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Landscape Transformations in Rapidly Developing Peri-urban Areas of Accra, Ghana: Results of 30 years

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Abstract: Beyond the loss of peri-urban agricultural and forested land as a result of built-up expansion, not much information exists on the changes in the structure of the peri-urban landscape in Ghana. The aim of this paper is to examine the extent to which urban expansion is driving changes in landscape structure of the peri-urban fringes of Accra. We submit that rapid peri-urbanisation will fragment the existing agricultural and forested landscape with consequent ecological, socio-economic and urban governance implications. Using Landsat satellite images for the years 1985, 1991, 2002 and 2015 the study area was classified into four land cover classes. The study adopted the use of Urban Intensity Index (UII) and the Annual Rate of Urbanization (R) as measures of urbanization. Edge density (ED), largest patch index (LPI) and Aggregation index (AI) were used as proxies to measure landscape structural transformations. The study reveals substantial reductions and fragmentation in agricultural lands, riverine and open forests, while there has been over 200 percent increase in built-up areas. Beyond these revelations in spatiotemporal changes in landscape structure, the paper points to the ecological implications of the changes, and three key socio-economic and urban governance implications.

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1 Introduction

1.1 Peri-Urbanisation and Land Cover Changes

Over the last two decades, rapid urban explosion, expansion of megacities and secondary metropolitan areas have been discussed, in the literature, as a metonym of cities in the developing world [1, 2]. The growth in the city implies the land interface between the city and rural areas which comprises valuable forested patches, woodlands, major agricultural lands and important wetlands [3, 4], is put under immense pressure [5, 6]. These peri-urban zones are transient and emergent rather than planned creating challenging situations for policymakers [7, 8].

The phenomenon of peri-urbanisation is complex and it is characterised by structural changes in the composition and diversity of the peri-urban landscape, significantly rendering it fragile [9–11]. The growth of urban areas into peripheries is recognised as the cause of loss of agricultural lands and the fragmentation of forests, wetlands and other natural habitats [12]. For sustainable management of peri-urban landscape, and for the purposes of conservation, understanding of landscape dynamics is imperative [13].

Within African cities, the spatial manifestations of urbanisation are observed in three main ways. Firstly, there is the emergence and concentration of informal socio-economic and land use activities in the inner parts of the city without approval from city planning authorities [14]. Secondly, informal and unapproved settlements grow at “dangerous and ecologically sensitive areas such as floodplains, riverbanks, steep slopes, along railroad tracks, or near waste dumb” [15]. The third spatial manifestation of urbanisation occurs at the fringes of cities [16] and appears to be the most prevalent and difficult to manage and/or control [17] and hence the central theme of this paper.

The main impacts of rapid urban expansion and peri-urbanisation discussed in the existing literature include: land cover and use changes [16, 18]; uncertainties in peri-urban land markets and tenure arrangements [19]; changing land values [20]; creation of rural-urban interfaces [21]; peri-urban morphology and typology [10, 22] and rural spatial planning [23], just to mention a few. While peri-urbanisation is present in almost all African cities, Simon et al. [21], explain that the process varies from city to city and has been differentiated by demographic patterns; land tenure and management; physical terrain and environmental barriers; and morphology of the city involved.

In Ghana, rapid urban expansion, sprawl, and peri-urbanisation are key features of major cities such as Accra, Tema, Kumasi, and Tamale [5, 24]. Ubink [25] suggests that most cities in Ghana are experiencing rapid sprawl with rising demand for residential, commercial and other urban land uses. In response to these demands, communal agricultural lands are gradually being lost to high-value urban uses, mainly residential, to the detriment of local agricultural livelihoods in rural-urban fringe communities [16].

Beyond the loss of active agricultural lands and associated land use changes, not much is known about the changes in the structure of the peri-urban landscape. Quantifying the spatial and temporal characteristics of a peri-urban landscape is an important step in understanding the ecological implications and key socio-economic and urban governance implications of rapid urbanisation in the peri-urban zones. Within the background of urban sprawl, land use dynamics and their related structural changes, it is important to collate reliable information that will inform appropriate policies for the sustainable development of peri-urban zones and to safeguard its ecological integrity [26].

