

# Analyzing the Implications of Land use Changes on Urban Planning in Mamfe Sub-Division, South West Region, Cameroon

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## ABSTRACT

Land use change is necessary for economic development and social progress; however, it does not come without costs. The efforts to meet the needs of the burgeoning population and its development activities, have amplified stress on the earth's land uses with significant implications on urban planning. This study seeks to examine the trends of land use changes, causes and associated implications in Mamfe Sub-division. The study made use of primary and secondary sources of data. Simple random sampling technique was used and 164 respondents were drawn from Ebekaw, Small Mamfe, Besongabang, Okoyong and Bachuo Neighbourhoods. Data was collected through interviews, field observation, questionnaires and Landsat imageries to examine the trends, causes and implications of land use changes in Mamfe Sub-division for 1980, 2000 and 2020. The results revealed that between 1980 and 2020 agriculture and built-up (infrastructural development) were identified as the dominant activities at the expense of vegetation cover. Population increase, institutional developments, socioeconomic organization, increase in income and affluence and technological development were seen as the main causes of land use changes. This was seen through the construction of roads, modern houses, thermal plan and increase in food production which has resulted to environmental implications such loss of biodiversity, land degradation and air and water pollution. In addition, to the socio-economic implications of land use changes such as limited livelihood opportunity, increase poverty and inequality, limited access to social services, displacement and migration, and land use conflicts. The study recommends a holistic, integrated land use planning and participatory approach that incorporates social, economic and environmental considerations as well as a meaningful engagement with affected communities and stakeholders.

**Keywords:** Land use, land use change, urban planning, implications, Mamfe Sub-division.

## INTRODUCTION

The efforts to meet the needs of the burgeoning population and its demand driven development activities, have amplified the stress on the earth's land (Foley *et al.*, 2011; Weinzettel *et al.*, 2013). Anthropogenic activities and its implications on Land Use changes (LUC) have become an inevitable issue for the present time and accentuating the risk of environmental degradation around the globe (Paiboonvorachat, 2008). Many developing countries are using their natural resources at rates faster than the natural rate of replacement to sustain their rapid population growth, generate foreign exchange and to produce raw materials for industries. Land, water and forests are amongst the most valuable resources under excessive pressure due to human exploitation.

Universally, land is used for diverse functions. These are however not limited to: housing for residential uses, agriculture (farming, animal husbandry, fishing, and horticulture), commercial, mining, education, health, recreation, industrial, religious sites and transportation purposes among others. The percentage of land

allocated to different land use in different parts of the world vary greatly due to factors such as: development level, availability of land, its relief, compliance with the planning laws and regulations and the function to which the land will be put (United Nations Environmental Project, 1999). Land use is a characteristic of the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it (Food and Agriculture Organization, 1999). Hence, Land use change is a result of human modification of the natural landscape. Land use change is necessary and essential for economic development and social progress. Some of these changes cause permanent transformation such as urban expansion (Ellis, 2007).

Meyer (2006) defines land use dynamics as conversion of land from one form to another. These changes involve modifications, either directly or indirectly on the natural habitat which impacts the environment. Studies show that about 50% of the earth surface has been significantly transformed through human activities (Balgah, 2007). In this process, they have modified and are modifying land in various ways and intensities. These changes are seen as; natural forests and grasslands are converted into agricultural and grazing areas for crops and livestock production, or urban and industrial lands. Wetlands are drained and converted to agricultural, residential, recreational and industrial uses, cropland undergoes intensification, marginalization and abandonment, and abandoned land may be reforested or may be degraded further. All settlements either urban or rural consist of buildings and other structures; open and enclosed spaces and circulation channels, arranged in different degrees and ways to produce a form and structure atypical to the settlement (Achi, 2004). However, land use change, does not come without costs, and may not always occur as a result of planned actions but may also be an unexpected effect on the environment. Man makes use of the land he inhabits to an extent supreme to any other species. Therefore, the field of urban planning holds the key in creating form and character of a physical environment as they design, modify and control the social, economic, technological and political changes taking place on the land.

