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The impact of land use and land cover changes on socioeconomic factors and livelihood in the Atwima Nwabiagya district of the Ashanti region, Ghana

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ABSTRACT

Land use and land cover change (LULCC) is a general term for the human modification of Earth's terrestrial surface. These modifications come by direct and indirect activities of human actions when securing essential resources. Therefore, it is necessary to analyze these land changes for the best management of natural resources and to ensure better livelihood of the inhabitants.

The influx of population from the Kumasi metropolis and peripheral areas coupled with urbanization is causing rapid changes to LULC in the Atwima Nwabiagya District. This has put pressure on the land cover especially in the forest cover areas and has affected the socioeconomic activities in the district. In view of this problem, this research sought to map and analyze the spatio-temporal LULCC patterns using multi-temporal satellite images from 1986-2019 and to identify the socioeconomic factors and their impact of LULC on the study area. Seven LULC classes were identified including; bare land, closed forest, cropland, open forest, savannah, settlement, and water. The results showed that during the period under review (1986-2019) there have been losses of 4178.5 hectares (7%) in closed and open forest and bare land whilst crop land and settlement have seen an increase of 21685.3 hectares (37%). In all, settlement establishment as a result of population increase, commercial activities, and porous land tenure system was identified as the main factors for LULCC in the Atwima Nwabiagya District.

1. Introduction

Land Use and Land Cover (LULC) change have been occurring since time immemorial, it is, however, rapid recently due to increasing anthropogenic activities including urbanization and industrialization (Gennaretti et al., 2011; Al-Bakri et al, 2013; Piña, 2014; Frimpong, 2015; Haque and Basak, 2017; Samal and Gedam, 2017). LULC changes are inescapable to the point that, when accumulated universally, they essentially influence key parts of the world's framework (Lambin et al., 2000) including the environment and local climate. The human influence on the modification of land cover and its usage is therefore key in analyzing land-use change patterns worldwide (Biney and Boakye, 2021). Analyzing LULC change is therefore of great relevance to scientists, environmentalists, planners, economists, policymakers, and everyone who cares about the sustainability of the natural resources (Gennaretti et al., 2011; Yeboah et al., 2017).

In Africa, LULC change has remained rapid due to humanly induced factors such as urbanization (Murayama et al., 2015, Tizora et al., 2016), overdependence on land-based resources for income or food (Antwi et al., 2014), farming activities, natural increase and unlawful felling of trees (Kamwi et al., 2017). Sahalu (2014) noticed that populace pressure is one of the significant main causes of land use and land spread changes in most parts of Ethiopia. Also, significant are population growth, high levels of migration, urbanization, and mining pressures which result in urban sprawl, marginalization of the poor, land deprivation, and climate variation which consequently trigger changes in land use and land cover in Western Cape Province of South Africa (Tizora et al., 2016; Sahalu, 2014; Nilsson et al., 2013). The high demand for land use increases the prices for land in the urban peripheries.

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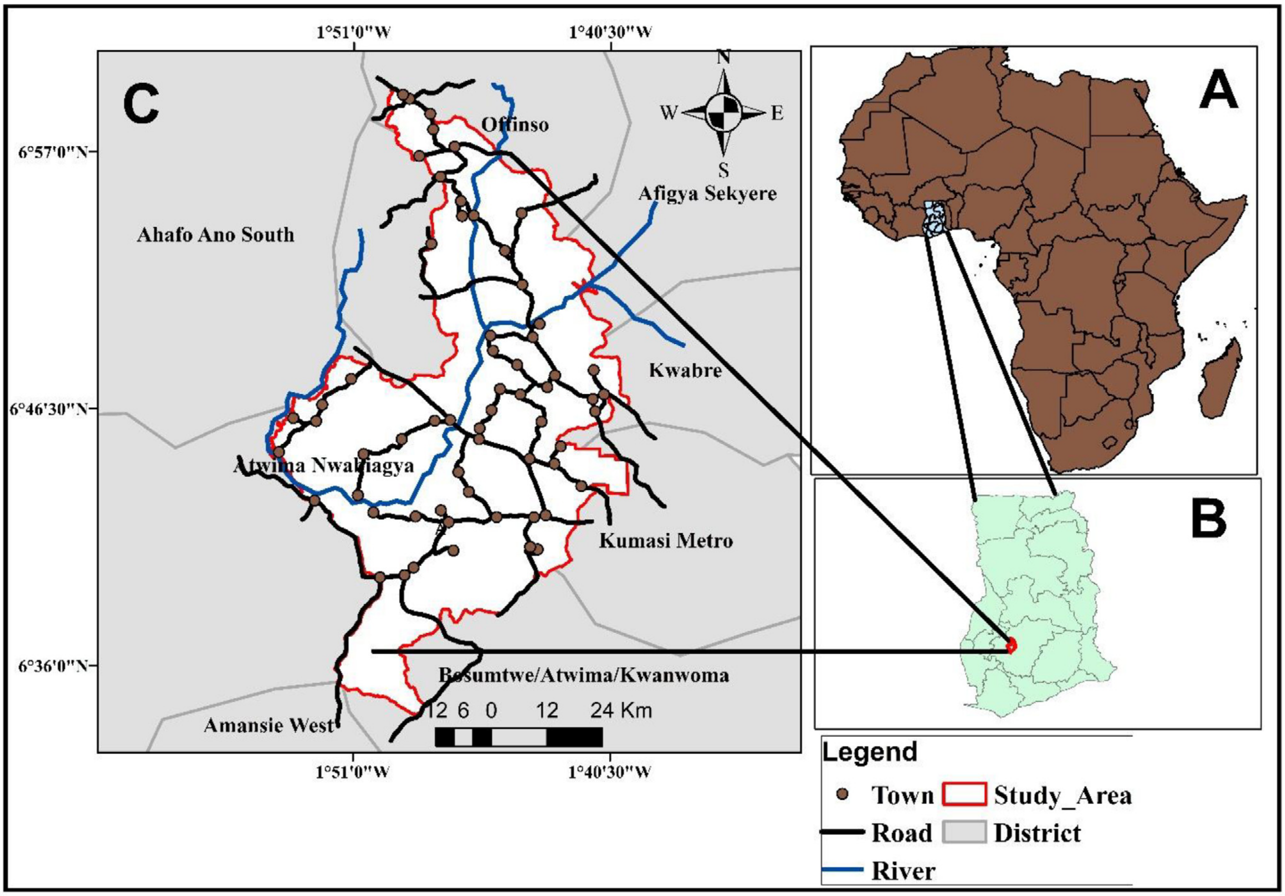