The aim of this paper is to examine the extent to which urban expansion is driving changes in landscape structure of the peri-urban fringes of Accra. In doing so, we submit that rapid peri-urbanisation will alter existing agricultural and forested landscapes into metropolitan and urbanised land uses with socio-economic and ecological consequences. We discuss; (1) some key socio-economic and urban governance implications; (2) the ecological implications, towards the building of sustainable peri-urban fringes in Ghana; and (3) The way forward towards a more sustainable peri-urban landscape development.

2 Methodology

2.1 Study Area

In line with the aim of the study, the Ga West Municipal Assembly was selected. The Ga West Municipal Assembly is one of the fast-growing peri-urban regions of Accra, the capital of Ghana. It is located on the north-western part of the Accra Metropolitan Area (Figure 1). It lies within latitude 5°29' to 5°35' North and longitude 0°10' to 0°24' West. The population of the Municipality according to 2010 population and housing census stands at 219,788, with 146,520 (66.7%) migrants (born elsewhere in the Greater Accra Region or other regions in Ghana or outside Ghana) [27]. The major economic activities in the musicipality are Agriculture, industry and commerce. The Ga West Municipal Area is also located within the Densu River Basin, making it a very important riparian zone.

2.2 Land cover classification and change analysis

Historical and current Landsat satellite images for the years 1985 (date: 1985-04-02), 1991 (date:1991-01-10), and 2015 (date: 2015-12-22)were acquired for the study. The images were selected based on availability and 0% cloud cover. Also, processing techniques e.g. extraction, layer stacking, and geo-referencing were performed on the images. All images were rectified to the same Universal Traverse Mercator (UTM) projection system.

The GPS coordinates for image training and accuracy assessment were collected in the study area using a stratified random sampling technique. In every land cover, data at even distribution was randomly collected. Google Earth was used to complement referenced data during field observation for the classification and accuracy assessments. The maximum likelihood algorithm was chosen to classify all the images [28], [29]. The descriptions of the land cover classes are detailed in table 1. Kappa and overall accuracies were selected to assess the accuracy of the classified images. 100 validation GPS points were used in performing the accuracy assessment over the study area. Accuracy assessment for the historical images was performed using GPS points for areas of 'no change' based on local community knowledge.

Table 2 shows report of the accuracy assessment for the land cover maps generated. The overall classification accuracy for the 2015 image is 88.54 % with a kappa of 0.88. The 2002, 1991 and 1985 land use maps respectively recorded an overall accuracy of 79.28%, 86.70% and 82.58% with kappa 0.729, 0.828 and 0.782.

