertile agricultural land and forested areas to make way for formal and informal residential infrastructure, as well as industrial development. To address this pressing issue, the researcher conducted a study to explore the intricate dynamics of land use changes in the city. Initially, the city of Addis Ababa was stratified into expanded and non-expanded subsites. The study focused on six strategically selected sub-cities Akaki Kality, Bole, Kolfe Keranio, Nifas Silk Lafto, Lemi Kura, and Yeka located on the outskirts of Addis Ababa. These sub-cities offer valuable insights into the expansion of built-up areas into peripheral regions, making them ideal for examining the impact of urban growth on surrounding landscapes.

Each of these selected sub-cities are further divided into districts, serving as the smallest local administrative units. Six districts, one from each sub-city, were purposefully chosen based on data provided by sub-city officials. This data highlighted rapid expansion in residential, infrastructure, and industrial sectors within these districts. In contrast, four inner sub-cities Arada, Addis Ketema, Kirkos, and Lideta have already reached maximum capacity and lack space for further expansion. Additionally, Gullele sub-city is fully occupied, with the remaining available space located on the mountain and a lack of industries around there.

2.3. Sources and Types of Data

The study utilized a mixed-methods approach, combining both quantitative and qualitative data sources and analytical techniques. This integrated methodology was essential for gaining a comprehensive understanding of LULC dynamics in Addis Ababa over a 30-year period.

The quantitative aspect of the analysis primarily relied on remote sensing data, specifically Landsat satellite imagery, to map and monitor spatial and temporal changes in land cover types across the city. Advanced classification algorithms were employed to automate the identification and delineation of various LULC categories. This geospatial analysis provided foundational data regarding the magnitudes, rates, and patterns of LULC transformation.

To complement and validate the findings derived from remote sensing, the researcher incorporated qualitative primary data collection methods. This included conducting in-depth interviews with key informants such as urban planners, land management authorities, and long-time residents. These discussions offered critical contextual information and expert insights into the underlying drivers, decision-making processes, and socioeconomic factors influencing land use changes.

By blending these quantitative and qualitative methods, the study developed a rich and multifaceted understanding of the complex, dynamic LULC changes occurring in Addis Ababa. The integration of spatial data, expert knowledge, community voices, and field-level verification resulted in a more robust and contextually grounded analysis to inform sustainable land management strategies for the city. The overall flow of the methodology has been shown in (Figure 2).