Fig. 1. Study area map(C), Ghana map (B) and Africa map(A).

Ghana's economy relies to a great extent on the use of natural resources and therefore has land use and cover issues (Frimpong, 2015). With a landscape fragmented into different classes (Agyarko, 2001), a greater percentage of land cover especially forest has been converted into several other uses (Appiah et al., 2014). The Atwima Nwabiagya District is rapidly transiting from rural to urban with lots of agricultural lands converted into settlements and for other land uses (Frimpong, 2011). This is due to its proximity to the Kumasi metropolis as well as the availability of Barekese and Owabi water resources. The relevance of land use and spread change in the upcoming of our setting as well as human endurance can be better valued by estimating where and when changes occurred, understanding the main impetuses, and the systems of the progressions from fine spatial scales (Lambin and Ehrlich, 1997).

Many research works have pointed out the relevance of investigating the land cover dynamics as a tool for justifiable supervision of all-natural possessions (Phong, 2004) as well as remote sensing (RS) has been widely used in establishing such changes (Toh et al., 2018). The difficult in most cases however is that RS is unable to yield results on the reasons for the land cover changes. This is more difficult when inhabitants' perceptions and socioeconomic conditions are not accessed to arrive at a meaningful conclusion. Adequate information on the changes and the driving forces will afford policy makers and resource managers the opportunity to take action at specific locations with specific interventions (Phong, 2004). Also, Murayama et al, (2015) noted that the accessibility of multi-temporal and spatially dependable LULC maps is still inadequate in most African regions.

Though the Atwima Nwabiagya district is one of the fastest-growing areas in Ashanti region (GSS, 2012), adequate information on LULC change over a considerable period is non-existent. There is therefore the need to research into the socio-economic implications of LULC change on the entire district using RS and GIS. Geographic Information Systems (GIS) and Remote Sensing (RS) are cost-effective and well-established technologies in understanding landscape dynamics (Subramani and Vishnumanoj, 2014). Also, geo-information techniques have made the monitoring of LULC changes relatively simple and effective (Murayama et al., 2015). The study, therefore, uses RS and GIS as geoinformation techniques to analyze the changes that have occurred in land use and land cover over a period between 1986 and 2019. The study further identified the socioeconomic factors causing LULCC and how it impacted the livelihood of inhabitants and the environment.

2. Materials and methods

2.1. Study area

With its capital at Nkawie-Kuma, the district is bordered to the west by both Ahafo Ano South and Atwima Mponua Districts, it is bounded in the east by the Afigya Kwabre District as well as Kumasi Metropolis. To the north, it forms a boundary with Offinso Municipal as well as Amansie West and Atwima Kwanwoma Districts to the south. Its latitudinal extent is estimated to be 6°32' and 6°75' in the northern hemisphere whilst the longitudinal boundaries are 1°45' and 2°00' in the western hemisphere (Fig. 1). Atwima Nwabiagya District is about 294.84 square kilometers in total land area. The District exists in the wet semi-tropical climatic zone set apart by double maxima rainfall. It occurs between March-July and September-November. The average annual rainfall amount is estimated to be between 1700mm and 1850mm. Four main streams of economic activities can be identified in the district. These are farming activities, industrial activities, trading activities, and service provision.