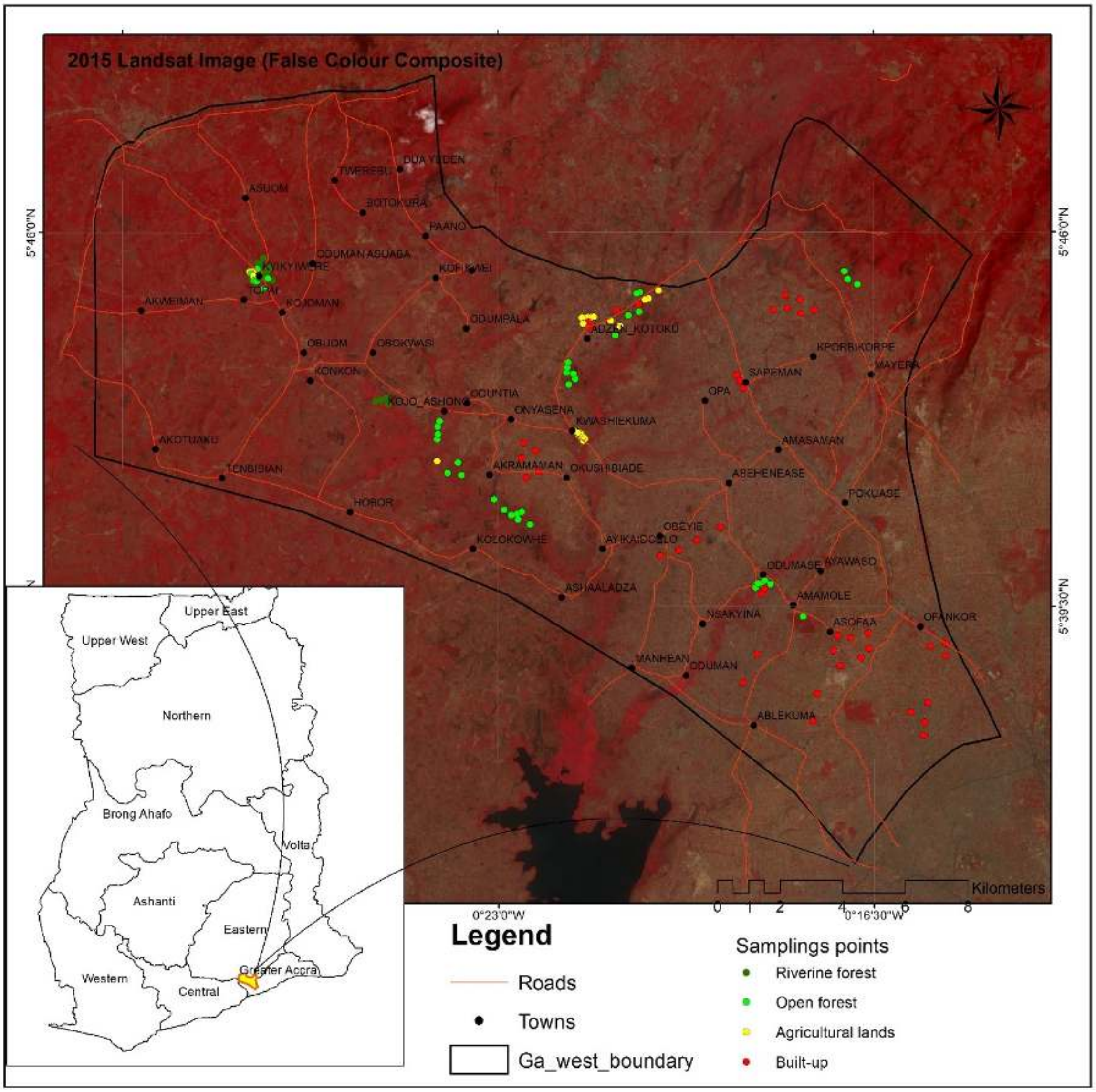

Figure 1: The Ga West Municipal Assembly (study area) showing training sample points overlayed on the 2015 Landsat Image

2.3 Analysis of Urban Expansion

The Urban Intensity Index (UII) and the Annual rate of urbanisation (R) were chosen as proxies to measure the quantum land cover transformations and urban sprawl. These variables were chosen due to their wide usage and acceptance in similar studies carried out in the recent past [30–32]. The UII and R indicate the spatiotemporal dynamics of urban expansion and significantly correlates with commonly used urbanisation indices, i.e. population density and percentage imperviousness. These two indices have been recorded and used to compare spatial differentiation of urban expansion per unit time to detect its evolution [33]. The UII and R for the study area were calculated for the periods: 1985 - 1991, 1991 - 2002, 2002 - 2015 and 1985 -2015; using equations 1 and 2 below:

$$UII = \frac{UL_{T2} - UL_{T1}}{nxTA} \quad (1)$$

The average annual rate of urbanisation is estimated using the equation below:

$$R = \sqrt[n-1]{\frac{UL_{T2}}{UL_{T1}}} - 1 \quad (2)$$

Where, UL is the total urban land in target years T2 and year T1; n is the time period, in years; and TA is the total area of the landscape.

Consequently, regression analysis was employed to extrapolate the number of years of analysis for the quantum extent of urban expansion for the area. This was done

Table 1: Description of land use classes used in the digital classification

Land cover categories	Description
Riverine Forest	Forested areas that are located along, rivers, streams and waterways. These vegetation areas are most semi-deciduous and usually characterised by a dense canopy forest.
Open forest	These are degraded forest areas with crown cover between 15% and 60%. Such areas are mostly constituted by thickets and trees (forest and fruit trees). Their low crown-cover canopy is a sign of degradation due to the impacts of urbanisation
Agricultural Lands	These are annual food crop lands, grasslands and fallow lands, shrub and brush rangelands.
Built-up Area	These are the non-vegetated parts of the landscape including areas with buildings, infrastructure, and bare lands.

Table 2: Accuracy assessment report of the LULC maps for the Ga West Muniscipal Assembly

Land use land cover map	Overall Accuracy (%)	Kappa Statistics
1985	82.58	0.783
1991	86.70	0.828
2002	79.28	0.729
2015	88.54	0.881

for the year 2020, and a three-time decadal interval until 2050.

