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LAND AND FARM MANAGEMENT | REVIEW ARTICLE

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Land-use and land-cover dynamics in East and the Horn of Africa: a regional synthesis of trends, drivers, impacts and interconnected transitions

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ABSTRACT

Land-use and land-cover (LULC) change has become one of the most significant drivers of climate change and environmental transformation globally. In East and the Horn of Africa, several factors have accelerated landscape transformation, yet evidence on regional patterns, underlying drivers, and associated impacts remains fragmented. In view of this, we synthesized a total of 56 existing studies aimed at generating evidence on LULC dynamics across East and the Horn of Africa. Specifically, the review identified dominant land-cover transitions, drivers, impacts and emerging research gaps. The review employed a systematic literature review approach guided by the PRISMA 2020 framework. Peer-reviewed studies published between 1980 and 2024 were identified from multiple databases. Studies were screened using predefined inclusion and exclusion criteria. The findings revealed widespread landscape transformation characterized by forest and woodland decline, wetland degradation, grassland conversion, agricultural expansion, and increasing built-up areas. Agricultural expansion emerged as the dominant proximate driver of LULC change, interacting with multiple underlying factors. The review further identified substantial methodological variation among studies. The review concludes that LULC dynamics in the EHoA are driven by interconnected social economic, institutional and environmental forces. The review recommends need for integrated regional approaches that combine sustainable land management processes that guarantee ecological restoration, livelihood realities and improved land-use governance.

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Land use and land cover change; East Africa and the Horn of Africa; agricultural expansion; biodiversity loss; urbanization and land degradation; sustainable land management; GIS & remote sensing

SUBJECTS
Agriculture and Food; Agriculture & Environmental Sciences; Environmental Sciences; Agricultural Development

Introduction

Land-use and land-cover (LULC) change represents one of the most significant forms of global environmental and climate transformation, reflecting complex interactions between human activities and ecological processes (Foley et al., 2005; Meyfroidt et al., 2022; Verburg et al., 2013). Changes in land use and land cover influence ecosystem functioning, biodiversity conservation, carbon cycling, hydrological regulation, food production systems, and the provision of ecosystem services for climate modification essential for human well-being (Assede et al., 2023; Ketema et al., 2020). Over recent decades, anthropogenic factors including population growth, agricultural expansion, urbanization, infrastructure development have accelerated landscape transformation across many regions of the world (Lambin et al., 2001; Lambin & Meyfroidt, 2011). These changes have profound implications for climate systems, sustainable development, food security and rural livelihoods (Branca et al., 2013; Bununu et al., 2023; DeFries et al., 2010).

Globally, LULC trajectories vary considerably depending on socio-economic development pathways, governance systems, environmental and technological advancements. In tropical regions of the world (Africa, Asia, and Latin America), land-use change has predominantly been associated with the conversion of ecosystems into agricultural land, urban expansion and settlements due to increasing demand for food, energy, and

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infrastructure and space (Foley et al., 2005; Lambin et al., 2003; Navarro & Pereira, 2015; Queiroz et al., 2014; Roy et al., 2015; Seto et al., 2012). Conversely, developed regions such as Europe and Mediterranean landscapes have recorded extensive ecosystem expansion associated with agricultural abandonment, restoration programmes, and changing sustainable land management practices (Napoli et al., 2026; Pereira et al., 2012; Plieninger et al., 2014). These contrasting global patterns highlight that LULC change is not a uniform process but rather a context-dependent phenomenon shaped by interacting social, economic, institutional, and environmental factors (Lambin et al., 2001; Turner et al., 2007).

Africa's landscapes have experienced substantial LULC transformations due to agricultural expansion, population growth, urban development, infrastructure investments, and changing livelihood systems among others (Brink & Eva, 2009; Gibbs et al., 2010; Lambin et al., 2013; Seto et al., 2012). These processes are particularly pronounced in East Africa and the Horn of Africa (EHoA), a region characterized by diverse ecosystems ranging from tropical forests and wetlands to savannahs, rangelands, and arid and semi-arid landscapes support millions of people (Angerer et al., 2023; Brandt & Stolle, 2021; Holechek et al., 2020; Winkler et al., 2021). In this region, agricultural expansion remains one of the dominant drivers of LULC change, particularly where increasing food demand and livelihood dependence on land resources result in conversion of forests, woodlands, wetlands, and grazing areas into cultivated land (Gibbs et al., 2010; Ordway, 2015). At the same time, population growth, urbanization, infrastructure development, climate variability among others influences land-use decisions (Kariuki et al., 2018; Lind et al., 2020). Several studies have documented significant LULC changes within individual countries of the EHoA region. For example; in Ethiopia, research has reported extensive changes in forest cover, agricultural expansion, and land degradation associated with population growth, agricultural intensification, and changing land management practices (e.g. Alemu & Abshare, 2021; Benti et al., 2017; Beyene, 2016; Biedemariam et al., 2022; Desalegn et al., 2014; Ketema et al., 2020; Muke, 2019; Tewabe & Fentahun, 2020).

Similarly, Kenya, Tanzania and Uganda's studies have highlighted increasing conversion of forests and rangelands, wetlands and woodland degradation due to agricultural expansion, settlement growth, infrastructure development and changes in land-use practices and resource extraction pressures (e.g. Biedemariam et al., 2022; Bolo et al., 2019; Kariuki et al., 2018; Pricope et al., 2013). Comparable patterns have also been reported in Rwanda, Djibouti, Somalia, and other countries within the region, although the magnitude and nature of changes vary according to ecological and socio-economic contexts (Bizimana et al., 2022; Bullock et al., 2021; Nshimiyimana et al., 2023; Pandit et al., 2024a; Zhang et al., 2025; Zhao et al., 2024).

Further, studies have highlighted the use of various remote sensing datasets, including Landsat, MODIS, Sentinel, and SPOT imagery (Table 1) being fundamental tools for detecting landscape changes across the region (Abate & Kibret, 2016; Bernard et al., 2011; Bullock et al., 2021; Groeneveld et al., 2021; Meles & Molla, 2025; Mwakalila, 2006; Njoroge et al., 2011; Nshimiyimana et al., 2023; Zenebe & Addisu, 1970). These Earth Observation technologies have significantly improved the capacity to monitor and analyze LULC dynamics across different spatial and temporal scales in the EHoA. These technologies are integrated with Geographic Information Systems (GIS) because they support a wide range of spatial analytical approaches, including land-cover classification, change detection, landscape fragmentation analysis, spatial modelling, and assessment of land-use transition pathways (Awoke & Debie, 2023; Lambin et al., 2003; Lu et al., 2004; Mnyali & Materu, 2021; Mulaw et al., 2023; Phiri et al., 2020; Twongyirwe et al., 2011). Furthermore, different image-processing and classification techniques have been applied in LULC studies in the EHoA, including supervised and unsupervised classification, maximum likelihood classification, object-based image analysis, and machine-learning algorithms such as Random Forest and Support Vector Machines (Bernard et al., 2011; Lu & Weng, 2007; Maxwell et al., 2018; Twongyirwe et al., 2011). These studies highlight that these approaches have improved the accuracy and efficiency of landscape monitoring (Foody, 2002; Stehman & Foody, 2019).

Despite the growing body of literature on LULC dynamics in East and the Horn of Africa, a comprehensive synthesis integrating land-cover trends, drivers, impacts, methodological approaches, and interconnected transitions remains limited. Existing studies have largely focused on specific countries, watersheds, protected areas, or individual landscapes, providing valuable local insights but limiting understanding of broader regional context. Furthermore, methodological differences in remote sensing datasets, and other parameters create challenges in comparing reported LULC trajectories across the region (Foody, 2002; Olofsson et al., 2014; Stehman & Foody, 2019).

Table 1. Comparative synthesis of GIS and remote sensing methodologies employed in LULC studies across East and the Horn of Africa.