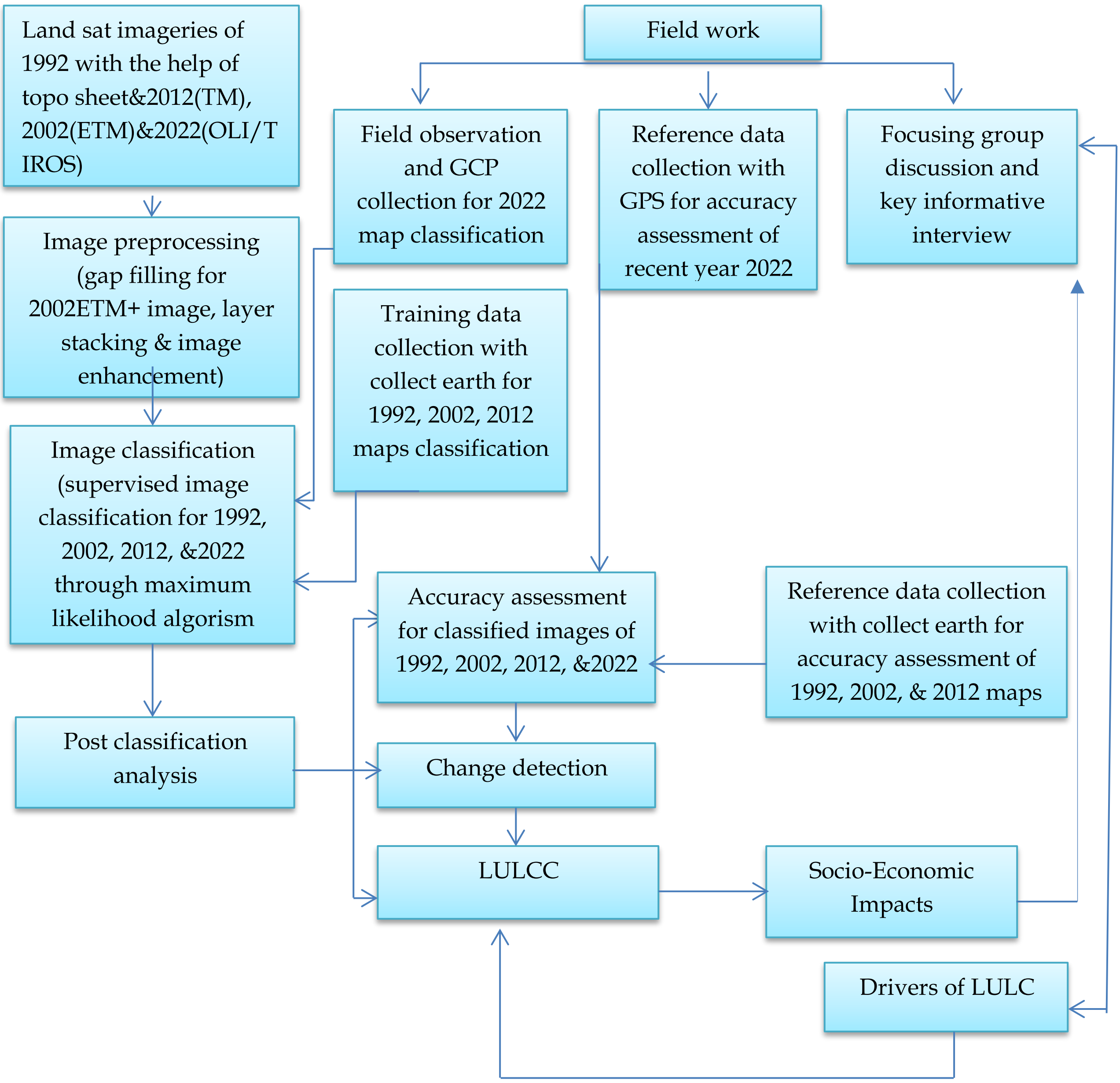

Figure 2. Flow Chart of the research methodology

Source:resaercher

The flow chart of research methodology (figure 2) employed a dual-track strategy that combines remote sensing data processing with extensive fieldwork. The remote sensing pipeline initiates with the acquisition of Landsat imagery from 1992 (utilized topographic sheets), 2002 (ETM+), 2012 (TM), and 2022 (OLI/TIRS). The images undergo preprocessing, which includes gap filling for the 2002 ETM+ picture, layer stacking, and image enhancement. The fieldwork component simultaneously generates critical supporting data divided into three categories: field observations and Ground Control Point (GCP) collection for the 2022 map classification; reference data collection via GPS for accuracy evaluation; and focus group discussions alongside key informant interviews. Moreover, training data is gathered using Collect Earth to facilitate the historical map classifications of 1992, 2002, and 2012.

Following the preprocessing and collection of training data, a supervised image classification is performed for the years 1992, 2002, 2012, and 2022 using a maximum likelihood method. The classified photographs later undergo post-classification examination. An accuracy assessment is conducted for the 1992, 2002, and 2012 maps using reference data acquired from Collect Earth, alongside GPS reference data collected during fieldwork, to validate reliability. Following validation, the data undergoes change detection to evaluate land use and land cover change (LULCC). The LULCC findings are integrated with data from focus groups and interviews to assess socio-economic impacts and identify the primary factors driving LULCC, thereby enhancing the understanding of land change dynamics.

2.4. Remote sensing data collection

The Global Land Cover Facility (NASAGLCF) Archive provides a valuable resource for researchers and enthusiasts alike, offering free access to medium-resolution satellite imagery (18), This imagery, obtained from satellites such as Landsat TM, Landsat ETM+, and Landsat 8 OLI-TIRS, covers the years 1992, 2002, 2012, and 2022. By visiting the USGS website. The spatial resolution of each image is an impressive 30x30 meters, allowing for detailed analysis and observation of the Earth's surface. To ensure the highest quality data, only images with less than 5% cloudiness and no unwanted shadows are selected for inclusion in the archive. This careful selection process is crucial because cloudy imagery can significantly impact the accuracy of resulting maps and analyses