2.4 Analysis of spatial patterns of urbanisation - computation of Landscape metrics

Due to the plethora of landscape metrics (LMs) in literature, it has become imperative to stick to one of two decisions apriori [34, 35]. The first is to select a minimum set of indicators based on *ex ante* assumptions, and the second is to empirically determine this set of indicators statistically from the abundance of available indices. Sticking to both decisions, 25 landscape metrics were first calculated using Fragstats at the class level based on their applicability to this study [36]. The metrics were calculated using the land cover maps and 8x8 cell rule for patch neighbours [37]. The metrics were further subjected to a Pearson correlation analysis and those with strong correlation ($r > 0.75$) were exempted. This reduced the original number of LMs to 15 metrics that were later subjected to a principal component analysis (PCA) with Varimax and Kaiser Normalization rotations. The PCA revealed the presence of 8 landscape class metrics (keeping PCA factor loadings > 0.8) which indicated a measure of class level/landscape aggregation [36]. Largest patch index (LPI), Edge density (ED) and Aggregation index (AI) were selected from the eight because they were sufficient to quantify the spatiotemporal dynamics in landscape structure in the study area [35]. The selected metrics were also corroborated by other urban studies and found to be sufficient to analyse and extract quantitative information for measuring the dynamic spatial patterns of urban expansion [38, 39].

3 Results

3.1 Spatio-temporal analysis of the urban expansion

From table 3, the period between 1985 and 1991 saw built-up area extending by 13.92 km^2 with an annual expansion rate of 2.32 km^2/year and UII value of 0.91%. In 11years, from 1991 to 2002, built-up areas extended by 72.54 km^2 with an annual expansion rate of 6.59 km^2/year and a UII of 2.58%. Between 2002 and 2015, built-up land increased by 63.43 km^2 with an annual expansion rate of 4.88 km^2/year and a UII value of 1.91%. Although urban expansion in the region has increased consistently, the epoch between 1991 and 2002 was the highest of all urban expansion indices.

Projections of built-up expansion as depicted in figure 2 show built-up increment to 186.6 km^2 by 2020, which will consequently reach 343.5 km^2 by 2050. Hence, urban expansion is expected to constitute about 96% of the land cover in the district by 2050. This translates into an average annual expansion rate of 5.2 km^2, which is greater as compared to the 2002 - 2015 epoch, but still lower as compared to 1991-2002 epoch. On the average, urban expansion from 1985 to 2015 is comparable to the predictions for 2015 to 2050 with approximately 5 km^2/year added annually for 35 years for each respective period.

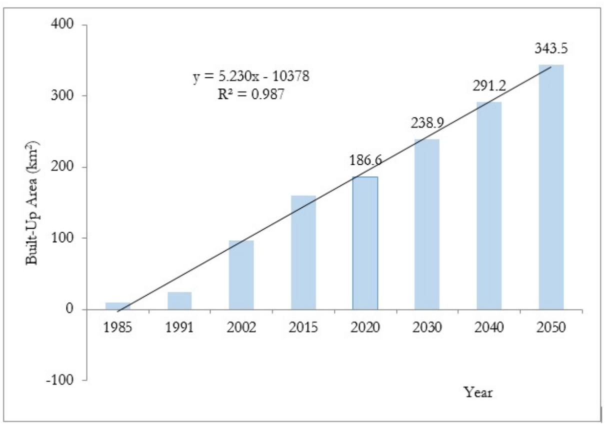

Figure 2: Projected urban expansion for 2020, 2030, 2040 and 2050

3.2 Spatio-temporal transformations in Land use Land cover and Landscape structure

The study revealed noticeable changes in Land use Land cover (LULC) in the Ga West Municipal area over the study period. Depicted in Figure 3 and Table 4, riverine forest, open forest and agricultural lands dominated the 1985 landscape at extents of 97.79 km^2, 174.29 km^2 and 66.3 km^2, respectively. By 2015, these areas had substantially reduced to 39.74 km^2, 88.45 km^2, and 60.29 km^2, respectively for the riverine forest, open forest and agricultural lands. In contrast, built-up areas increased exponentially at the expense of these land cover types over the same period, from 12.40 km^2 in 1985 to 161.52 km^2 in 2015 (see Table 3).