Methodological component	Predominant approaches identified	Representative studies	Strengths	Limitations and implications
Satellite imagery	Landsat MSS, TM, ETM+, OLI (30–80 m); Sentinel-2 (10 m); MODIS; SPOT; QuickBird; WorldView	Molla et al. (2010); Mathewos et al., 2019); Mulaw et al. (2023); Fekadu et al. (2025); Nshimiyimana et al. (2023)	Landsat provides long-term historical archives; Sentinel and commercial imagery improve detection of small landscape features.	Differences in spatial resolution influence detection of fragmented landscapes, small wetlands, settlements, and narrow riparian vegetation, reducing comparability among studies.
GIS and image-processing software	ArcGIS, ERDAS Imagine, ENVI, ILWIS, Google Earth Engine (GEE), ArcSWAT	Twongyirwe et al. (2011); Awoke and Debie (2023); Mulaw et al. (2023); Mnyali and Materu (2021)	Advanced GIS platforms improve image preprocessing, visualization, spatial analysis, and cloud-based processing.	Different preprocessing workflows may introduce inconsistencies in LULC outputs.
Classification algorithms	Maximum Likelihood Classification (MLC); Random Forest (RF); Unsupervised Classification; Pixel-based and Object-Based Image Analysis	Meles and Molla (2025); Mulaw et al. (2023); Awoke & Debie, (2023); Twongyirwe et al. (2011)	RF generally provides higher classification accuracy than conventional MLC; object-based methods reduce mixed-pixel errors in heterogeneous landscapes.	Earlier studies relying on unsupervised or MLC methods may underestimate land-cover heterogeneity, contributing to differences in reported LULC trends.
Change detection techniques	Post-classification comparison; Change matrices; Cross-tabulation; Time-series analysis; Transition matrices; SWAT-based simulations	Mwanukuzi (2020); Awoke & Debie, (2023); Muhangane et al. (2024)	Enables quantification of temporal transitions and identification of donor–recipient land-cover relationships.	Results depend heavily on classification accuracy; classification errors accumulate during post-classification comparison.
Accuracy assessment	Error matrix; Overall accuracy; Producer's accuracy; User's accuracy; Kappa coefficient; Ground-truth GPS validation	Mulaw et al. (2023); Awoke & Debie, (2023); Fekadu et al. (2025); Mathewos et al., (2019)	Most recent studies reported overall accuracies exceeding 85%, improving confidence in mapped LULC changes.	Older studies frequently lacked detailed validation procedures or reported only qualitative field verification, limiting confidence in reported changes.
Ground verification	GPS points; Google Earth; Topographic maps; Field surveys; Key informant interviews	Molla et al. (2010); Twongyirwe et al. (2011); Nshimiyimana et al. (2023); Meles and Molla (2025)	Improves classification reliability by validating remotely sensed outputs with field observations.	Ground-truth sample sizes and validation strategies varied considerably among studies, affecting reproducibility.
Emerging technologies	Google Earth Engine, Sentinel-2, Random Forest, Machine Learning, SWAT modelling	Mulaw et al. (2023); Muhangane et al. (2024); Kibugu et al. (2022)	Higher-resolution imagery and cloud computing improve efficiency, classification accuracy, and regional-scale monitoring.	Adoption remains uneven across the region, limiting methodological standardization.

Consequently, a systematic synthesis of the available evidence is needed to characterize regional LULC trends, identify the dominant drivers, assess their socio-economic and ecological implications, and examine the interconnected transitions among land-use and land-cover classes across East and the Horn of Africa. Accordingly, this review addresses these knowledge gaps by integrating evidence from published studies to provide a comprehensive understanding of LULC dynamics across the region. The results will inform sustainable land use management environmental policy and climate change adaptations.

Materials and methods

Study area

East and the Horn of Africa (EHoA) (Figure 1) comprises of a geographically and ecologically diverse region characterized by humid highlands, extensive arid and semi-arid rangelands, and the African Great

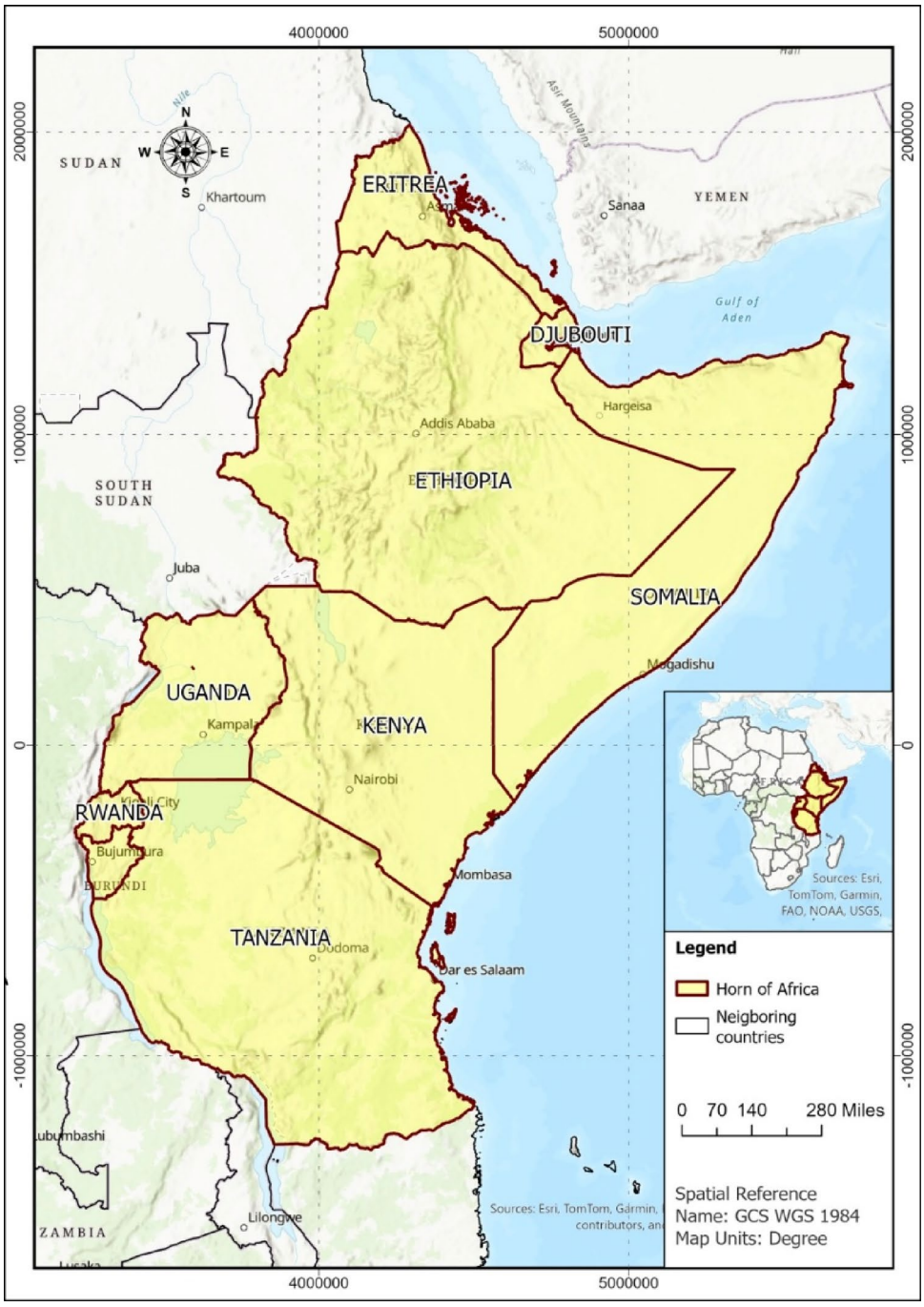


Figure 1. Map of the East and the Horn of Africa (EHoA) showing the countries where the reviewed studies were conducted.

Lakes. Additionally, the region is characterized by extensive basins, which together have shaped the region's diverse topography, soils, hydrology, and land-use patterns (Degefu et al., 2018; Mwangi, 2019; Otieno & Kinyamario, 2018; Prăvălie, 2016; Winkler et al., 2021).

This review synthesizes evidence from studies conducted across Ethiopia, Kenya, Somalia, Uganda, Tanzania, Eritrea, Djibouti, and Rwanda (Bański, 2025) (Figure 1) to identify regional patterns, drivers, impacts and interconnected relationships of LULC.

Literature search and strategy

This study employed a systematic literature review process. The review protocol was guided by the PRISMA guidelines, which follows four sequential stages: (i) identification, (ii) screening, (iii) eligibility

assessment, and (iv) final inclusion and synthesis of eligible studies (Page et al., 2021) (Figure 2). This approach was intended to enhance methodological rigor, transparency, and reproducibility in evidence synthesis (Moher et al., 2009; Page et al., 2021; Snyder, 2019).