Tools that were employed : Google Earth Engine (GEE): A cloud-based technology employed for processing vast, petabyte-scale satellite imagery datasets (including Landsat and Sentinel) over extended periods without requiring local computational resources. QGIS: A free, open-source desktop geographic information system employed for the visualization, modification, analysis, and charting of spatial data. ArcGIS: A comprehensive suite of commercial desktop and web GIS software employed for advanced spatial analysis and professional mapping. Collect Earth: A specialist tool developed by the FAO that employs Google Earth imagery to obtain high-resolution land use data for national forest inventories and evaluations of land use change. R-Shiny: An R package employed for developing interactive web applications and dashboards directly from R code, facilitating non-technical individuals to interact with complex statistical models and spatial data. The Global Positioning System (GPS) is a satellite-based navigation system employed to precisely record geographic coordinates for ground-truthing and data collection. Bing Maps: A digital mapping service primarily employed as a high-resolution base map layer in GIS software for the visual validation of land cover data.

2.5. LULC Classification

For this study four LULC classes (Forest, Built Up, crop land and Other Land) have been identified for classification purpose,

Table 1. LULC calss; description and training data samples

LULC types	LULC classes descriptions	Training data in each Study year			
		1992	2002	2012	2022
Forest	in February 2015, Ethiopia adopted a new forest definition as follows: "Land spanning at least 0.5 ha covered by trees, attaining a height of at least 2 m and a canopy cover of at least 20% or trees with the potential to reach these thresholds in situ in due course (19)	75	75	75	75
Built up	Built up includes residential, commercial, services, industrial, mixed urban areas, and transportation (20)	80	80	80	80
Crop land	Agricultural: These are areas permanently being used for crop cultivation and various kinds of vegetables (21)	100	100	100	100
Other land	Other land includes water bodies, bare soil, rock, unused open space between buildings and settlements, and all lands not included in the above three classes (22)	60	60	60	60
	Total	315	315	315	315

Training data for classification were collected on the ground using a handheld GPS receiver during preliminary field observations in the recent year (2022), while data from previous years (1992, 2002, and 2015) were obtained from Google Earth, a three-dimensional representation of the Earth that enables clear identification of features on the ground.

Table 2. Remote Sensing Image Data Information

Data Source	Satellite	Path	Row	Spatial Resolution (meter)	Date of acquisition
USGS	Landsat 5 TM	168	54	30	29/02/1992
USGS	Landsat 5 TM	168	54	30	26/01/2002
USGS	Landsat 7 ETM+	168	54	30	28/02/2012
USGS	Landsat 8 OLI	168	54	30	19/01/2022

Source: USGS

3. Results and Discussion

3.1. LULC Classification, Area Calculation and Accuracy Assessment

The obtained outcome illustrates the categorized LULC maps of the designated area. from 1992, 2002, 2012, and 2022. The area of each LULC was calculated based on classification results (Table 3). In 1992, forest covered 9217.08 hectares (17.3%), followed by built-up areas of 10970.1 hectares (20.6), agriculture of 26728.02 hectares (50.3%), and other land of 6249.6 hectares (11.8%). In 2002, forest covered 7558.02 hectares (14.1%), followed by built-up areas, 15839.01 hectares (29.4%); cropland, 24198.66 hectares (45%); and other land, 6191.91 hectares (11.5%). In 2012, the area covered by forest was 5481.81 hectares (10.2%), followed by built-up areas, 21980.88 hectares (40.86%); agriculture, 19820.97 hectares (36.84%); and other land, 6511.59 hectares (12.1%). In 2022, the forest covered 3888.2 hectares (7.2%), followed by built-up areas, 29314.35 hectares (54.6%), agriculture 15267.6 hectares (28.5%), and other land 5172.57 hectares (9.6%) (Table 3). From 1992 to 2002, agriculture was the dominant LULC type in the study area; however, by 2012 and 2022, built-up had surpassed it. Although the built-up area increased during the entire study period, the largest increase occurred in 2022 as illustrated in table 3 and figure 3.