In Cameroon, for over four decades now, urban planning and development have become striking issues to urban dwellers themselves, government bodies and the professionals. The rate of urban growth has been unprecedented, as cities are incubators of innovation and help foster employment and economic growth. Rapid urbanization has brought with it enormous challenges, including inadequate housing, increased air pollution, poor transformation of the land, social adjustment problems, poor and inadequate zoning, inadequate urban route infrastructure and many more. This implies that lands are not used for their actual purposes as inhabitants strive to maximize every inch of their land. Given this situation, the planning process cannot be taken for granted as it is a prerequisite for providing an enabling environment for development. Planning ensures that resources at any level of change are used efficiently so that the needs of the people are met while safeguarding future resources (Jeffrey *et al.*, 2018).

In Mamfe Sub-division, settlement expansion presents a number of planning challenges which must be addressed. Cameroon's Vision 2035 has as a challenge the need for urban development, regional development, and environmental protection. While research efforts have been directed on urbanization and environmental problems (Amawa & Kimengsi, 2009; Kimengsi & Amawa, 2012; Balgah, 2007), much attention still needs to be paid to the growth of peri-urban areas. Mamfe town has been characterized by changes in land use, including a sharp decrease in agricultural use, down from about 80% in 2000 to 50% in 2014 (National Institute for Statistics, NIS 2014). The natural environment of Mamfe Sub-division and its environs that knew little or no stress around the 1980s has suddenly witnessed a progressive change on its land use patterns in recent years. The high and uncoordinated demand as a result of rural exodus has increase the pressure on the natural environment to meet residential, commercial needs, social amenities and socio-economic infrastructures. In Mamfe Sub-division, the continuous loss of agricultural land and forest cover is not only becoming a threat to resource sustainability, but it is having a great impact on the landscape pattern, atmosphere, environment, biodiversity and human vulnerability. It is the result of this dynamism that this study seeks to examine the trends, causes of land use change and their implications in order to suggest measures for a coordinated urban planning policy in the face of apparently unavoidable changes in land use in Mamfe Sub-division.

## LITERATURE REVIEW

### Trends of Land Use Change

Ejaro and Umar (2013) posit that, mapping land use and land cover change using remote sensing and Geographic Information System (GIS) techniques is an area of interest that has been attracting increasing attention globally. Most environmental issues of major concerns have great complexities especially in the handling of multidisciplinary data sets; thus GIS is a new technology that provide data to study and monitor the dynamics of natural resources for environmental management. Understanding the significance and potential consequences of land cover changes for climate, biogeochemistry, or ecological complexity is difficult without land use information.

Land use and land cover change is a major global environmental change issue and projecting these changes is essential for the assessment of environmental impacts (Mubea & Menz, 2012). They reported that, a combined use of satellite remote sensing, geographic information systems (GIS), and markov chains stochastic modeling techniques are essential in analyzing and projecting LULC changes. Haven undergone an analytic study of Nakuru municipality in Kenya, the results proved that, there has been a notable and uneven urban growth and substantial loss in forest land.

### Causes of Land Use Change

Campbell *et al.*, (2005:765), explained that rapid land use change is the result of intricate factors stemming from economic, cultural, political, institutional and demographic processes. Supporting this argument, Lambin *et al.* (2003) asserts that land use change is the result of complex interacting factors working at different levels and at different places on the human environment system. This calls for area specific assessment of drivers of land use/cover changes. Similarly, Kuemmerle (2009) reported that the conversion of cropland to grassland in Arges is due to rapid changes in socio-economic, demographic and institutional conditions after 1989.

According to Klein (2001), remarkable population increases has boosted the need for food and fodder production. Land used for crops and ranching has expanded at the expense of forests and natural grasslands. Supporting this argument, Balgah (2013) reported that urbanization and population growth are the main causes of rapid land use dynamics in urban areas of Cameroon. From 1976 to 1988, the rate of urbanization in Cameroon grew from 28.5% to 40.4% (Fombe & Balgah, 2012). Between 1970, 1990 and 2011, residential, agricultural, social amenities and industrial land uses have increased while areas covered by forests have reduced.

### Implications of Land Use Changes

Drechsel *et al.*, (2001) observed that the fast growing population in Sub-Saharan Africa has been exerting considerable stress on land use activities and the agricultural populations are moving to unoccupied and protected areas resulting in biophysical deterioration like soil fertility and deforestation. Similarly, Balgah (2007) noted that the rising population of Buea has unleashed a series of developmental problems. These modern land use mutations result in environmental mishaps such as; loss of prime agricultural land, deforestation, destruction of watersheds and wetlands, loss of wildlife habitats, poor agricultural practices and also urban decay.