The literature search was conducted using five major scientific databases including Google Scholar, Web of Science, Science Direct, Research Gate, and African Journal Online (AJol). These databases provide comprehensive, multidisciplinary coverage of high-quality peer-reviewed literature. The search strategy was developed from the review objectives using Boolean operators, phrase searching, and combinations. The principal search string included combinations of: ('land use' OR 'land cover' OR 'land-use change' OR 'land-cover change' OR LULC) AND ('East Africa' OR 'Horn of Africa' OR Ethiopia OR Kenya OR Uganda OR Tanzania OR Rwanda OR Somalia OR Eritrea OR Djibouti) AND ('remote sensing' OR GIS OR satellite imagery OR change detection OR landscape dynamics OR land transition). A standardized data extraction template was used to capture information on publication characteristics, study location, study period, satellite datasets, remote sensing and GIS techniques, dominant land-use transitions, reported drivers, impacts, methodological limitations, and key recommendations.

Following the removal of duplicate and irrelevant records, the remining articles were subjected to title and abstract screening. Only 56 studies satisfied the predefined eligibility criteria and were included in the final qualitative synthesis (Figure 2). Eligible studies were those (i) published between 1980 and 2024, (ii) investigated land-use and/or land-cover dynamics within East and the Horn of Africa, (iii) used empirical approaches based on remote sensing, GIS, field observations, or mixed methods, and (iv) published as peer-reviewed journal articles or accredited postgraduate theses (Page et al., 2021). Studies conducted outside the study region, lacking explicit LULC analysis, presenting insufficient methodological information, or duplicating previously published datasets were excluded. Given the considerable heterogeneity among the included studies in terms of temporal coverage, analytical techniques, and reporting approaches, a quantitative meta-analysis was not appropriate. Instead, findings from the eligible studies were synthesized using thematic narrative analysis, whereby evidence was organized according to the review objectives and grouped into major themes as presented in the subsequent sections.

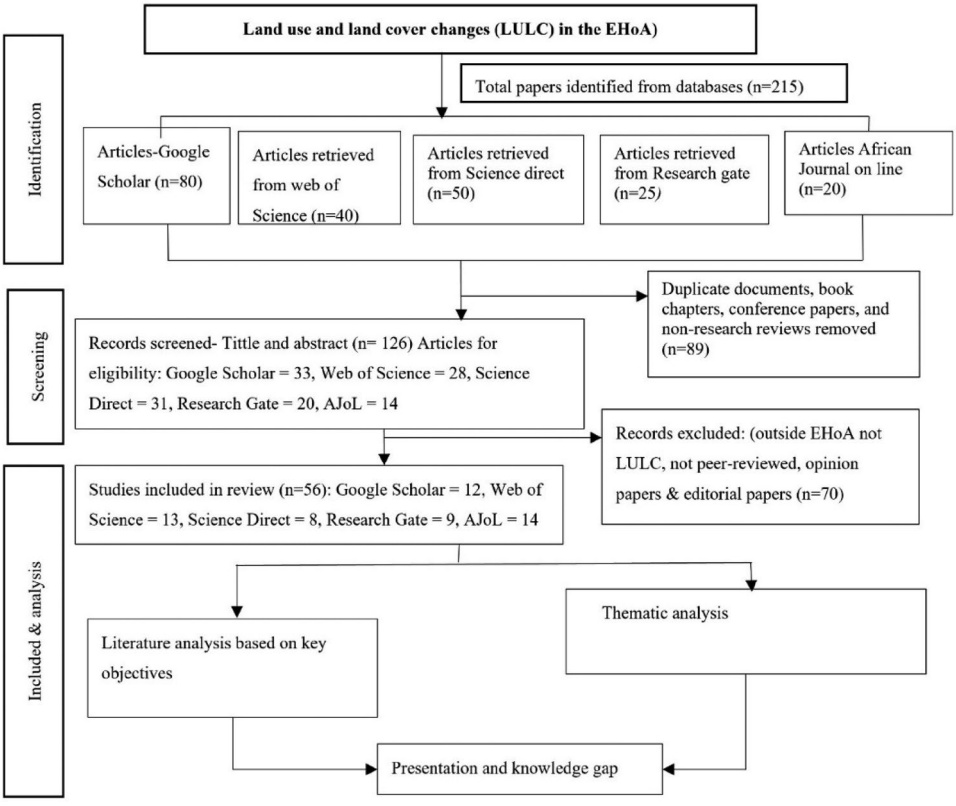


Figure 2. Schematic representation of the systematic review process employed in the review. Adopted from Page et al. (2021) and modified by the researcher.

Limitations of the review methodology

Although this review adopted a systematic and transparent methodology, there were several limitations. First, only English-language publications were included, potentially excluding relevant studies published in French, Arabic, or other regional languages. Second, grey literature was not comprehensively included because methodological quality could not always be verified consistently. Third, methodological heterogeneity among the reviewed studies limited direct quantitative comparison of reported LULC changes. Nevertheless, the consistency of major regional trends across multiple countries and analytical approaches provides confidence in the overall findings of this review.

Results

Characteristics of the reviewed studies

A total of 56 studies met the eligibility criteria and were included in the final synthesis (Figure 2). The selected studies were published between 1980 and 2024, representing more than four decades of research on land-use and land-cover (LULC) dynamics across East and the Horn of Africa. The studies encompassed a wide range of ecological settings, including tropical forests, woodlands, wetlands, savannahs, rangelands, agricultural landscapes, protected areas, watersheds, and rapidly urbanizing environments. Geographically, Ethiopia, Kenya, Tanzania, and Uganda (Figure 1) accounted for the largest proportion of the reviewed studies, whereas relatively few studies originated from Somalia, Eritrea, Djibouti, Burundi, and South Sudan, indicating an uneven geographical distribution of LULC research across the region.

The reviewed studies also demonstrated substantial methodological variation in the application of remote sensing and Geographic Information Systems (GIS) for LULC analysis (Table 1). Earlier studies predominantly employed Landsat imagery, Maximum Likelihood Classification (MLC), and conventional GIS-based analytical approaches. More recent studies increasingly utilized higher-resolution satellite datasets, particularly Sentinel imagery, cloud-computing platforms such as Google Earth Engine, and machine-learning algorithms, especially Random Forest. Variations were also observed in the satellite datasets, spatial resolutions, image preprocessing techniques, classification algorithms, and accuracy assessment procedures adopted across studies. These methodological differences were reflected in the diversity of reported LULC estimates and change trajectories across the reviewed literature.

Regional trends of land-use and land-cover change

The synthesis revealed consistent evidence of substantial land-use and land-cover transformation across East and the Horn of Africa over the past four decades. Reviewed studies reported significant changes in one or more land-cover categories (Figure 3). Despite differences in study locations, most studies reported widespread conversion of natural ecosystems into agricultural land and built-up areas. Forests, woodlands, wetlands, and grasslands consistently exhibited declining spatial extent, while cropland and settlements expanded in response to increasing demand for food, housing, infrastructure, and other socio-economic activities. Although patterns of LULC change differed across countries and ecosystems, evidence consistently pointed to the conversion of forests, woodlands, grasslands, and wetlands into agricultural land as the dominant transition. Specific transitions by category in the reviewed studies are presented below:

Bareland land use transitions

Changes in bare land were reported in 21 of the reviewed studies, indicating considerable temporal variability across the EHoA. Most studies documented expansion of bare land, while a smaller number reported localized declines. Increased bare land was commonly reported alongside reductions in vegetation cover and transitions from other land-cover classes, whereas declining bare land was observed in landscapes undergoing ecological restoration and improved land management. For instance, Soita et al.

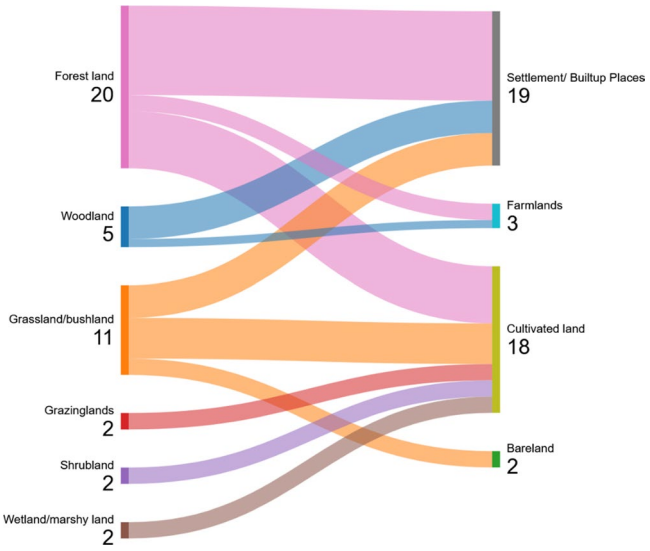


Figure 3. Sankey diagram synthesizing the LULC transitions reported across the reviewed studies. Developed by the researcher. Flow widths are proportional to the number of reviewed studies reporting each transition, thereby highlighting the dominant pathways of landscape transformation across East and the Horn of Africa.