Table 3. LULC classes in Ha and % in the year 1992, 2002, 2012 and 2022

Land Use Land Cover in ha and percentage								
	1992		2002		2012		2022	
Class	Area	%	Area	%	Area	%	Area	%
Forest	9217.1	17.3	7558.02	14.1	5481.81	10.2	3888.2	7.2
Built up	10970	20.6	15839	29.4	21980.9	40.9	29314	54.6
Crop land	26728	50.3	24198.7	45	19821	36.8	15268	28.5
Other land	6249.6	11.8	6191.91	11.5	6511.59	12.1	5172.6	9.6

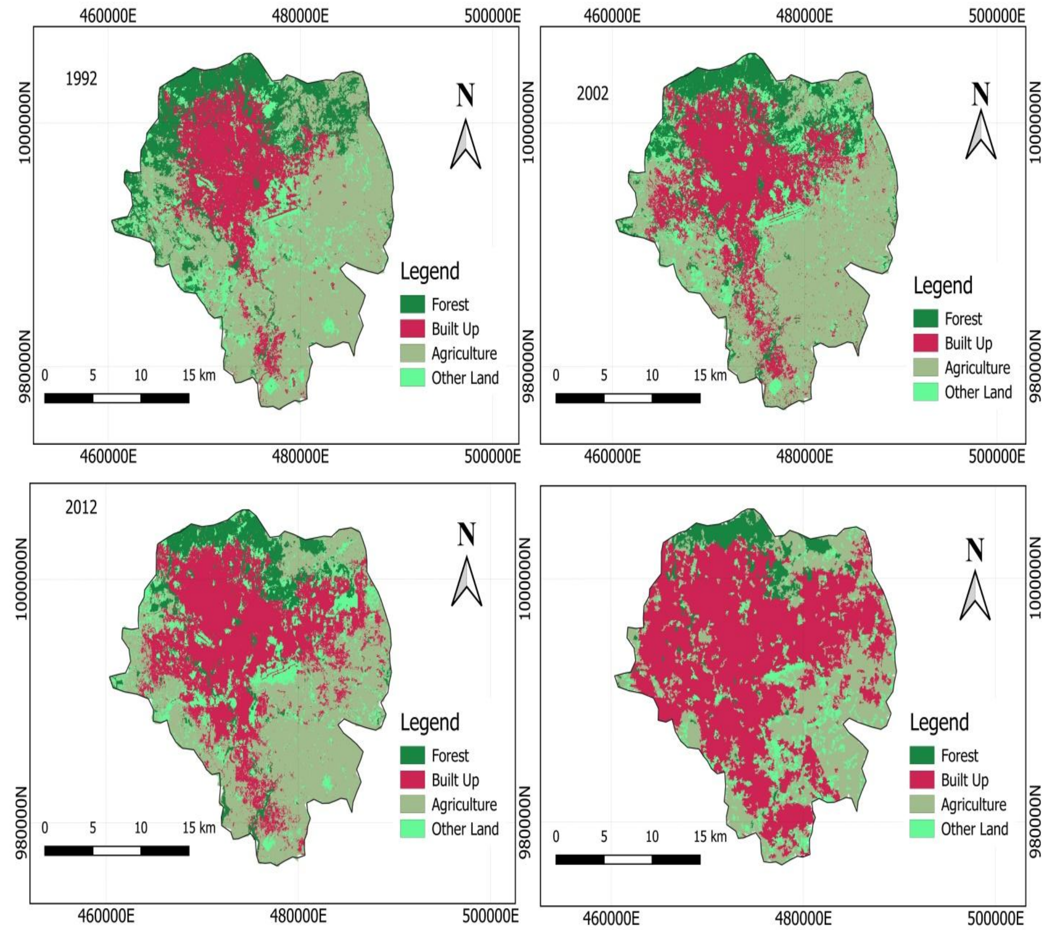

Figure 3. Cover map between 1992 to 2022
Source: analyzed from geospatial data

Overall, the above map shows how the spatia distribotion of urbinazation increased from year to year while forest, agriculture and other declined from 192 to 2022 in the study area.

3.1.1. Accuracy Assessment

In accordance with satellite data classification, the reliability of the results is determined by examining the overall accuracies of the classified images.

Table 4. Result For Accuracy Assessment

Year of Classification	Overall Accuracy (%)	Kappa coficient(K)
1992	87.18	0.81
2002	85.64	0.79
2012	91.82	0.88
2022	89.25	0.84

The classification models exhibited commendable accuracy across all decadal intervals, generally surpassing 85% overall accuracy and sustaining Kappa coefficients of 0.79 or above. Peak Accuracy (2012): In 2012, the classification performance reached its zenith, with an overall accuracy of 91.82% and a Kappa coefficient of 0.88. Minimum Accuracy (2002): In 2002, the relative performance reached its lowest point; however, it remained strong, attaining an overall accuracy of 85.64% and a Kappa coefficient of 0.79. Trends spanning from 1992 to 2022: The classification for 1992 achieved an accuracy of 87.18% (K = 0.81); however, the most recent year, 2022, showed an improvement with an accuracy of 89.25% (K = 0.84) as illustrated in table 4.