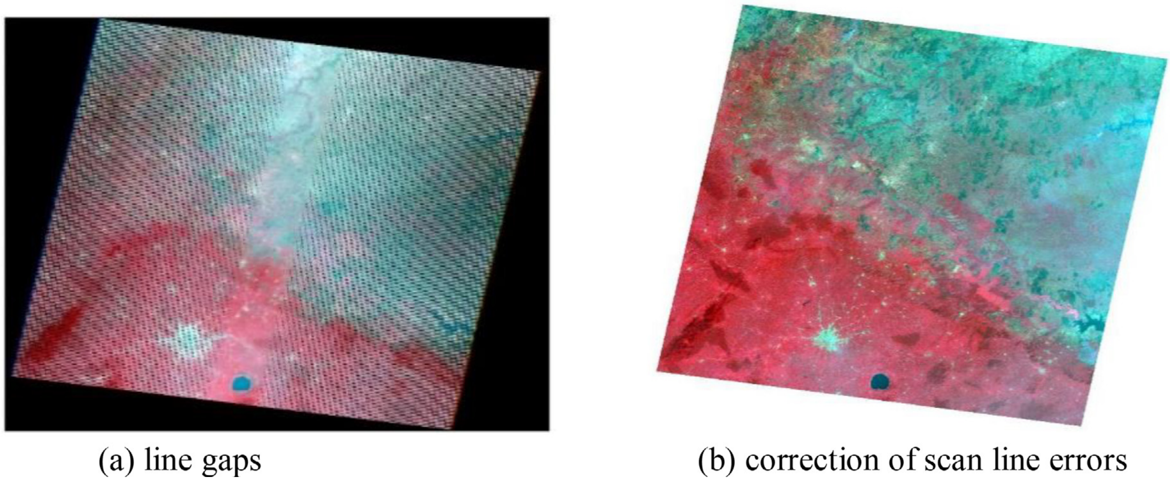

Fig. 2. Images showing the (a) line gaps (b) correction of scan line errors.

Table 1
The Metadata on the satellite images acquired.

Year	Satellite	Sensor	Path/Row	Date acquired	Season	Cloud cover (%)	Number of Bands
1986	Landsat 5	TM	194/055	29th December	Dry	0	7
2003	Landsat 7	ETM+	194/055	19th February	Dry	3	8
2007	Landsat 7	ETM+	195/055	13th January	Dry	0	8
2019	Landsat 8	OLI/TIRS	194/055	22nd January	Dry	6	11

The sector which employs more people is the service provision with 31.7%, followed by the trading or commercial activities with 29.9%. this is followed by farming, forestry, and fishing activities with 22.8%. industrial activities employed the least with 19.6%.

2.2. Data and software used

Satellite images of Landsat 5 Thematic Mapper (TM) for 1986, Landsat 7 Enhanced Thematic Mapper Plus (ETM+) for 2003, Landsat 7 Enhanced Thematic Mapper Plus (ETM+) for 2007, and Landsat 8 Operational Land Image and Thermal Infrared Sensor (OLI and TIRS) for 2019 with Path 194 and Row 055 (P194R055) were acquired from the United States Geological Survey (USGS) earth explorer website for classification and analysis. The images used had a cloud cover of less than 10% and a spatial resolution of 30m × 30m. However, the inability to use images with equal intervals was due to the high consideration in using images with less than 10% cloud cover. Table 1 summarizes the Landsat images acquired and used in the change detection analysis. Also, the major software employed in this project include Google Earth Engine Explorer, SPSS, ESRI ArcGIS, and QGIS. the Google Earth Engine Explorer was employed in the selection of training data for the LULC classifications as well as data for validation. Socioeconomic data collected were entered into SPSS and the results were generated. QGIS was used to handle the classification and prediction of the images and ArcMap was utilized to produce the output maps.

2.3. Image pre-processing

The Landsat 7 image acquired on 13th January 2007had line gaps on the image (Fig. 2) and this was corrected using the QGIS software to obtain a better imagery for the study (Fig. 2). Further, a radiometric correction was done on all the images to calibrate the pixel values and then band stacked into a single image to enhance visual interpretability. Using the false colour composite, the subsetted or clipped-out images were processed to identify the land cover classes of the district.

2.4. Image classification

Identification of the LULC classes and their spatial distributions for better land utilization by both inhabitants and policymakers is a major objective in this study. As a test classification method, an amalgam of supervised and unsupervised classification approaches was used to improve the accuracy of the classification (Appiah, 2016). Peprah, (2015) and Appiah (2016) noted that land use classes in image classification are not easily sorted without an unsupervised classification. This is because unsupervised classification does a first-hand sorting of the image using an algorithm (such as K-Means Classifier) and a defined number of classes. This was performed on all the satellite images to produce seven (7) classes. The classified images using the K-Means Classification were compared and visualized with the original satellite images to help in the training of pixels during the supervised classification. The supervised classification was performed on all the images using Random Forest Classifier, which is the most recent adopted classification algorithm (Nti Asamoah et al., 2018). Using both supervised and unsupervised classification, the classified images were compared and the overall accuracy assessment was performed to validate the images. The QGIS software is made to accept a validation overall accuracy greater than 80% for process continuations or start the classification process all over again with different signatures when validation accuracy is less than 80%. The process continues to yield final supervised images of Atwima Nwabiagya District showing the seven classes of Water Body, Settlements, Bare Land, Savannah, Open Forest, Closed Forest, Crop Land. These land use classes and their corresponding brief descriptions are outlined in Table 2.

2.5. Accuracy assessment

According to Lidzhegu (2012), no LULC classification is complete without doing accuracy assessment. This is because precise change detection results depend on the accurate classification of satellite imageries. Testing the results is therefore a prerequisite in ascertaining the precision or otherwise of the classification performed. Awotwi (2009) argued that since errors occur in most classifications,

Table 2
LULC classes and their descriptions.