(2024) reported changes in bare land classes with increase from 32,438 to 36.11 hectares between 2009 and 2022 in Kenya's Koitobos River Catchment, while Bikeko and Venkatesham (2024) documented a reduction in bare land extent from 12,375.51 ha to 11,06.47 ha between 2008 and 2017 in Ethiopia's Bilate River Basin (Table 2).

Farmland expansions

Farmland expansion was one of the most frequently reported land-use transitions across the reviewed studies. In most cases, cultivated land expanded at the expense of forests, woodlands, shrublands, grasslands, and wetlands, making agricultural expansion a dominant pattern of LULC change throughout the EHoA. The magnitude and rate of cropland expansion varied across study locations and periods of assessment. Studies conducted in humid and sub-humid agroecological zones consistently reported substantial increases in cultivated land, accompanied by corresponding declines in natural vegetation cover (Abate & Kibret, 2016; Desta & Fetene, 2020; Gessesse & Bewket, 2014; Ketema et al., 2020; Regasa & Nones, 2021). In contrast, studies from semi-arid landscapes reported more heterogeneous cropland dynamics, with both expansion and contraction of cultivated land observed across different locations and time period.

Forest cover loss

Forest decline was among the most frequently reported land-cover changes across East and the Horn of Africa. The reviewed studies consistently documented reductions in forest extent across diverse ecosystems and time periods, making forest loss one of the predominant regional LULC trends. In many study areas, forest cover declined concurrently with increases in cultivated land, settlements, and other land-use categories. Conversely, a limited number of studies reported localized increases in forest cover, particularly in areas implementing afforestation, reforestation, or forest restoration programmes.

Grassland and grazing LULC

Changes in grassland and grazing land were among the most frequently reported LULC transitions across the reviewed studies. The predominant trend was a decline in grassland and grazing areas, with many studies documenting their conversion to cropland and, to a lesser extent, settlements and other built-up areas.

Table 2. LULC transitions with country specific observations in the EHoA.

LULC transition	Observed changes	Country specific observations (examples)	Authors
Forest land to Cultivated Land	Forestlands are experiencing rapid depletion due to deforestation for agricultural production. In some areas, there are afforestation efforts to restate the balance.	The escarpments of Ethiopia's rift valley, and in Wadla Delanta Massif highlands showed that cultivated land systems have expanded significantly between 1988 and 2018. In Awoja watershed in Ngora district Uganda, cultivated land decreased from 223.35 to 109.35 km^2. In Kenya, between 1976 and 2000, riverine vegetation and forest land decreased by 67% and 60%, respectively, while barren surfaces and urban areas increased by over 100% and 98%.	(Andrew & Sembosi, 2017; Groeneveld et al., 2021; Ketema et al., 2020; Mathewos et al., 2019; Molla et al., 2010; Mwanukuzi, 2020; Twongyirwe et al., 2011)
Forest land to Settlement/ Built up places	There is wide spread built up areas driven by growth in population, and infrastructural development. Forest land has been taken up to accommodate increasing population for refuge	Ethiopia's Esira district, Dawuro Zone, settlement increased from 11.9% to 32% between 1990 and 2019, in Embamamie watershed, settlement expanded from 1.53 Ha in 1990 to 18.72 Ha in 2021. Also, northern Amhara which was mainly 3946 Ha of bushland, 80,033.06 hectares of farmland, 12,866.46 hectares of forestland, 740.23 hectares of bare land, and 601.87 hectares of water bodies were converted into built-up areas.	(Alule et al., 2023; Andrew & Sembosi, 2017; Bernard et al., 2011; Groeneveld et al., 2021; Mashafi et al., 2024; Mathewos et al., 2019; Minale & Rao, 2011; Molla et al., 2010; Muhangane et al., 2024; Njoroge et al., 2011; Nzunda et al., 2013).
Forest land to farmland	Cultivated lands have progressively replaced the existence of forestlands, and shrubs. humid and sub-humid agroecological zones indicates sustained agricultural expansion. semi-arid and environmentally fragile landscapes exhibit more complex and sometimes opposing trends.	In Jima Arjo district – Ethiopia, dense forests annually reduced by 5.186 km^2 between 1973 and 1986. Also, in Esira district, forest cover reduced by 10% between 1990 and 2019. But in northern Amhara, forest cover increased to 44.3% in 2020. In Uganda, forest changes were mainly linked to historical occurrences. in Koitobos river catchment, 2242 Ha of land reduced to 1647 Ha between 1995 and 2009, and further down to 222Ha in 2022.	(Bernard et al., 2011; Minale & Rao, 2011)
Woodland to Settlement/ Built up places	Woodlands have declined characterized by significant conversion pressures from agricultural expansion, extraction of fuelwood, and social economic development.	In Uganda's Nakasongola, the woodland cover reduced by 6.5% from 24,288 Ha to 22,712 Ha between 1987 and 2005. woodland cover in Magamba forest in Tanzania has reduced from 2333.37 Ha to 1216.76 Ha between 1995 and 2015.	(Andrew & Sembosi, 2017; Lazaro et al., 2023; Molla et al., 2010; Nduwamungu et al., 2010)
Woodland to farmland	Woodlands have also declined by significant conversion to farm expansion, and development of settlements.	In Uganda's Nakasongola, the woodland cover reduced by 6.5% from 24,288 Ha to 22,712 Ha between 1987 and 2005. woodland cover in Magamba forest in Tanzania has reduced from 2333.37 Ha to 1216.76 Ha between 1995 and 2015	(Bernard et al., 2011)
Grassland/Bushland to cultivated land	Grassland/Grazing land LULCC is attributed to expansion of agricultural lands and settlement lands, as well as ecological variability.	In Tara Gedam – Ethiopia, the grasslands have declined from 1,721.09 Ha to 947 Ha between 1980 and 2003. in Kakooge Nakasongola district Uganda, grassland cover increased from 12,292 Ha to 15,236 Ha between 1987 and 2005 as a result of reduced cultivation in certain areas and land abandonment.	(Byenkya et al., 2014; Ketema et al., 2020; Kisoza, 2014; Molla et al., 2010; Mwamlavya et al., 2021)

(*Continued*)

Table 2. Continued.

LULC transition	Observed changes	Country specific observations (examples)	Authors
Grassland/Bushland to Bare land	Signals ecological stress linked to overexploitation, climate variability, and poor land management practices	Kenya's Koitobos River had increase in bareland converted from agricultural land from 32,438 Ha in 2009 to 36.11 Hectares in 2022. Ethiopia's Bilate River Basin had a slight reduction in bareland cover from 12,375.51 Ha to 11,06.47 Ha between 2008 and 2017.	(Byenkya et al., 2014; Pandit et al., 2024)
Grassland/Bushland to Settlement/Built up places	Declining due to increased grazing, infrastructure developments and growing urban developments	In Nakasongola district, bushlands decreased from 6431 Ha to 2919 Ha between 1987 and 2005. in Mbulu and Karatu district – Tanzania, bushlands are continuously declining by 75 Ha per year.	(Pandit et al., 2024; Molla et al., 2010; Mashafi et al., 2024; Minale & Rao, 2011)
Grazing land to cultivated land	Due to increased population, transitions from grazing land to cultivated land has been observed to feed the ever-increasing population		(Muhangane et al., 2024; Twongyirwe et al., 2011)
Shrubland to cultivated land	Declining due to agricultural conversion, grazing, and settlements. Decline rates vary regionally, but consistent reduction observed		(Mathewos et al., 2019; Molla et al., 2010)
Wetland/marshland to cultivated land	Wetlands and other areas of ecological significant are observed reducing to due to conversions to farm lands and cultivated areas.		(Ketema et al., 2020; Mwamlavya et al., 2021)

These declines were reported predominantly in agro-pastoral and semi-arid landscapes. Conversely, a smaller proportion of studies documented localized increases in grassland cover, particularly in areas undergoing land abandonment, ecological succession, restoration interventions, or seasonal hydrological fluctuations.