3.1.2 Analysis of LULCC

Total LULCC during the whole study period (1992-2022).

Table 5. Total Land Use and Land Cover Change in (Ha) and percentage

LU types	1992-2002 Δ	2002-2012 Δ	2012-2022 Δ	1992-2022 Δ
Forest	-2447.01	-1363.23	-2174.04	-5984.28
Built Up	3804.66	8107.96	6115.72	19028.34
Crop Land	-2255.13	-2141.37	-6467.94	-10864.44
Other Land	-857.34	616.14	-1685.34	-1444.14

Table 5 demonstrates a substantial expansion in built-up area from 1992 to 2022, recording a total of 19,028.34, with the highest growth rate during 2002 to 2012. The rapid expansion of urban regions has encroached onto agricultural and natural green spaces, resulting in a substantial decline in cropland and forest lands.

Table 6. Annual LULCC in hectare and its rate (%)

LULC Class	1992-2002		2002-2012		2012-2022		1992-2022	
	Ha	Rate	Ha	Rate	Ha	Rate	Ha	Rate
Forest	-165.9	-1.8	-207.6	-2.8	-159.4	-2.9	-532.9	-1.9
Built up	486.9	4.4	614.2	3.9	733.3	3.3	1834.4	5.6
Crop land	-252.9	-1	-437.8	-1.8	-455.3	-2.3	-1146	-1.4
Other land	-57.69	-1	1.9	0.03	-103.9	-1.6	-107.7	-0.6

Continuous Urban Expansion: Developed areas have consistently expanded over three decades, averaging an annual increase of 1,834.4 hectares, with an overall annual growth rate of 5.6%. Accelerating Forest Loss: The annual hectare loss peaked between 2002 and 2012 at -207.6 Ha, while the annual deforestation rate worsened, rising from -1.8% (1992–2002) to -2.9% (2012–2022). Steady Reduction of Farmland: Over a 30-year period, farmland saw a continuous and accelerated annual decline, decreasing at a rate of -1% in the first decade and increasing to -2.3% in the final decade. Other land experienced net yearly declines totaling -107.7 hectares per year, reflecting a decrease of -0.6%, notwithstanding a slight increase of +0.03% from 2002 to 2012.

3.1.3 Land Use Land Cover Change Area Transition Matrix

The results display a cross-tabulation change matrix illustrating the altered areas and their respective percentages, indicating the transition from one land use and land cover (LULC) class to another in relation to the total area of each LULC class between 1992 and 2022.

Table 7. Area transition matrix of 1992 and 2022

	LULC 1992						
	Classes	unit	Forest	Built up	Crop land	Other land	Grand Total
LULC 2022	Forest	ha	**3341.9**	0.9	2	543	3887.8
	Built up	ha	5756	**10967.1**	8698.94	3892.9	29314.94
	Crop land	ha	106.9	0.3	**13821.4**	1338.8	15267.4
	Other land	ha	13	2	4206	**951**	5172
	Gran Total	ha	9217.8	10970.3	26728.34	6250	**53642.14**

The area transition matrix from 1992 to 2022, reveals a substantial conversion from natural and agricultural land to urbanized areas between 1992 and 2022. Urbanized areas had significant growth, rising from 10,970.3 hectares to 29,314.94 hectares by incorporating large portions of previous agricultural land (8,698.94 hectares) and forested areas (5,756 hectares). Consequently, total forest cover diminished by more than fifty percent, reducing to 3,887.8 hectares, while agricultural land significantly declined to 15,267.4 hectares. Concurrently, "Other Land" had substantial turnover, ultimately reducing to 5,172 hectares despite the acquisition of 4,206 hectares from degraded agricultural land.