LULC Classes	Description
Water	This is made of the Barekese and Owabi Dams which are the main water bodies in the study area.
Settlements	This is dominated by residential and industrial structures most of which showed urban, peri-urban, and rural characteristics.
Bare land	This is comprised of uncovered rock surfaces and other uncovered zones coming about because of both human activities and natural causes.
Savannah	This comprises all the creeping and elephant grasses scattered across the study area.
Open Forest	The vegetation here is dominated by sparsely scattered trees with open canopies.
Closed Forest	This is made up of rainforest and moist semi-deciduous forest trees with three layers of emergent, canopies, and undergrowth.
Crop Land	Land used mainly for both cash and food crops cultivation.

the accuracy of such data should be assessed by juxtaposing the classified image data with some other independently acquired data or reference data or ancillary data (Ground Truthing) of the same area. In this project, accuracy assessment was done using the Semi-Automatic Classification Plugin (SCP) in QGIS. A classification error matrix was also formed to articulate the accuracy by tabulating the classified image data and the reference data. Overall accuracy, producer's accuracy, user's accuracy, and Kappa statistics are the elements common in precision valuation and therefore were calculated.

2.6. Change detection

Change detection is relevant in image analysis since it enables us to determine the gains or losses in the land classes identified (Appiah, 2016). In determining the extent and trends of LULC changes in the Atwima Nwabiagya District, post-classification change detection was employed to examine the land cover changes. This involved the use of multitemporal images of 1986, 2003, 2007, and 2019 to differentiate the changes amongst these images. Areas of change which include the transition matrix and class statistics were calculated. The mainland use classes were reclassified before change detection was done.

2.7. Socio-economic analysis

To examine the socio-economic factors of LULC change and their impact on the environment and livelihood of the district, a quantitative and qualitative research design was employed. For the quantitative research design, close-ended questionnaires were used whereas the qualitative design used interview guided to offer respondents, especially family heads, the opportunity to explain further the issues of LULC change affecting the study area. Lopez-Fernandez and Molina-Azorín (2011) noted that the use of both quantitative and qualitative methods does not only reflect the respondents' accurate responses, it also provides flexible methodology in the research. This is not very different from Wisdom and Creswell (2013) who identified the mixed method to be effective in comparison to solve contradictions during the research as well as the collection of rich and comprehensive data. Though Schoonenboom and Johnson (2017) realized few limitations of such a method such as costs and the complexity of evaluation, the mixed-method is seen as one of the best when quality research is to be carried out.

A purposive or judgemental non-probabilistic sampling technique was used during data collection. This was because communities towards the Kumasi metropolis were noted (from the satellite image analysis) to be experiencing greater changes in LULC. The questionnaires and interview guide were therefore purposively administered around such communities to ascertain the reasons behind such changes. In all, 11 communities from a total of about 53 peri-urban and rural communities were selected as a sample frame which is representative enough for the research. The sample frame was designed to target heads of various households in the study communities. In the case of multiple households, structured questionnaires were administered to all available heads of households and their occupants.

The sample size was heads of households from the eleven selected communities namely; Abuakwa, Nkawie-Kuma, Asenemaso, Toase, Nerebehi, Maakro, Agog, Sepaase, Manhyia, Mim, and Hiawu Besease. The sample size was gotten using the Eq. (1) (Sarmah and Hazarika, 2012):

$$n = \frac{N}{1 + N(e)^2} \tag{1}$$

where; **n** is the sample size, **N** is the total number of people in the eleven communities, **e** is the margin of error (0.05), and **1** is a constant. Administered questionnaires were cleaned and entered into SPSS to generate results and analysis. Descriptive and inferential statistics such as frequencies and regression were employed in analyzing the data.

3. Results and discussions

3.1. Classification analysis of 1986, 2003, 2007, and 2019 landsat images

As shown in Fig. 3, the study area images were classified into seven classes and in the year 1986, Savannah covered 26027.5 hectares (ha) of the area which translates into 44.9% (Figs. 3 and 4). The forest zone comprising of open and closed forests occupied a total of 8650.7 hectares representing 14.9% of the land area. Bare lands also covered 6251.3 hectares of the land which is 10.8%. These were followed by cropland, settlements, and water with 7982.6 hectares (13.8%), 7143.8 hectares (12.3%), and 1857.5 hectares (3.3%) respectively (Fig. 4).

However, in 2003, there was a slight improvement in some classes. Open forest decreased marginally to 4167.2 hectares representing 7.2 % whilst closed forest declined to 4.5 % or 2620.2 hectares (Fig. 4). Savannah continues to occupy a sizable percentage of the area though it declined to a total of 16463.4 hectares representing 28.4 %. This was the case since the district was recovering from the drought and temporal degradation of the land surface, particularly vegetation cover that occurried main in 2002 (Appiah, 2016). Bare land and settlements also saw an increment of 10326.3 hectares (17.8%) and 9602.5 hectares (16.6%) respectively (Fig. 4). Cropland also increased to 12969.4 hectares representing 22.4% of the total land area. The dams classified as water decreased slightly to 1764.4 hectares representing 3.1 %.