Expansion of settlements and built-up areas

Settlement and built-up area expansion were a consistent land-use transitions reported across the EHoA. The reviewed studies documented substantial increases in urban and peri-urban built-up areas during the study periods, accompanied by the conversion of agricultural land, forests, wetlands, grasslands, and other natural land-cover types. These patterns were reported across multiple countries, although the magnitude of change varied among study locations (Table 2). Specific examples were documented in Ethiopia, Rwanda, Uganda, and Tanzania in Table 2, where peri-urban expansion increased competition for productive land and contributed to ecosystem service decline (Mulaw et al., 2023; Nshimiyimana et al., 2023).

Woodlands cover reductions

Woodland decline was frequently identified as highly vulnerable ecosystems undergoing progressive degradation. The main transition pathways involved conversion of woodlands into cropland, settlements, bushlands, grasslands, and degraded land. Agricultural expansion and biomass extraction were the dominant causes of woodland reduction. Unlike abrupt forest conversion, woodland degradation often occurred gradually through repeated harvesting, charcoal production, and grazing pressure. Several studies noted that woodland regeneration was slow and spatially constrained, with recovery frequently interrupted by renewed human pressure (Bernard et al., 2011; Mbaziira, 2019).

Bushlands/shrublands transitions

Finally, Bushland and shrubland changes were documented in the reviewed studies highlighting their role as transitional ecosystems within changing landscapes. These ecosystems were reported commonly converted

into agricultural land, grazing areas, settlements, and degraded landscapes. Agricultural encroachment was reported as the dominant transition pathway in followed by biomass extraction and grazing pressure.

The transitions (Figure 3) demonstrate a clear movement from natural ecosystems toward human-dominated land uses, particularly cultivated land and settlements. Forest land accounted for the largest source of transitions (20 transitions), followed by grassland/bushland (11 transitions), woodland (5 transitions), while grazing land, shrubland, and wetlands each contributed 2 transitions). Cultivated land emerged as the principal recipient land-use category, accounting for 18 transitions), followed closely by settlements and built-up areas with 19 transitions). Comparatively fewer transitions resulted in farmlands (3 transitions) and bare land (2 transition).

Forest land represented the most dynamic land-cover class, with the majority of transitions occurring towards settlements and built-up areas, followed by conversion to cultivated land, and a smaller proportion transitioning to farmland. Grassland and bushland also exhibited substantial transformation, contributing primarily to cultivated land, while additional transitions were observed towards settlements and bare land. Woodland was mainly converted into settlements, with a smaller proportion transitioning to farmland. Grazing lands, shrublands, and wetlands showed fewer but consistent transitions, almost exclusively converting into cultivated land, highlighting the increasing pressure on these ecosystems for agricultural expansion.

Drivers of the land use and land cover dynamics

The reviewed studies demonstrate that land-use and land-cover (LULC) changes across East and the Horn of Africa (EHoA) are driven by a complex interaction of socio-economic, environmental, demographic, and institutional factors rather than by single isolated processes (Figure 4). Across the 56 studies synthesized in this review, the observed transitions among forests, woodlands, grasslands, shrublands, wetlands, agricultural lands, and built-up areas were consistently explained along with interacting pressures including agricultural expansion, population growth, urbanization, climate variability, resource demand, and changes in land governance. Although the relative importance of individual drivers varied across countries, ecosystems, and agroecological zones. The reviewed evidence indicates that these factors operate simultaneously and reinforce one another, shaping diverse LULC trajectories across the region. The subsection below presents the major categorical underlying and proximate drivers (Figure 4) and their associated LULC transition pathways identified across the reviewed studies.

Underlying drivers

Demographic factors

Demographic factors were the most frequently reported drivers of land-use and land-cover (LULC) dynamics across the reviewed studies. Population growth emerged as the dominant demographic driver, with most studies identifying it as a major factor associated with LULC change. Urbanization and

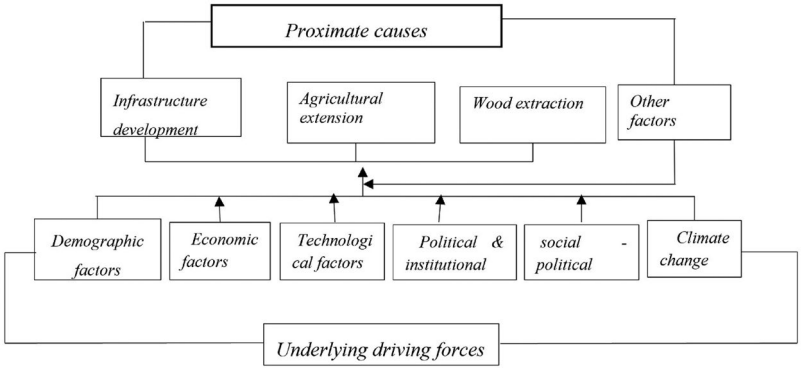


Figure 4. Categorical drivers of land use change (proximate and underlying factors). Adopted from Geist and Lambin (2002) and modified by the researcher.

settlement expansion were the second most frequently reported demographic drivers, with studies documenting the expansion of rural settlements and the outward growth of existing towns and urban centers. Migration and population displacement were also commonly reported, particularly in relation to the establishment of new settlements and changing land-use patterns in receiving areas. In addition, several studies identified household growth and land fragmentation resulting from the subdivision of family landholdings as important demographic drivers of LULC change. A smaller number of studies also reported population redistribution, including refugee settlements and internally displaced populations, as localized drivers of land-use change.

Technological factors

Technological advancement constituted another important category of drivers influencing land-use and land-cover (LULC) dynamics across the reviewed studies, although it was reported less frequently than demographic and economic factors. Agricultural mechanization and the expansion of irrigation infrastructure were the most commonly reported technological drivers. Some studies documented that the increased use of tractors, power tillers, irrigation systems, and other farm machinery coincided with the expansion of cultivation into previously uncultivated forests, woodlands, and rangelands. The review also identified the adoption of improved agricultural technologies, including high-yielding crop varieties, inorganic fertilizers, and modern farming equipment, as important technological drivers of LULC change. In addition, a smaller number of studies reported infrastructure development, particularly road construction and expansion of transportation networks, as contributing to observed land-use changes.

Political and institutional factors

Political and institutional factors constituted another important category of drivers influencing land-use and land-cover (LULC) dynamics across the reviewed studies. Land tenure policies and land reform were the most frequently reported political drivers. Several studies documented that changes in land ownership, tenure security, and land allocation policies were associated with shifts in land-use practices, including agricultural expansion, commercial farming, and settlement development, particularly in Kenya. In contrast, insecure land tenure was frequently reported alongside unsustainable land management practices. Government policies promoting agricultural modernization, commercial agriculture, food security, and rural development were also commonly identified as drivers of LULC change. Some studies reported political instability, armed conflict, and civil insecurity as localized drivers of land-use change. Similarly, the establishment and expansion of protected areas, forest reserves, and wildlife conservation areas were associated with reduced agricultural encroachment and the maintenance or recovery of natural vegetation. Several studies also highlighted governance effectiveness and the enforcement of environmental regulations, noting that weak institutional capacity and limited regulatory enforcement were associated with continued deforestation, wetland encroachment, and unsustainable natural resource use. Cross-border policies and regional development initiatives were the least frequently reported political drivers across the reviewed studies.

Cultural and social drivers of land-use and land-cover dynamics

Socio-cultural factors were also reported as important drivers of land-use and land-cover (LULC) dynamics across the reviewed studies. Traditional land-use practices, including customary farming systems, pastoral mobility, and communal grazing arrangements, were the most frequently reported socio-cultural drivers influencing land-use transitions. Several studies identified changing lifestyles and consumption patterns, environmental education and awareness, and community participation in natural resource management as factors associated with LULC change. Participatory land-use planning and collective resource management initiatives were reported to support more sustainable land-use practices in some study areas.