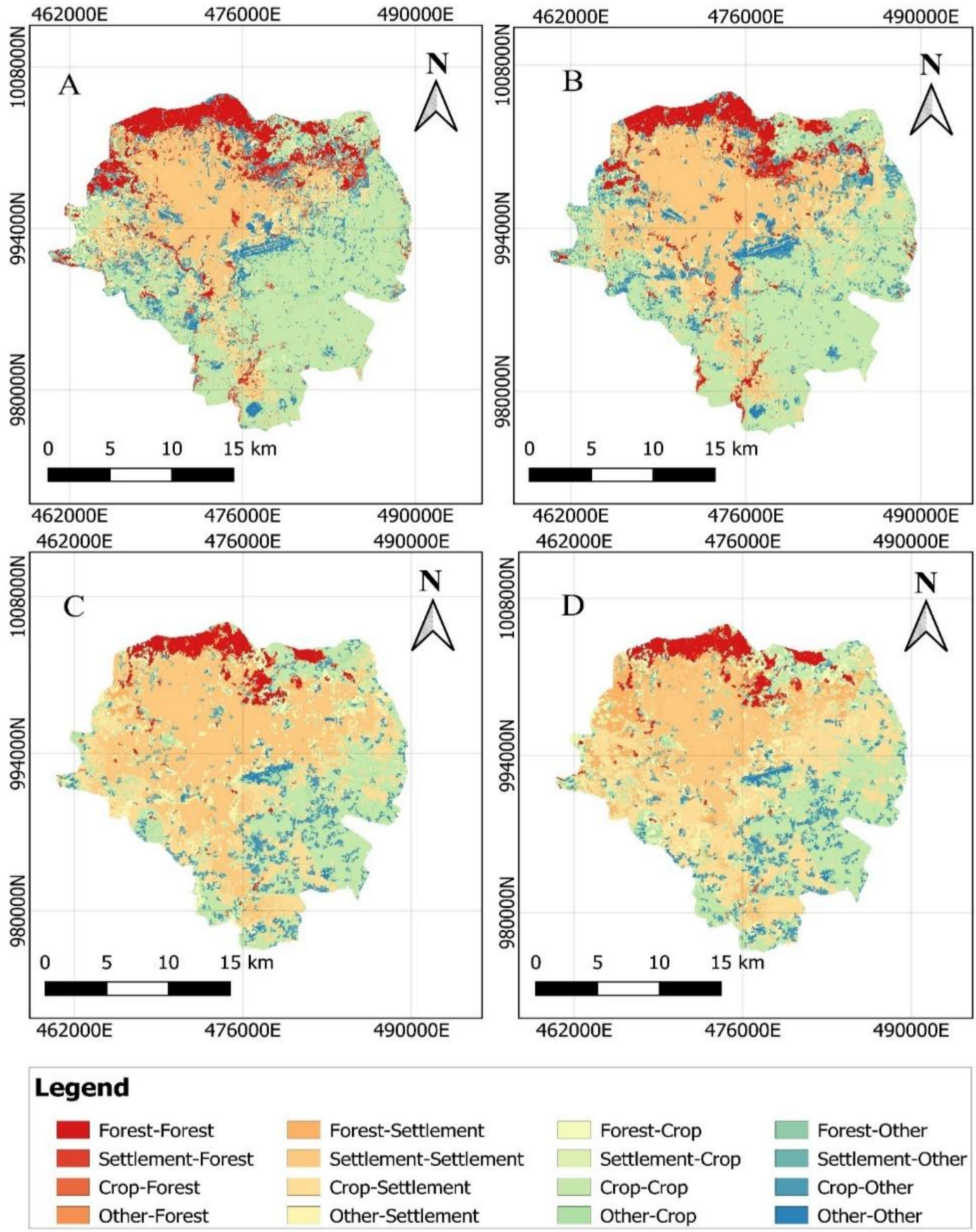

Figure 4. Change map of 1992-2002(A), 2002-2012(B), 2012-2022(C) and 1992-2022(D)

The findings reveal significant landscape alteration from 1995 to 2025, marked by swift growth of developed area and simultaneous reductions in agricultural land, forests, other terrains, and aquatic environments.

3.2. Drivers of LULC Change

LULCC drivers are divided into two categories: (i) direct or proximate drivers and (ii) indirect or underlying drivers (UNCCD, 2008). The proximate and underlying determinants of LULCC in the study region were identified using KII and FGD.

3.2.1. Proximate Drivers of LULCC

The primary proximate drivers of LULC changes in the research area are urbanization, industry, and transportation network growth. The FGD members assumed that these driving factors had primarily engulfed the city's agricultural and woodland areas.

Urbanization

In the past three decades, the process of urbanization in Addis Ababa has been nothing short of remarkable. The city has undergone rapid expansion, particularly in its peripheral regions, catching many by surprise. This accelerated urban growth can be attributed to the availability of land and the development of road infrastructure.