In 2007, dams classified as water continued to decrease significantly to 2.5% with an area coverage of 1453 hectares. LULC classes of settlements, bare land, and crop land saw an increment to 13611.6 hectares representing 23.5%, 12200.6 hectares representing 21.1%, and 14762.9 hectares representing 25.5 % respectively (Fig. 4). Close forest, savannah, open forest and water however realized a decrease to 1290.5.9 hectares (2.2%), 10436.6 hectares (18.0 %), and 1012.8 hectares (2.9%) respectively. Open forest slightly decreased to 4158.8 hectares (7.2%). (Fig. 4).

Analysis of the 2019 classified image showed some interesting dynamics in settlements and cropland. The total land area for settlements realized its highest increase to 25900.6 hectares which translates into 44.7%. Cropland also decreased in area to 10911.1 hectares, representing 18.8%. There was also an increase in closed forest coverage to a total area of 1314.6 hectares which is 2.3% of the study area. Savannah land cover saw a significant reduction to 9365.4 hectares (16.2%) which is a considerable reason for a rise in settlement (Fig. 4). Bare

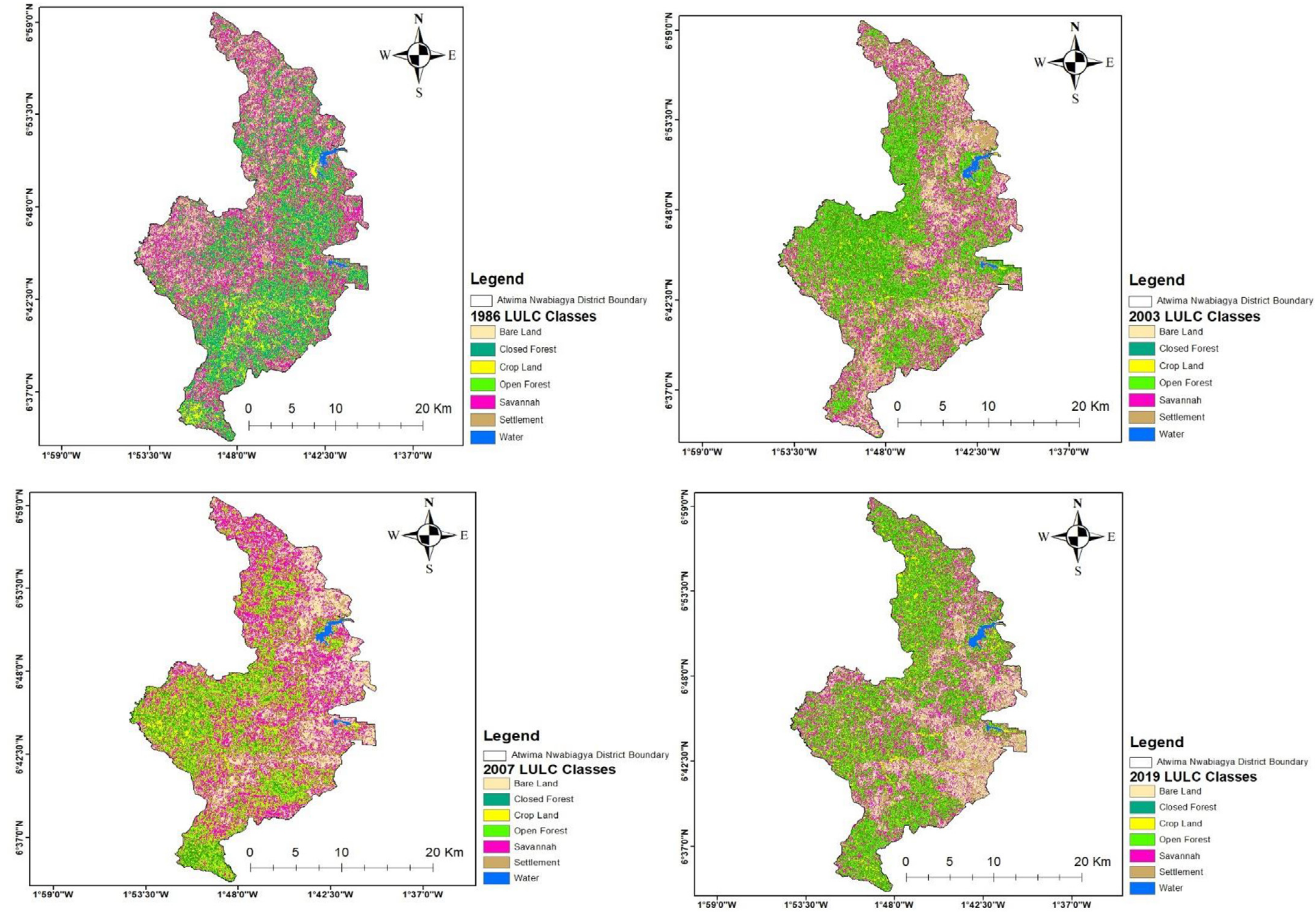

Fig. 3. Classified land use land cover maps from 1986 to 2019.

Table 3
Area statistics of the classified images.