Consistently, the edge density (ED), largest patch index (LPI) and aggregation index (AI) indicated that forest, riparian vegetation and agricultural lands have all changed in composition and structure during the study period in response to built-up expansion (Table 3). Built-up ED increased more than four times from 4.5 m/ha in 1986 to 21.9 m/ha in 2015. ED is a measure of the breaking or consolidation of land cover patches, and thus gives quantitative information on both the composition and configuration. LPI is also a measure of landscape composition, and thus demonstrates the dominance of a particular land cover type. The built-up LPI increased exponentially from 0.27% to 18% between 1985 and 2015. The increased dominance of the built-up land cover type was further observed in AI, which consistently increased from 78% to 93% between 1985 - 2015.

As built-up dominated the district's landscape as the years progressed, other land cover types became fragmented by breaking into smaller isolated patches and eventually diminishing in size. Agricultural lands increased in ED values from 34.7 m/ha in 1985 and peaked at 50.3 m/ha in 2002 and then reduced drastically to 37.3 m/ha by 2015. Such an increase and eventual decrease in ED is an indication of anthropogenic disturbance. This general reductions trend was also observed in LPI (from 3.1% to 0.5%) and AI (74% to 69%) values within the same change period. Open and riverine forests consistently reduced in ED by almost half of its original values in 1985. That is ED for open forest lands decreased from 67.23 m/ha to 35.52 m/ha, and riverine forest also experienced a similar decline from 37.59 m/ha to 15.48 m/ha. Generally, a decrease in ED is an indication of less fragmentation and stability of patches, however, in this instance, it is an indication of increased isolation of vegetation patches and consequent loss of land to built-up. The reduced dominance was observed in LPI, which decreased from 23.9% to 5.8% in open forests, and from 4.8% to 2.7% in riverine forest in the same study period. AI values were fairly constant for both open and riverine forest, a further indication of integrated isolated patches.

Also, as shown in Table 5, open forest lands generally converted into agricultural lands during the 30 years change period. Between 1985-1991, 48.86 km^2 of open forest was converted to agricultural lands. Subsequently, from 1991 to 2002, as the spatial extent of the built-up area increased, 47.69 km^2 of open forest lands were further converted to agricultural lands. The periods between 2002 and 2015, showed 28.84 km^2 of open forest lands converted to agricultural lands.

Table 3: Spatiotemporal analysis of urban expansion in the Ga West district of Ghana

Change Period	Spatial extent (km^2)	Annual expansion rates (km^2/year)	UII
1985 - 1991	13.92	2.32	0.91
1991 - 2002	72.54	6.59	2.58
2002 - 2015	63.43	4.88	1.91
1985 - 2002	86.46	5.09	1.99
1991 - 2015	135.98	5.67	2.22
1985 - 2015	149.90	5.00	1.96

Table 4: Changes in LULC and landscape indices from 1985 to 2015

Landscape Structural Indices	**1985**	**1991**	**2002**	**2015**
Riverine forest area (km^2)	97.79	48.97	37.52	39.74
Open forest area (km^2)	174.29	186.35	124.25	88.45
Agricultural land area (km^2)	66.33	89.14	90.14	60.29
Built-up area (km^2)	12.40	26.37	97.80	161.52
Largest Open forest Patch Index (%)	23.92	27	12.62	5.89
Largest Riverine forest Patch Index (%)	4.87	0.9	0.61	2.73
Largest Agricultural land Patch Index (%)	3.14	2.06	2.09	0.51
Largest Built-up Patch Index (%)	0.27	2.02	6.11	18.31
Edge density of Open forest (m/ha)	67.23	56.84	49.8	35.52
Edge density of Riverine forest (m/ha)	37.59	21.53	17.11	15.48
Edge density of Agricultural land (m/ha)	34.75	42.57	50.31	37.3
Edge density of Built-up (m/ha)	4.5	7.92	23.79	21.97
Open forest Aggregation index (%)	80.83	84.86	80.06	80.07
Riverine forest Aggregation index (%)	80.95	78.26	77.52	80.68
Agricultural land Aggregation index (%)	74.01	76.32	72.31	69.35
Built-up Aggregation index (%)	78.01	83.58	87.83	93.21

Table 5: LULC class transition matrix from 1985 to 2015 in the Ga West Municipal assembly