Various six groups and key informant interviews conducted during a study period have confirmed the significant expansion of the urban area in Addis Ababa, particularly encroaching upon agricultural land. In fact, according to six focus groups, it is believed that at least half of the cultivable land has been transformed into built-up areas over the past three decades.

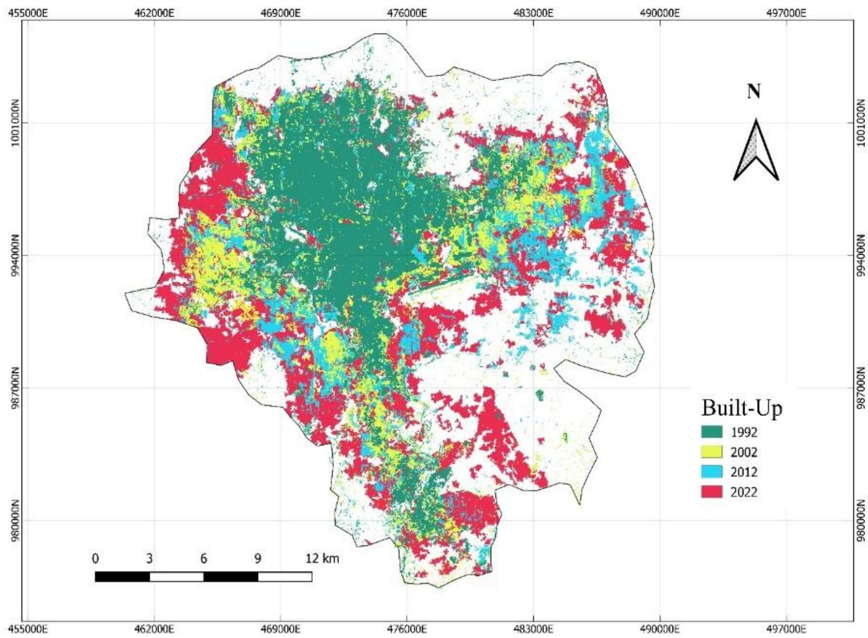

Figure 5. Trends of urbanization in the past 30 years in Addis Ababa
Source:analyzed from remote sensing data in the study area

The figure (5) shows that how urbanization expand horizontally from year to year within the study area, specifically over the past thirty years

Industrialization

Based on the insights gathered from six focus groups and 80% of the key informant interview participants, it is evident that industrialization has played a pivotal role in the (LULCC) in Addis Ababa over the past three decades. The city boasts a significant share of the national industrial sector, and the rapid expansion of industries has created a substantial demand for industrial land. As a result, numerous factories have been established in the outskirts of the city.

The need for additional space has compelled industries to seek new sites in the outskirts, leading to the development of factories in previously agricultural or rural areas. This expansion of industrial activities has not only transformed the physical landscape but has also necessitated the construction of new roads, communication networks, and other essential services to cater to the needs of these companies. Consequently, the conversion of land for industrial purposes has had a notable impact on the overall land use and land cover in Addis Ababa.

3.2.2. Underlying Drivers of LULC Change

Population Growth

Rapid population growth in Addis Ababa, the capital city of Ethiopia, has prompted significant spatial expansion, as highlighted in a report by UN-Habitat in 2017. The findings from Six Focus Group Discussions (FGDs) and 94.3% of Key Informant Interview (KII) participants indicate a notable increase in migration rates into the city over time. Additionally, 82.9% of the KII participants emphasized that the present population growth has accelerated, necessitating the construction of additional housing facilities.