LULC Class	1986		2003		2007		2019	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Bare land	6251.3	10.8	10326.3	17.8	12200.6	21.1	5551.7	9.6
Close forest	3840.5	6.6	2620.2	4.5	1290.5	2.2	1314.6	2.3
Crop land	7982.6	13.8	12969.4	22.4	14762.9	25.5	10911.1	18.8
Open forest	4810.2	8.3	4167.2	7.2	4158.2	7.2	3857.2	6.7
Savannah	26027.5	44.9	16463.4	28.4	10436.6	18	9365.4	16.2
Settlement	7143.8	12.3	9602.5	16.6	13611.6	23.5	25900.6	44.7
Water	1857.5	3.3	1764.4	3.1	1453	2.5	1012.8	1.7
Total	**57913.4**	**100**	**57913.4**	**100**	**57913.4**	**100**	**57913.4**	**100**

lands and open forest also reduced with total areas of 5551.7 hectares representing 9.6% and 3857.2 hectares representing 6.7% respectively (Fig. 4).

A composite analysis of LULC classes shows that there is has been a significant change in the two dams classified as water from 1986 to 2019. The other land cover classes however realized appreciable changes from one period to another. In 17 years (1986-2003), there were significant increases in both settlements, crop land and bare lands. This shows that other land cover classes were converted into other uses such as settlement establishment, agriculture and construction (e.g., roads) purposes. Other vegetative covers (that is closed forest, open forest, and savannah) decreased considerably. The statistics also show that from 2003 to 2019 (16 years), open forest decreased from 7.2% in to 6.2% in 2019 (Table 3). Within the same period, cropland moved from 22.4% in 2003 to 18.8% in 2019. Most of savannah, and close forest were converted possibly as croplands in 2007. This is because savannah and close forest land cover reduced significantly whilst cropland increased. However, closed forest land cover increased from 2.2% in 2007 to 2.3% in 2019 (Table 3). This could be as a result of the government's intervention measures of youth in afforestation and the ban on illegal mining activities that were contributing to vegetation loss. In general, from 1986 to 2019, only settlements saw significant increases. This is an indication that other land cover classifications, for instance, savannah, water and forest were converted into humanly induced land uses. Table 4 indicates the area statistics of LULC classes from 1986 to 2019 in hectares and percentages.

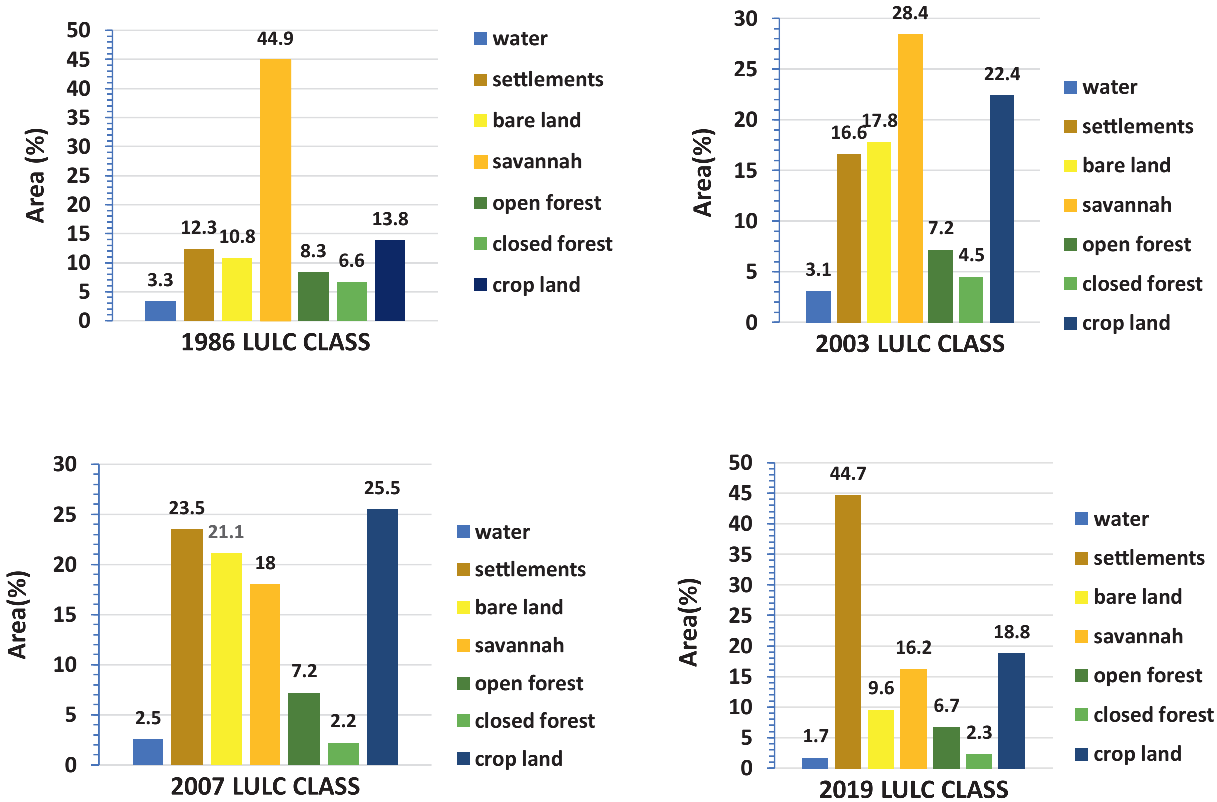

Fig. 4. class statistic of classified map in percentage from 1986 to 2019.