	Area (km^2)			
	Riverine forest	Open forest	Agricultural land	Built-up land
		1985 - 1991		
Riverine forest	24.48	57.30	14.70	1.28
Open forest	19.82	98.43	48.86	7.18
Agricultural land	4.04	27.37	22.94	11.96
Built-up land	0.63	3.22	2.64	3.49
		1991-2002		
Riverine forest	20.20	19.30	5.20	4.24
Open forest	14.54	82.25	47.69	41.84
Agricultural land	2.47	21.57	34.30	30.81
Built-up land	0.27	1.12	2.97	19.56
		2002 - 2015		
Riverine forest	15.43	13.59	4.66	3.81
Open forest	18.22	45.80	28.84	31.36
Agricultural land	5.51	24.57	19.18	40.88
Built-up land	0.55	4.47	7.59	83.83

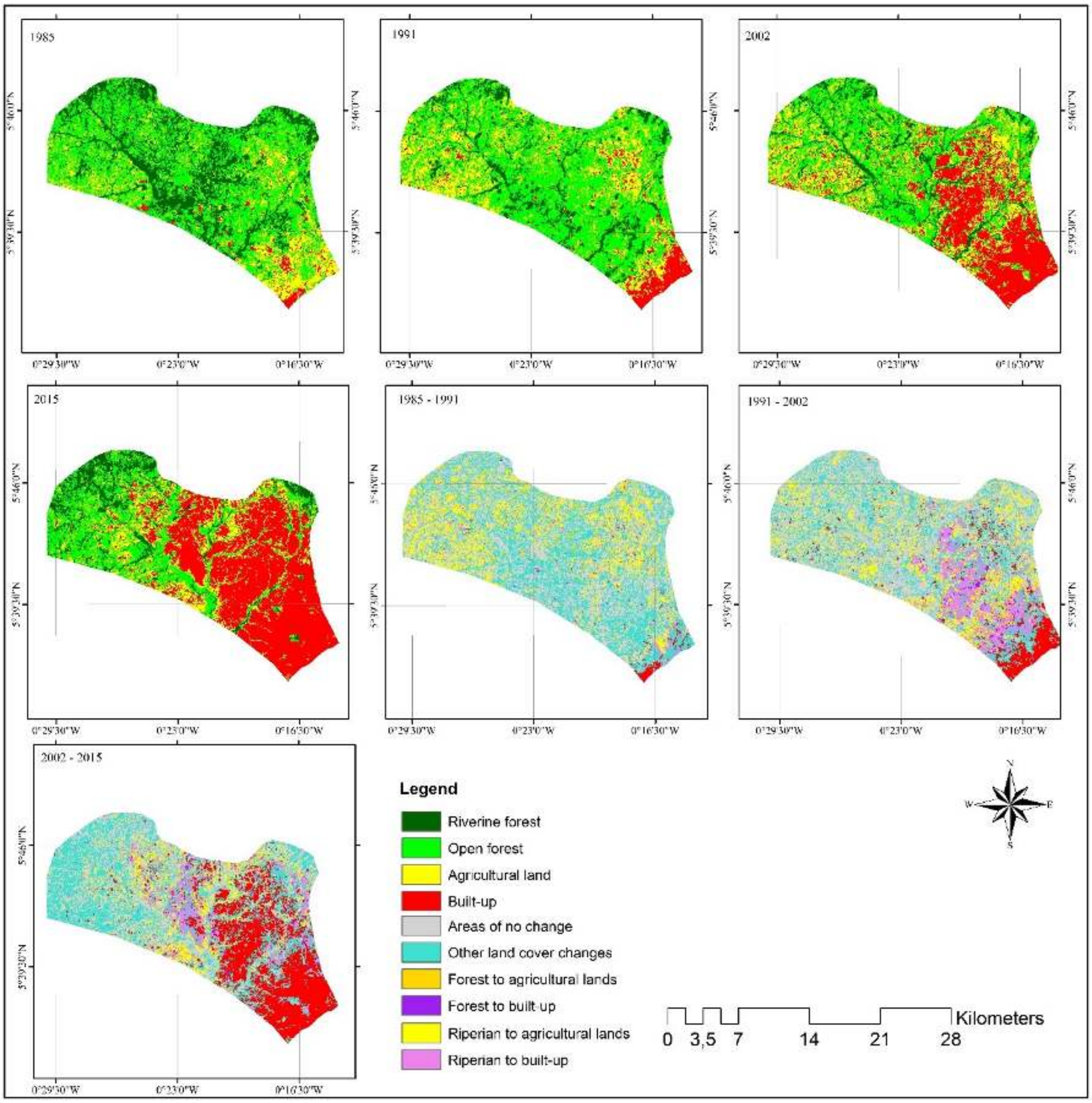

Figure 3: Changes in land use land cover in the Ga West Municipality from 1985 to 2015