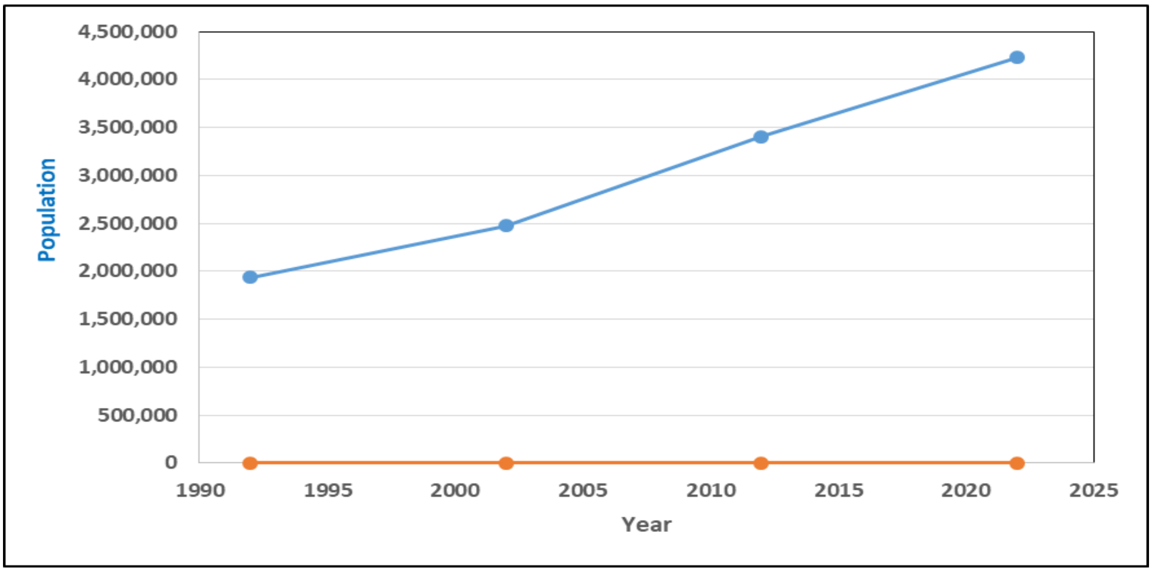

Figure 6. Trend of population growth in Addis Ababa from 1992 to 2022

Source: projected from SCA (1994, 2007)

3.3. Impacts of LULC Change on Socio-Economic Aspects

3.3.1. Impacts On Dislocated Farming Communities

Urban expansion often leads to the conversion of agricultural land into built-up areas. This can result in the displacement of farming communities who rely on the land for their livelihoods. Dislocated farmers may struggle to find alternative sources of income and face challenges in adapting to urban environments.

Loss of agricultural livelihoods, Changes in employment patterns, Disruption of social networks and community cohesion, increased urban poverty and inequality and Environmental implications: LULCC can also have environmental consequences, such as the loss of green spaces, decreased ecosystem services, and increased pollution and urban heat island effects

3.3.2. The Income Situation of the Dislocated Farming Community

The findings indicate that a significant majority (88%) of FGDS and KII Agreed that a decrease in their annual income following displacement, while a smaller proportion (12%), Agreed an increase in income. Several factors contribute to this income disparity. Firstly, dislocated farmers often have to share a portion of their income with landowners, as their primary source of income is derived from agriculture, Moreover, limited access to farmland poses a challenge for dislocated farmers in generating income, Additionally, the high cost of living in urban areas can further strain the income of dislocated farmers.

3.3.3. Impacts On Education

Disruption of existing educational infrastructure, Limited access to quality education, educational gaps and discontinuity, Social and cultural adjustments, Psychological and emotional effects

Conclusions

The FGDs and the majority of KII participants confirmed the significant LULC changes they observed in the city over the past three decades. According to their observations, agricultural land, forests, and other types of land have decreased, while built-up areas have expanded. These findings align with the results obtained from satellite image analysis, providing further validation to the study's findings. The identified drivers of LULCC in Addis Ababa include urbanization, industrialization, road network development, population growth (natural increase and inward migration), weak urban land governance, high land prices, and biophysical factors such as elevation and slope. These factors have collectively contributed to the transformation of the city's landscape and land use patterns. Urbanization and industrialization have played significant roles in driving LULCC, as the city has witnessed rapid growth and the expansion of urban areas to accommodate increasing population and economic activities. The development of road networks has facilitated accessibility and connectivity, further influencing land-use changes. Population growth, both through natural increase and inward migration, has placed additional pressure on land resources, leading to changes in land use. The impacts of urban LULCC due to dislocation on education can be significant and multifaceted, including disruption of educational infrastructure, limited access to quality education, educational gaps, and discontinuity. The results revealed that, although most displaced farmers saw a decrease in income, a minority reported an uptick in earnings. This disparity can be linked to factors like a smooth shift to alternative livelihood options, access to fresh job prospects in non-agricultural fields, or profitable entrepreneurial endeavors

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Conflicts of Interest

The authors declare no discernible competing financial interests or personal affiliations that might have ostensibly affected the work described in this study.

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