Table 4
Accuracy assessment of classification.

LULC Class	User's Accuracy (%)				Producer's Accuracy (%)			
	1986	2003	2007	2019	1986	2003	2007	2019
Water	90.00	100.00	100.00	80.00	100.00	100.00	90.91	100.00
Settlement	100.00	100.00	90.91	100.00	73.33	100.00	76.92	90.32
Bare land	94.12	97.85	95.05	96.47	95.52	100.00	98.97	97.62
Savannah	97.58	97.74	95.76	96.72	98.77	98.48	98.75	98.33
Open forest	98.39	97.40	97.20	98.50	99.19	97.40	95.86	97.76
Close forest	98.04	97.56	98.39	94.90	98.04	93.02	92.42	96.88
Crop land	96.30	81.82	92.86	96.77	92.86	90.00	92.86	88.24
Overall Accuracy (%)	***97.24%***	***97.44%***	***96.25%***	***96.65%***				
Kappa Coefficient	***0.96***	***0.97***	***0.95***	***0.96***				

3.2. Accuracy assessment

In the study, Kappa was computed using QGIS software. The overall classification accuracies of 1986, 2003, 2007, and 2019 images were 97.24%, 97.44%, 96.25%, and 96.65% respectively(Table 4). The corresponding overall kappa statistic values were 0.96, 0.97, 0.95, and 0.96 for 1986, 2003, 2007, and 2019 images respectively. The substantially high accuracies of all four images are a confirmation of the precision of the LULC sample points obtained.

3.3. Socio-economic analysis

This section presents the results of the socio-economic analysis by analyzing key socioeconomic factors or indicators of the changes within the district and the effect of these factors or drivers.

3.3.1. Comparison of the types of land cover that existed before and after respondents settled in the district

Table 5 showed that forests cover (Closed and Open) was dominant in the study area with about 57.5% (31.4% – open forest; 26.1% – closed forest) of land cover but reduced drastically to a total of 22.9% as at the time of this study. This confirmed the results from the classified images from 1986 to 2019. Conversely, bare land, cropland, savannah and settlement have increased from 8.2%, 12.2%, 9.1% and 11.4% to 18.4%,

Table 5
Types of land cover that existed before and after respondents settled in the district.

Prevailing Land Cover	Before		After	
	Frequency	%	Frequency	%
Bare Land	20	8.2	45	18.4
Closed Forest	64	26.1	24	9.8
Open Forest	77	31.4	32	13.1
Crop Land	30	12.2	45	18.4
Savannah	22	9.1	33	13.5
Settlement	28	11.4	61	24.9
Water	4	1.6	5	1.9
Total	**245**	**100**	**245**	**100**

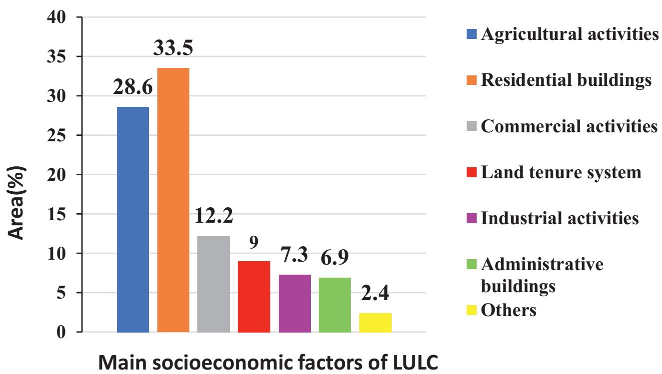

Fig. 5. Main socioeconomic factors of LULC in Atwima Nwabiagya District.

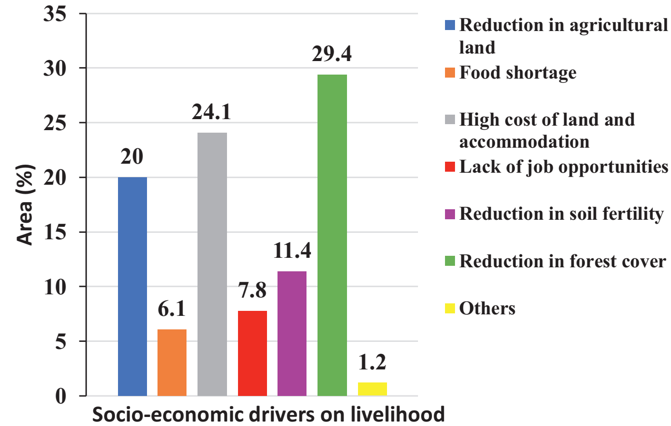

Fig. 6. Impact of socioeconomic drivers of LULC on the livelihoods of inhabitants.

18.4%, 13.5% and 24.9% in that order. It is important to note that these variations have occurred over the period because of the numerous socioeconomic features, for instance, demographic increase, farming activities as well as urban growth prevailing in the district. These factors have led to a rapid increase in human activities such as putting up residential buildings to house the rising population and also meet the demand for accommodation among others. A lot of challenges have arisen due to the massive modifications in LULC in the district over the period. Notably, traffic congestion partly because of the vigorous movements most business people undertake, conflicts in land ownership as a result of selling one parcel of land to more than one person by some of the sub-chiefs as well as social vices occurring out of urban growth and struggle to meet the high living conditions are some of the challenges inhabitants are grappling with.