According to Lubowski *et al.*, (2006:54) Land use change is necessary for economic development and social progress, however, it does not come without costs. Conversion of farmland and forests to urban development reduces the availability of land for food and timber production. Soil erosion, salinization, desertification, and other soil degradations associated with intensive agriculture and deforestation reduce the quality of land resources and future agricultural productivity.

### Sustainable options for land use changes

Jia *et al.*, (2003) reported that land use planning systems and zoning can promote environmentally sound land use and management options such as tackling land degradation, effecting ecosystem rehabilitation and/or restoration, resolving conflicting land use demands, and ensuring territorial cohesion towards sustainability.

Metternicht (2017) opined that managing increasing competition over land and different stakeholders’ interests requires land use planning for efficient land allocation that promotes sustainable land use options, and that aids in finding a balance among competing and sometimes contradictory uses. Sustainable land management encompasses the ecological, economic and socio-cultural dimensions of sustainable development as a process which comprises land use planning, land use design and land development.

Sustainable resource use refers to the use of environmental resources to produce goods and services in such a way that, over the long term, the natural resource base is not damaged so that future human needs can be met (Lambin, 2005). According to Ziadat *et al.*, (2015) a comprehensive land-based approach would involve identifying and prioritizing target areas where certain options have high potential for success; selecting the most appropriate Sustainable Land Management regime; and disseminating its practices, supported by proper policies, financial mechanisms and continuous monitoring to maintain adaptability in the face of climatic and socio-economic change. According to Therivel & González (2020: 4) land-use planning deals with spatial arrangements of the use to which land is put, while environmental assessment mitigates the land use plan’s environmental risk, streamlines its project and strategic actions, facilitates its approval, and better implementation.

## STUDY AREA

Mamfe Sub-division is found in Manyu Division, South West Region of Cameroon. Mamfe is the headquarters of the Manyu Division. Mamfe is situated within the rolling hills and plains of the Southwestern Cameroon Plateau. Mamfe is located on latitude 5° 18’0N to 5° 99’0N and longitude 9° 01’0E to 9° 44’0E It is about 74km away from the Cameroon-Nigeria border and has a total surface area of 7000km<sup>2</sup>. It has an estimated population of about 36,500 inhabitants growing at a rate of 3.2%. Mamfe is bordered to the North by Akwaya Sub-division, to the South and East by Eyumojock and to the West by Tinto (Figure 1). The Mamfe Council Area also has 35 Municipal councilors (Mamfe Council Communal Development plan, 2012). Mamfe falls within the Equatorial Climate Zone with the Equatorial Rain Forest Climate, which is characterized by elevated temperatures (30°c-32°c). Mamfe receives significant rainfall, likely exceeding 3500 mm (154inches) annually. The rainy season is most intense from May to October. The Manyu River, a tributary of the Cross River, flows through the city. This forms the primary drainage system, carrying rainwater towards the Cross River and ultimately the Atlantic Ocean.

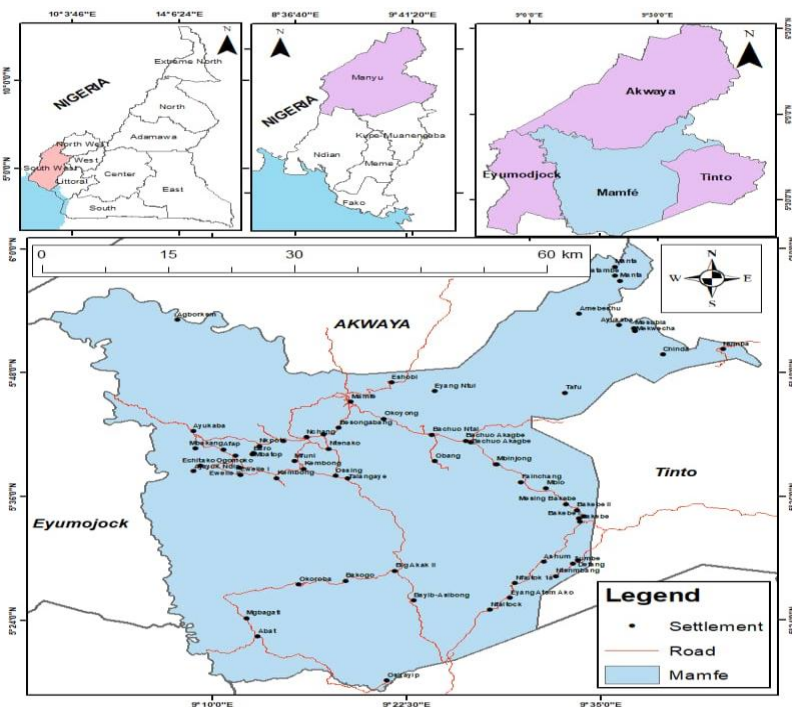


Figure 1: Location of the Study Area in Mamfe Subdivision, South West Region of Cameroon