Environmental factors

Biophysical factors were consistently reported as important drivers of land-use and land-cover (LULC) dynamics across the reviewed studies. Climatic variables, particularly rainfall variability, temperature, and evapotranspiration, were the most frequently reported biophysical drivers (Defersha & Melesse, 2012; Mainuri & Owino, 2014). Soil characteristics, topography, and landscape accessibility were also commonly identified, alongside environmental constraints such as land degradation, soil erosion, declining soil fertility, and nutrient depletion. Several studies further reported that pests and diseases, as well as proximity to roads, markets, rivers, and urban centers, influenced observed land-use patterns (Crk et al., 2009; Kaimowitz & Angelsen, 1998; Olson et al., 2004; Wyman & Stein, 2010). In addition, flooding and other extreme weather events were reported to contribute to localized LULC changes through alterations in cropland, settlements, and wetland ecosystems.

Proximate drivers of land-use and land-cover dynamics

Proximate drivers represent the immediate human activities directly responsible for LULC changes (Table 3). The reviewed studies consistently identified several proximate drivers that directly influenced land-use and land-cover (LULC) change across East and the Horn of Africa. Agricultural expansion was the most reported proximate driver with expansion of both subsistence and commercial agriculture leading to the conversion of forests, woodlands, grasslands, wetlands, and shrublands into cropland. Agricultural encroachment was particularly pronounced in densely populated highlands and areas with high agricultural potential. Similarly, deforestation and vegetation clearance for cultivation, timber harvesting, fuelwood collection, and charcoal production directly reduced forest cover and fragmented natural habitats. In many landscapes, deforestation preceded agricultural expansion, representing the initial stage of land-use conversion. Further, settlement and urban expansion was another reported significant proximate driver attributed to rapid growth of urban centers, peri-urban settlements, and rural villages

Infrastructure development, including road construction, dams, irrigation schemes, industrial parks, and energy projects, were other factors identified directly to alter land cover. Finally, wetland drainage for agriculture, uncontrolled burning, over grazing, mining and expansion of tourism facilities, were each pronounced consistent proximate drivers contributing to localized land-cover transformations across the EHoA.

Impacts of land-use and land-cover changes in East and the Horn of Africa

The reviewed studies consistently demonstrated that land-use and land-cover (LULC) changes have generated substantial environmental and socio-economic impacts across East and the Horn of Africa (EHoA). The review reported one or more ecological or socio-economic consequences associated with LULC change. The impacts are summarized below:

Declining ecosystem capacity as a result of population growth and increasing demand for food were mostly reported. The impact was consistently explained through the expansion of cultivated land into forests, woodlands, shrublands, grasslands, and wetlands. Land Degradation and declining soil productivity was another widespread environmental consequence of LULC change. The results reveal that land degradation primarily contributed to increased soil erosion, soil compaction, nutrient depletion, and expansion of bare land across diverse landscapes. Furthermore, biodiversity loss was consistently identified as a major ecological consequence of LULC change, with agricultural expansion and infrastructure development the most contributors throughout the region. This affects the regulatory, provisioning, and supporting ecosystem services, including water regulation, carbon storage, pollination and climate regulation. Other studies reported increasing conflicts as a result of competition for agricultural land, grazing areas, forests, and water resources among farmers and other resource users. Declining livelihood resilience resulting from reduced agricultural productivity, diminishing availability of natural resources, and increasing dependence on degraded ecosystems was also reported.

Table 3. Categorical drivers of LULC change in East and the Horn of Africa (EHoA) based on underlying and proximate factors.

Category	Sub-category/driver	Key mechanisms/description in EHoA	Examples/evidence (region-specific)
Demographic factors (Underlying)	Population growth House hold growth	Increases demand for food, fuel, housing, and land; leads to land fragmentation and expansion of cultivation and settlements	Expansion of cultivated land and built-up areas at the expense of forests, grasslands, wetlands (Byenkya et al., 2014; Ketema et al., 2020; Minale & Rao, 2011; Zenebe & Addisu, 1970)
	Urbanization Migration and displacement	Expansion of towns and peri-urban areas; encroachment into natural ecosystems; unplanned settlements Internally displaced people in in refugee camps- degrade land etc	Rapid growth of built-up areas in peri-urban zones; conversion of forests and agricultural land (Bernard et al., 2011; Nshimiyimana et al., 2023; Soita et al., 2024).
Economic factors	Market demand & commodity prices	Drives agricultural expansion and intensification, especially cash crops	Conversion of forests and rangelands into cropland (Maitima et al., 2010; Olson et al., 2004; Reid et al., 2014)
	Poverty & livelihood constraints	Limited income and employment push reliance on natural resources and land expansion	Dependence on forests and marginal lands for subsistence (Olson et al., 2004; Reid et al., 2014)
	Commercialization & market access	Encourages expansion of cultivated areas linked to infrastructure and trade	Agricultural expansion linked to improved access to markets (Maitima et al., 2010; Mundia & Aniya, 2006)
	Macroeconomic constraints	Debt, fiscal limitations reduce environmental management capacity	Indirect contribution to resource degradation (Olson et al., 2004)
Technological factors	Low agricultural inputs Agricultural mechanization Adoption of inputs	Adoption of fertilizer/pesticide use - low productivity leads to land expansion Expansion of irrigations	Expansion of cultivated land due to low yields (Kaimowitz & Angelsen, 1998; Olson et al., 2004)
	Improved technologies	Irrigation, improved seeds increase yields and may reduce pressure on land	Productivity gains where technologies are adopted
	Biomass energy technologies	Traditional wood-based energy extraction increases pressure on forests	Fuelwood and charcoal dependence driving woodland degradation (Amsalu et al., 2007; Maitima et al., 2010)
Political & institutional factors	Land policies & settlement schemes	Government-led land allocation and resettlement promote land conversion	Expansion of cultivation in Ethiopia and Uganda (Holden & Tilahun, 2018; Mulugeta, 2013)
	Governance & property rights	Weak tenure security discourages sustainable management and promotes degradation	Land governance challenges linked to deforestation (Deininger et al., 2008; Holden & Otsuka, 2014)
	Land tenure reforms and ownership	Privatization/formalization alters land access and use patterns	Fragmentation of rangelands and land conversion (Galvin, 2009; Mwangi, 2007)
	Institutional capacity	Weak enforcement and corruption limit land-use planning effectiveness	Ineffective regulation of land conversion
Land tenure dynamics (Institutional sub-driver)	Tenure reform (titling, privatization)	Encourages investment but also accelerates conversion of communal/ecological lands	Mixed outcomes: intensification vs land conversion (Abate & Kibret, 2016; Amsalu & Kefale, 2023; Shiferaw & Singh, 2015).
	Communal-private tenure shift	Reduces communal grazing, increases fragmentation	Increased pressure on rangelands (Maina & Waiganjo, 2024; Njoroge et al., 2011)
	Land allocation policies	Promote commercial agriculture but may trigger land conflicts and ecosystem conversion	Conversion of wetlands and forests (Egeru et al., 2011; Kibugu et al., 2022).
Cultural & socio-political factors	Societal values & beliefs	Influence land use preferences and attitudes toward environment	Land as cultural/identity asset (Broegaard et al., 2017).
	Environmental awareness; Community participatory resource management	Low awareness leads to resource pressure; high awareness may influence conservation behavior	Community-based conservation outcomes (Mango et al., 2017)
	Social relations & power dynamics Traditional land use practices	Elite capture, rent-seeking influence land allocation and use; changing life styles Local practices may alter ecosystems and degrade land	Impacts on land access and conservation (Western et al., 2015)

(*Continued*)

Table 3. Continued.

Category	Sub-category/driver	Key mechanisms/description in EHoA	Examples/evidence (region-specific)
Environmental factors (biophysical)	Climate variability	Rainfall, drought influence vegetation productivity and land suitability Proliferation of new pests and diseases Lead to land degradation and soil erosion and flooding in some cases	Dry areas more prone to conversion (Kaimowitz & Angelsen, 1998)
	Accessibility (roads, rivers)	Improved access reduces transport costs and promotes land conversion	Road proximity linked to agricultural expansion (Mundia & Aniya, 2006)
	Rainfall variability & drought	Drives mobility, grazing pressure, and land degradation	Pastoral movement into productive zones (Minale & Rao, 2011; Serneels et al., 2007)
Proximate drivers (Direct causes)	Agricultural expansion	Conversion of forests, rangelands, wetlands into cropland	Rainfed agriculture expansion (Maitima et al., 2010; Olson et al., 2004).
	Fuelwood & charcoal extraction Deforestation	Woodland and forest degradation due to biomass energy demand	Dominant household energy source (Amsalu et al., 2007; Maitima et al., 2010).
	Infrastructure development	Roads and settlements facilitate access and land conversion	Expansion of settlements and market access (Mundia & Aniya, 2006).
	Settlement and urban expansion	Urban growth and resettlement programs convert natural land	Encroachment into forests and rangelands (Nzunda et al., 2013; Soita et al., 2024)
	Resource extraction Wetland drainage	Mining and intensive exploitation of land resources	Land degradation and landscape alteration (Bizimana et al., 2022; Zenebe & Addisu, 1970).