3.3.2. Major socioeconomic drivers and human activities causing LULC change in Atwima Nwabiagya District

Several activities contributed to the notable modifications of land-use changes that took place in the district over the period. Fig. 5 indicate the statistics of the major ones realized during the study. In all, 82 respondents (33.5%) agreed that putting up houses for residents' purposes contributed largely to the conversion of forests (closed and open) as well as agricultural land to other uses. The results show that migration and other population indicators are responsible for the increases in housing establishment in the Atwima Nwabiagya District. With 28.6%, Agricultural activities such as peasant farming and oil palm plantations were also seen as the second largest socioeconomic activity responsible for the LULC changes. Commercial activities such as trading contributed 12.2% according to the responses. It was realized that most of the people into commercial activities move from the Kumasi metropolis to the district and return after a successful activity. Land tenure system was seen as a driver of land-use change in the district with 9.0%. It was revealed during the study that most sub-chiefs lease a greater part of the forest land migrants for setting up buildings, using it for agriculture, and putting up a business site. This has made the demand for land high since the district has become a fertile ground for developers from the city (Kumasi) to purchase land. 2.4% of respondents said the presence of other social amenities such as schools, community centres, and potable water (from the Barekese and Owabi Dams) are responsible for land use modifications.

Generally, the influx of population either as migrants or through natural increase as well as infrastructural expansion are major socioeconomic drivers leading to increases in residential establishments, agricultural activities, commercial and industrial expansions, and administrative activities. These are fueled by the porous land tenure system and the quest for money by some sub-chiefs in the district.

3.3.3: Impact of socioeconomic factors of LULC on the livelihood of people in the study area

There has also been a negative impact of LULC on livelihoods in Atwima Nwabiagya district through the reduction in forest cover and high cost of accommodation since there are a lot of immigrants and urbanization in the area is increasing exponentially. 72 and 59 respondents representing 29.4% and 24.1% respectively from the data showed that the socioeconomic factors of urbanization and population increase have resulted in the continued reduction in forest cover and high cost of land and accommodation in the district. These result in high living conditions for the people in the study area. The analysis of the socioeconomic drivers on livelihood is presented in Fig. 6.

3.3.4 Summarized discussion on the analyzed data

After the statistical analysis, the information revealed that the predominant occupation in the district is Farming and Trading with most of the inhabitants being migrants who quest for land property, and agriculture. The predominant size of the household is from 1 to 5 people in a house which is mostly a single household. The household is made up of parents and children with relatives. The condition of the household is either mud or a blockhouse. Most of the inhabitants have stayed in the area for less than 5years and mostly 6-10years and this shows that the area is presently occupied more by immigrants. Most of the land in the area was acquired through inheritance and lease. This indicates that most of the lands are family lands. The average land sizes that are owned by the inhabitants through inheritance or lease are 3acres to 10acres.

The types of land cover that were initially prevailing in the area were open and closed forest. The most common land use is residential and agricultural. This has increased the land use in settlement, Bare land, and croplands by reducing the Forest areas.

The socio-economic factors that are prevailing in the area are building of residential zones since there are a lot of immigrants and Agricultural activities since most inhabitants are farmers and traders. This has resulted in challenges in land ownership as a result of land disputes and traffic congestion. There has also been a negative impact of LULC on livelihoods in Atwima Nwabiagya district through the reduction in forest cover and high cost of accommodation since there is a rise of the number of immigrants and urbanization in the area is increasing exponentially.

4. Conclusion

Landsat images were used for classification to reveal the major LULC changes within the Atwima Nwabiagya for the period 1986 to 2019. It was revealed that forests (closed and open) reduced continuously from 1986 (about 14.9%) to 9.4% in 2007. It however increased marginally between 2007 and 2019 partly due to the government afforestation programme. Built up (settlement establishment) improved to 44.7% (2019) from 12.3% (1986). It is significant to note that this is due to population increase and other socioeconomic factors such as the quest for land for settlement establishment. Other LULC classes that saw increases include bare lands and cropland.

The socioeconomic data revealed that the predominant occupation in the district is Farming and Trading with most of the inhabitants being migrants who quest for land property and agriculture. The types of land cover that were initially prevailing in the area were open and closed forest and the most common land use are residential and agricultural. This has increased the land use in settlement, Bare land, and croplands by reducing the Forest areas. Also, the socio-economic conditions that are prevailing in the area are building of residential zones since there are a lot of immigrants and Agricultural activities and most inhabitants are farmers and traders. This has resulted in challenges in land ownership as a result of land disputes and traffic congestion. There has also been a negative impact of LULC on livelihoods in Atwima Nwabiagya district through the reduction in forest cover and high cost of accommodation since there are a lot of immigrants and urbanization in the area is increasing exponentially.

Author contributions

Emmanuel Kullo Daata designed the concept of the manuscript supervised by Eric Kwabena Forkuo, and Ernest Biney, Jonathan Arthur Quaye-Ballard and, Emmanuel Harris contributed to the analysis of the results and to the writing of the manuscript. The findings, discussions, and manuscript writing were all contributed by all authors.

Declaration of Competing Interest

The authors declare no conflict of interest.

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