Source: Adapted from the Administrative Map of Cameroon, 2016

## METHODOLOGY

### Research design

A survey research design was used for this study to collect information from a sample of individuals through their responses to questions. It allows the researcher to collect both quantitative and qualitative information from the respondents. The techniques of data collection used for this study was interviews, field observations, questionnaire, documents and records. These techniques were considered appropriate because they are flexible and cover wide range domains.

### Data collection

The target population was made up of the population of Mamfe Sub-division and the accessible population was Mamfe. The population of the area as of 2017 estimate was 32,326 inhabitants (BUCREP, 2018). The target population was drawn from this population as five neighborhoods were identified by random sampling (Egbekaw, Small Mamfe, Besongabang, Okoyong and Bachuo) who were judged to have witnessed significant dynamics were purposively chosen. Each individual had a zero probability of being selected, meaning it was based on chance. The study equally employed a simple random sampling technique to select 164 household heads drawn from these neighbourhoods. Within each neighbourhood, the study systematically sampled household heads from every 7<sup>th</sup> household.

Table 1: Categorical Distribution and Proportions of Sampled Respondents

Neighborhoods	2023 Population	Frequency	Proportion (%)
Egbekaw	3,702	40	24
Small Mamfe	3,425	38	23
Besongabang	2,334	30	18
Okoyong	2,300	32	19.5
Bachuo	2,565	24	14.5
<b>Total</b>	<b>32,326</b>	<b>164</b>	<b>100</b>

Source: Demographic Data of MINSANTE (2023)

Table 1 shows the distribution of respondents from whom data was collected in Mamfe. From the statistics presented, 164 household heads were sampled. All these different groups who have lived for over 10 years were interviewed to know their experiences on how the town has changed due to rapid urbanization, their factors, challenges and implications for urban planning. In the neighborhoods selected, the proportions of respondents were sampled based on their population sizes. For example, Egbekaw has a more significant population, hence a higher proportion (24%).

### Data analysis

The questionnaires were structured into different parts, including sections on the trends and causes of land use changes, socio-economic and environmental implications and implications for urban planning. Field observations were also carried out to get more insight into some unsustainable practices, and a camera was used to take snapshots of these practices. Furthermore, interviews were conducted to the Mayor of Mamfe council and other stakeholders who further traced the history of urban growth in Mamfe. These data complemented by field observations and secondary data sources (population figures and land use dynamics).

To determine changes in land uses, land use maps for 1980, 2000 and 2020 were developed with the aid of Satellite Images (Enhanced Thematic Mapper Plus (Land Sat ETM) (30M resolution) satellite images and

Google Earth Images for 2022) obtained from the United States Geological Survey (USGS) website. This assisted in the analysis of land use change in Mamfe as it portrayed the changes taking place with respect to settlement expansion, commercial and other social and infrastructural developments in the study area. The images were imported into Arc GIS 10.0 (ESRI, 2010), a Computer-Assisted Geographical Analysis Software. The different bands were modulated and corrected to reveal the various and most prominent land use types and geographic features using Arc GIS. GIS software (ESRI, 2010) was used for data processing and analysis. Google Earth was then used for pattern recognition as the polygons representing the various land use types were measured with Arc GIS and computed using Microsoft Excel 2016. Ground truth was done for confirmation, and pictures were taken for more evidence to bridge the gap between perception and what is. The bands were adjusted using Arc GIS to reveal the various land use types and geographic features. The polygons representing the different land use types were measured with Arc GIS and computed using Microsoft Excel 2016 to obtain valid and reliable data. In order to ensure reliability of the instruments, the researcher carried out the test-to-test reliability. Their correlation co-efficiency indicated that the instruments were reliable. Information collected before the field work was analyzed and compared to the data collected during the fieldtrip to Mamfe Sub-division, including GIS data and land use maps. In addition, descriptive and inferential statistical tools were used to analyse the data with the aid of the Statistical Package for Social Sciences (SPSS Version 23.0). The chi-square inferential and one-way ANOVA tests were employed, which showed the relationship between variables. The interpretation assumes a 0-1 Likert scale (0 representing no concern, 1 representing highest concern). Most outcomes of the analyses were presented on tables and figures. Ethic-wise, there was a strict implementation of inform consent during the data collection process.