4 Discussion

4.1 Landscape transformations in the Ga West Municipal Assembly

Over the entire period, the Ga West Municipality have experienced profound development in urban built-up areas exerting pressure on agricultural lands, as well as riverine and open forests lands. Though some changes in land cover were expected, the rate and proportions over the thirty-year period present an overwhelming urban expansion rate around Accra. Earlier studies on urbanisation in the Accra Metropolitan Area (AMA) have pointed to rural-urban migration, increasing population densities, housing demands and the growth of informal settlements as reasons for the transformation [20].

Several reasons may have accounted for the rapid urbanisation observed in the district. The effect of peri-urban migration as a result of population spillover from neighbouring Accra. The population of Accra grew from 969,195 in 1984 to 1,665,086 in 2014 at 4% per annum as against a national population growth of about 2.6% per annum [40]. The growth in the population of Accra forced more people to settle in neighbouring municipalities to commute daily to the capital for business. As depicted in the results, built-up expanded from the southern part of the district which is where it borders with the AMA. As discussed by Doan and Oduro [41] and Yankson and Bertrand [40], the exponential population growth in the AMA has strongly influenced neighbouring residential towns such as Madina and Gbawe, converting them into remote business districts that have also become hotspots for urban expansion independent of the AMA. The results of this study support such a phenomenon as the capital of the district (Amasaman) has eventually become a peri-urban hotspot for urban expansion within the vicinities of AMA.

The extension of urbanisation trend beyond Accra is accelerated not only by population pressure but also the availability and easy accessibility to the Accra-Kumasi transportation corridors passing through the study municipality [41]. Urban expansion in Ghana and in most African cities has been demonstrated to happen along major road networks [41]. For instance,Doan and Oduro [41], observed that about 90% of urban residents in the Greater Accra metropolitan region of Ghana were within 4 km of the trunk roads. Thus, it is plausible that since the Accra-Kumasi trunk road passes through the study area, it is also another way for urban expansion in the district.

In this study, built-up areas expanded into forest and agricultural lands through complete removal of these vegetated areas. As the district continuously receive population spill-over from Accra metropolitan area, land sources of rural livelihood are converted to urban residential areas. Consistent with observations elsewhere in Ghana [22, 42], the high demand for residential housing leads to encroachment of pristine areas like riparian zones. These together with other associated factors such as road network extension and densification led to the observed fragmentation of the fairly connected agricultural and forested peri-urban landscapes in the Ga-West District.

4.2 Socio-economic and urban governance implications of peri-urban landscape transformations in Ghana

The rapid urban expansion over the last thirty years of the Ga West Municipality revealed by this study points to three key socio-economic and urban governance implications. These implications can be seen and discussed under the following frames of change: (a) community assets and livelihood changes, (b) socio-cultural and value change systems; and (c) urban planning and development management changes.

In the first frame of change, a physical and participatory observation of the communities in the results revealed a transformation of agricultural related activities to small-scale industrial, service or commercial activities. Thus, it is deduced that land resources have rapidly reverted from communal ownership held in trust by customary leaders to private ownership; as they have been transferred from agricultural lands to residential and industrial properties (built-up). While these appear to alienate indigenes of the area from the collective ownership of their land resources, many of these communities appear to have opened up, with the creation of menial urbanised employment opportunities. As a result, increasing proportions of residents of these communities that were visited were engaged in non-agricultural sectors as their main employment, while holding on to the less dominant agricultural sector on a subsistent basis.

The second frame of change points to continuously reduced power of local and traditional decision making structures. Local chiefs who, hitherto, were the custodians of land resources, in trust for their people are gradually losing grip of the socio-cultural structure of their communities. Substantial proportions of community land resources are now in the hands of private individuals, groups and institutions who have used various processes- approved and unapproved - to obtain and developed them for various purposes. These private individuals who are mostly non-indigenes, having paid for their acquired land, owe no socio-cultural allegiance to the customary set-up. Hence, they do not participate in any communal activities which used to define these affected peri-urban communities. Hence, rapid urbanisation and changes in land use cover have not only had spatial implications for the Ga West Municipality, they have also shaped the current socio-cultural settings of the municipal area.