Interconnected relationships between LULC in the EHoA

The reviewed studies reveal strong interrelationships among land-use and land-cover (LULC) categories across EHoA, with transitions largely reflecting interactions between demographic pressures, agricultural expansion, settlement growth, policy changes, and environmental variability. The dominant conversion pathways identified include: i) the transformation of natural ecosystems, such as forests, woodlands, grasslands, and shrublands, into cultivated and built-up areas (Figure 3), as well as localized vegetation recovery in areas experiencing reduced land-use pressure. For example, forestlands and woodlands emerged as among the most vulnerable land-cover types, with widespread conversion into cultivated areas and settlements across EHoA. This was followed by the conversion of bushlands, shrublands, and grasslands into cultivated land with specific examples cited in Uganda's Nakasongola district and Ethiopia's Tara Gedam and Sdeyni watersheds, (Byenkya et al., 2014; Fekadu et al., 2025; Molla et al., 2012) as well as conversion of wetlands and water sheds into agricultural lands and settlements frequently reported in Uganda and Tanzania (Groeneveld et al., 2021; Lazaro et al., 2023; Mbaziira, 2019).

Rapid expansion of settlements and built-up areas were often reported occurring through conversion of agricultural land and natural vegetation with specific example cited in Ethiopia's Esira district, Uganda's Awoja water shed and Rwanda (Akello et al., 2018; Bizimana et al., 2022; Mamude et al., 2021). Although most transitions reflected losses of natural vegetation, a smaller section of studies localized vegetation recovery and ecological restoration. These gains were associated with reforestation programmes, establishment of protected areas, community-based natural resource management, and reduced anthropogenic pressure in selected landscapes.

Discussion

Characteristics of the reviewed studies

The findings of this review demonstrate a substantial increase in research on land-use and land-cover (LULC) dynamics across East and the Horn of Africa over the past four decades, reflecting growing scientific and policy interest in understanding landscape change and its implications for sustainable land

management. Similar trends have been reported globally, driven largely by advances in remote sensing technologies and increasing concerns over environmental change, biodiversity loss, and climate change (Lambin et al., 2003; Pettorelli et al., 2014; Winkler et al., 2021). The predominance of studies from Ethiopia, Kenya, Tanzania, and Uganda likely reflects relatively stronger research capacity, wider availability of long-term satellite imagery, and greater investment in environmental and agricultural research.

Conversely, the limited number of studies from Somalia, Eritrea, Djibouti, Burundi, and South Sudan highlights important geographical knowledge gaps that may constrain a comprehensive regional understanding of LULC dynamics and the development of evidence-based land management strategies. These findings are consistent with previous studies that have reported unequal geographical distribution of environmental research across developing regions due to differences in research infrastructure, data availability, and socio-political conditions (Lambin et al., 2003; Pettorelli et al., 2014). Similar conclusions have been reported by Song et al. (2018), who showed that advances in Earth observation technologies have substantially improved the consistency and accuracy of global land-cover change assessments. However, the methodological diversity observed among the reviewed studies also highlights the need for greater harmonization of classification schemes, reporting standards, and change-detection approaches to improve comparability across studies.

Regional trends in land-use and land-cover change

The findings of this review indicate that East and the Horn of Africa has experienced substantial land-use and land-cover (LULC) transformation over the past four decades, characterized by widespread declines in forests, woodlands, wetlands, grasslands, and shrublands, alongside continuous expansion of cropland and settlements (Table 2). Agricultural expansion emerged as the dominant land-use transition, occurring primarily through the conversion of natural ecosystems into cultivated land. This pattern is consistent with global evidence demonstrating that agricultural expansion remains the principal cause of landscape transformation and tropical deforestation, largely driven by increasing food demand associated with population growth (Curtis et al., 2018; Foley et al., 2005; Pendrill et al., 2022).

The extensive loss of forests and other natural vegetation observed across the region is comparable to trends reported elsewhere in tropical Africa, where expanding agriculture, settlement growth, and infrastructure development continue to accelerate ecosystem conversion (Geist & Lambin, 2002; Lambin et al., 2003). Similarly, the observed increase in settlement and built-up areas reflects the rapid urbanization occurring across sub-Saharan Africa, with much of this expansion taking place at the expense of agricultural land and natural ecosystems (Seto et al., 2012).

Although several studies documented localized vegetation recovery following afforestation, watershed restoration, and protected area management, these gains were limited relative to the widespread loss of natural ecosystems. The transition pathways identified in this review further indicate that forests, woodlands, shrublands, grasslands, and wetlands predominantly served as donor land-cover classes, whereas cropland and settlements functioned as the principal recipient land uses. Collectively, these findings suggest that current LULC trajectories continue to alter ecosystem structure and function, with important implications for biodiversity conservation, ecosystem services, and the long-term sustainability of land resources in the region (Lambin et al., 2001; Newbold et al., 2015).

Interconnected drivers of land-use and land-cover change

This review demonstrates that land-use and land-cover (LULC) change across East and the Horn of Africa is driven by complex interactions among multiple underlying and proximate factors rather than a single cause. Consistent with the framework proposed by Geist and Lambin (2002) (Figure 4), demographic, economic, technological, institutional, socio-cultural, and biophysical factors shape land-use decisions, while agricultural expansion, settlement development, deforestation, and natural resource extraction constitute the immediate drivers of landscape transformation. Similar observations have been reported globally, where LULC change results from the interaction of social, economic, institutional, and environmental processes rather than isolated factors (Geist & Lambin, 2002; Lambin et al., 2003).

Among the underlying drivers, population growth emerged as the most influential factor across the reviewed studies. Increasing demand for food, housing, and natural resources has accelerated agricultural expansion and the conversion of forests, woodlands, wetlands, and grasslands into cultivated land. This finding corroborates previous studies identifying demographic pressure as a major driver of agricultural expansion and ecosystem conversion in tropical regions (Foley et al., 2005; Lambin et al., 2003). Likewise, growing market integration, agricultural commercialization, and infrastructure development have intensified the transformation of natural ecosystems into productive land uses, reflecting broader patterns reported in developing regions (Meyfroidt, 2018).

The review further indicates that technological and institutional factors exert both positive and negative influences on LULC dynamics. While improved agricultural technologies and irrigation can enhance productivity and potentially reduce pressure on natural ecosystems, increased mechanization and improved transport infrastructure may also facilitate the expansion of cultivation into previously undisturbed landscapes (Lambin & Meyfroidt, 2011). Similarly, weak land-use planning, insecure land tenure, and limited enforcement of environmental regulations were frequently associated with unsustainable land-use practices, emphasizing the importance of effective governance in promoting sustainable landscape management.

Environmental variability was an important driver interacting with socio-economic factors. Recurrent droughts, rainfall variability, declining soil fertility, and land degradation were frequently associated with shifts in agricultural practices, expansion of cultivation, and changes in grazing patterns across semi-arid landscapes. These findings are consistent with previous studies showing that climatic variability often amplifies existing socio-economic pressures and influences land-use decisions, rather than acting as an isolated driver of LULC change (Lambin & Meyfroidt, 2011; Verburg et al., 2013). Collectively, these findings highlight that addressing LULC change in East and the Horn of Africa requires integrated approaches that simultaneously consider demographic, economic, technological, institutional, and environmental drivers.

Impacts of land-use and land-cover changes in East and the Horn of Africa

The findings of this review demonstrate that land-use and land-cover (LULC) change has generated substantial ecological and socio-economic impacts across East and the Horn of Africa. The widespread conversion of forests, woodlands, grasslands, and wetlands into cropland and settlements has contributed to declining ecosystem integrity, biodiversity loss, habitat fragmentation, and increased pressure on ecosystem services. Similar impacts were consistently reported across the reviewed studies, where agricultural expansion and settlement development were associated with deforestation, wetland encroachment, rangeland degradation, and reduced ecosystem resilience (e.g. Akello et al., 2018; Byenkya et al., 2014; Mbaziira, 2019; Mnyali & Materu, 2021). These findings are consistent with previous studies identifying LULC change as a major driver of biodiversity decline and ecosystem degradation worldwide (Foley et al., 2005; Newbold et al., 2015).