The two change frames above have shaped the existing urban planning and land management processes – which forms the third implication of the spatiotemporal analysis presented in this study. The rapid urban expansion and peri-urbanisation of Ga West Municipal area present major urban planning and land management challenges between the Accra Metropolitan and the Ga West Municipal Assemblies. For instance, the rapid growth between the two assemblies appears to have blurred their boundaries and made development control difficult. As a result, land management and administration for both customary and state institutions between the two local government areas have faced challenges of corruption, uncertainties in acquisition processes, and multiple sales of land to different prospective developers. In many cases, these have led to various conflict situations. There are many such land disputes lodged at various courts in Accra which have taken years to be resolved. Thus, beyond the identification and quantification of LULC changes, peri-urbanisation is key socio-economic, cultural and political issue yet to be properly resolved.

4.3 Ecological implications of peri-urban landscape transformations

The peri-urbanisation phenomenon is a significant land use planning and management issue that impacts significantly on the ecological function of the landscape. There is increasing consensus among scholars that, ecological implications of landscape transformations should be brought into land use decisions to mitigate environmental degradation and resource misallocation [43]. Generally, the natural peri-urban ecosystem provides various resources, services, and benefits to local population and wildlife community. However, in the midst of the massive transformations observed in the study landscape, humans have neglected the ecosystem services value which implies a diminished provision of ecosystem services and environmental quality.

Important ecological benefits of the peri-urban green infrastructure are largely related to the provision of habitat, maintenance of biodiversity, improving air quality, climate change and adaptation responds, and the regulation of urban climate etc. As the peri-urban landscape is increasingly fragmented into more numerous but smaller remnant patches, it produces a gradient of habitat loss. These and associated habitat loss is, considered a threat to biodiversity and ecosystem function which impacts greatly on local climate [44–46]. It also alters the biogeochemical cycles and decreases native biodiversity [11]. Biodiversity - the underpinning ecological processes that create ecosystem services - is essential in the co-production processes that link the biophysical stocks in ecosystems to human well-being and plays an important role in the global carbon cycle [47]. Therefore, the consequent biodiversity loss as a result of the landscape fragmentation observed in the study landscape is a major worry. The loss in biodiversity will also affect the flow of ecosystem services and amongst these services is the role of sequestration of greenhouse gases and climate regulation [48].

5 Conclusions

Using the analysis of satellite remote sensing data, it is evident that urban expansion over the last thirty years of the Ga West Municipality has been rapid. The Ga West Municipality has experienced profound development in urban built-up areas exerting pressure on agricultural lands, riverine and open forests i.e. the green infrastructure of the peri-urban landscape. This increasing dominance of built-up further observed with progressing years, compelled other land cover types to became fragmented by breaking into smaller isolated patches and eventually diminishing in size. Vegetation lost is likely to be intensified if sustainable management interventions are not implemented to safeguard the catchment. A critical analysis of the spatiotemporal changes and the landscape structure revealed fragmentation in forest and agricultural land cover and in some cases and complete removal. These growing influence of the city on the agricultural and forested lands in the peri-urban fringe as discussed has significant implications on socio-economic and urban governance; and the ecological integrity of the landscape.

Citizens disregard for urban planning and building regulations, and the existence of a dual urban land market system dominated by customary, indigenous and private actors, operating without the approval of the state's land use planning and administration system are the main reasons that have contributed to the lost and fragmentation of vegetation cover of the peri-urban landscape. As in the case of many African cities, this brings into focus an immediate need for urban land use planning and policy intervention to control the rate of physical expansion and vegetation lost around the Accra metropolis. In the face of plural and/or complex institutional and regulatory framework for land management, wanton disregard for land laws and regulations, uncontrolled peri-urbanisation; urban land use planning has been considered as weak and struggling to keep pace with land use and land cover changes around the city. In order to address this challenge, urban land use planning must re-examine: a) the powers and practices of customary land ownership and b) institutional and legal frameworks for public land administration and land use planning regimes.

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