Land degradation was another reported impact, manifested through soil erosion, nutrient depletion, declining soil fertility, and reduced agricultural productivity. Similar relationships have been widely documented in the literature, demonstrating that unsustainable land-use practices diminish ecosystem functions and reduce the capacity of landscapes to provide essential ecosystem services, including carbon storage, water regulation, and soil conservation (Bryan et al., 2018; Lal, 2001).

Furthermore, the reviewed studies indicate that habitat loss and landscape fragmentation have increased pressure on biodiversity and natural resources, with several studies reporting heightened competition over land, forests, grazing areas, and water resources. Collectively, these findings highlight the interconnected nature of ecological degradation and livelihood vulnerability, emphasizing the importance of integrated land-use planning and sustainable natural resource management to balance agricultural production with long-term ecosystem conservation.

Relationships of LULC in the East and the Horn of Africa

The findings of this review demonstrate that land-use and land-cover (LULC) change in East and the Horn of Africa occurs through interconnected transition pathways rather than isolated conversions

between individual land-cover classes. Forests, woodlands, grasslands, shrublands, wetlands, and grazing lands predominantly function as donor ecosystems, whereas cropland and settlements constitute the principal recipient land uses. This pattern supports the land system framework of Lambin et al. (2001), which recognizes landscape change as the outcome of interacting socio-economic and environmental processes.

The predominance of forest-to-cropland and forest-to-settlement transitions observed across the region is consistent with evidence from tropical regions, where agricultural expansion and urbanization remain the primary pathways of land conversion (Curtis et al., 2018; Foley et al., 2005; Geist & Lambin, 2002). Likewise, the conversion of woodlands, grasslands, shrublands, and wetlands into cultivated land reflects increasing pressure on natural ecosystems to support food production and rural livelihoods.

The review further indicates that LULC change frequently occurs as a sequential process rather than a single conversion event. In several landscapes, natural vegetation progressively transitions through intermediate land-cover types before eventual conversion to cropland or settlements. Similar transition pathways have been reported by Lambin et al. (2003), who argued that landscape transformation results from cumulative interactions among demographic, economic, institutional, and environmental drivers.

Empirical evidence from Uganda and Ethiopia further suggests that once natural ecosystems are converted, recovery is often limited despite localized restoration efforts (Byenkya et al., 2014; Fekadu et al., 2025; Molla et al., 2012). These findings emphasize that LULC transitions should be understood and managed as interconnected landscape processes rather than independent changes in individual land-cover classes. Consequently, integrated landscape approaches that simultaneously consider agricultural production, biodiversity conservation, ecosystem restoration, and sustainable livelihoods are likely to provide more effective and resilient land management strategies (Freeman et al., 2015; Reed et al., 2016; Sayer et al., 2013).

Conclusions

This systematic review synthesized over four decades of evidence on land-use and land-cover (LULC) dynamics across East and the Horn of Africa, highlighting widespread and interconnected landscape transformations driven by demographic, economic, technological, institutional, socio-cultural, and environmental factors. The review revealed a consistent regional trend of declining forests, woodlands, wetlands, grasslands, and shrublands alongside the expansion of cropland and settlements, with agricultural expansion emerging as the dominant land-use transition. This trend demonstrate that LULC change is not an isolated phenomenon but a cumulative process shaped by interactions among multiple underlying and proximate drivers.

The review further established that land-use transitions have resulted in significant ecological and socio-economic consequences, including land degradation, biodiversity loss, declining ecosystem services, reduced land productivity, and increased vulnerability of livelihoods to environmental change. The observed transition pathways indicate that natural ecosystems primarily function as donor land-cover classes, while cultivated land and built-up areas remain the principal recipients of land conversion. This interconnected nature of landscape transformation across the region and the need to consider relationships among different land-use categories when developing land management strategies.

Accordingly, the evidence suggests that achieving sustainable land management in East and the Horn of Africa will require integrated approaches that balance agricultural production, urban development, and ecosystem conservation. Strengthening land-use planning, promoting sustainable agricultural intensification, improving land governance, restoring degraded ecosystems, and enhancing climate-resilient landscape management are critical for reducing further degradation while supporting food security and sustainable livelihoods.

Knowledge gap

Despite the substantial body of literature reviewed, important knowledge gaps remain. Research from Somalia, Eritrea, Djibouti, Burundi, and South Sudan remains limited, and relatively few studies have

quantified the interactions between socio-economic drivers and biophysical processes using integrated modelling approaches. Future research should therefore prioritize underrepresented countries, adopt harmonized LULC classification and reporting frameworks, and strengthen the integration of remote sensing with socio-economic and policy analyses to improve regional understanding of land system dynamics and support evidence-based decision-making.

Policy recommendations

The findings of this review underscore the need for integrated and evidence-based policies to address the accelerating land-use and land-cover (LULC) changes across East and the Horn of Africa. Given that agricultural expansion and settlement development remain the dominant pathways of land transformation, future policies should promote sustainable agricultural intensification to increase productivity on existing farmland while reducing pressure on forests, wetlands, woodlands, and other natural ecosystems.

Governments should strengthen integrated land-use planning and governance by enforcing land-use zoning, improving land tenure security, and harmonizing agricultural, environmental, and urban development policies. Such measures would minimize unplanned land conversion, reduce encroachment into protected ecosystems, and improve coordination among sectors responsible for land management.

National and regional programmes should prioritize restoration of degraded forests, woodlands, wetlands, and grazing lands through community-based natural resource management, afforestation, assisted natural regeneration, and watershed rehabilitation. These interventions will contribute to biodiversity conservation, improved ecosystem services, climate change mitigation, and enhanced resilience of rural livelihoods.

Considering the growing influence of climate variability on land-use decisions, policies should integrate climate adaptation and disaster risk reduction into land management strategies. Expanding climate information services, drought-resilient agricultural technologies, and sustainable rangeland management will help reduce vulnerability while supporting long-term landscape resilience.

Finally, regional governments should strengthen LULC monitoring systems by investing in geospatial technologies, long-term environmental monitoring, and open-access land information systems. Enhanced collaboration among research institutions, governments, and regional organizations will improve evidence-based decision-making and support coordinated management of transboundary ecosystems across East and the Horn of Africa.

Research limitations

Although this review provides a comprehensive synthesis of LULC dynamics across East and the Horn of Africa, several limitations should be acknowledged. First, the geographical distribution of the reviewed studies was uneven, with most evidence originating from Ethiopia, Kenya, Tanzania, and Uganda, while relatively few studies were available from Somalia, Eritrea, Djibouti, Burundi, and South Sudan. Consequently, the regional patterns presented may not fully capture LULC dynamics in underrepresented countries.

Second, substantial methodological variation existed among the reviewed studies, including differences in satellite imagery, land-cover classification schemes, and analytical approaches. These differences limited direct quantitative comparisons of land-cover change magnitudes and prevented the conduct of a formal meta-analysis.

Third, most studies relied primarily on remote sensing and GIS techniques, with relatively limited integration of socio-economic, institutional, and policy data. As a result, while the review identifies major drivers of LULC change, the complex interactions among demographic, governance, and economic factors were not fully represented. Finally, because this review synthesized findings reported in published literature, it is subject to potential publication bias and may underrepresent unpublished reports, government documents, and grey literature that could provide additional insights into local land-use dynamics.

Future research focus

Future research should prioritize underrepresented countries, adopt standardized LULC classification and reporting frameworks, integrate remote sensing with socio-economic and institutional analyses, and utilize advanced modelling approaches to improve understanding of future land-use trajectories and support sustainable landscape management across the region.

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Author contributions

CRediT: **Basaliza Edigar**: Conceptualization, Formal analysis, Methodology, Writing – original draft; **Musinguzi Simon Peter**: Supervision; **Nagasha Irene Judith**: Supervision.

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Data availability statement

This study did not involve the use of primary data. All data used in this research were derived from previously published studies identified through a systematic literature search. The sources supporting the findings of this study are fully cited within the article and referenced accordingly

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