## RESULTS AND DISCUSSION

This section presents the findings, through interpretation and discussion the trends, causes and implications of land use changes.

### Trends of Land Use Changes

Field investigation on the type of land use activities practice in Mamfe Sub-division revealed a diverse agricultural activities ranging from cocoa farming, palm oil and animal breeding to infrastructural development such as residential, commercial, road construction, educational facilities, health services and administrative facilities. The land use and land cover situations of Mamfe Sub-division were examined for 1980, 2000 and 2020 gotten from satellite imageries and were grouped under residential, farmland and vegetation cover. Maps and table showing land use and cover were produced using GIS packages to show the areal coverage of the different land uses (Figure 2 and Table 2).

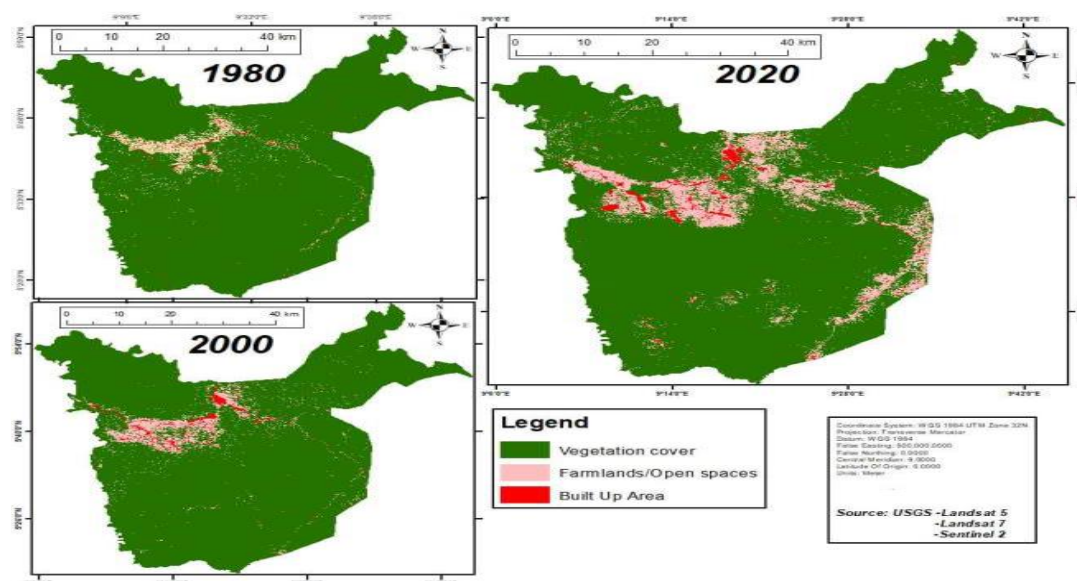


Figure 2: Land use Maps showing different Land use Activities in Mamfe Sub-division, South West Region of Cameroon from 1980 to 2020

Source: USGS-Landsat 5, Landsat 7, Sentinel 2

Table 2: GIS data on land uses and rate of changes in time and space

Land use	Surface area in 1980 (km <sup>2</sup> )	Surface area in 2000 (km <sup>2</sup> )	Rateof change in % (1980-2000)	Surface area in 2020 (km <sup>2</sup> )	Rateof change in % (2000-2020)	Rateof change in % (1980-2020)
Built-up	16.7314	36.8803	19.39	50.2968	12.9118	32.3028
Farmlands	67.7094	81.3070	5.7135	88.9716	3.2205	8.9341
Vegetation	182.9750	133.8140	-11.2318	120.9030	-2.9497	-14.1816
<b>Total</b>	<b>267.4158</b>	<b>252.0013</b>	-	<b>260.1714</b>	-	-

Source: Calculations based on LUC Maps form 1980- 2020

Table 2 reveals the land use activities (residential, Farmlands, vegetation) captured by the satellite imageries and their rate of changes. In 1980 the built-up area occupied a surface area of 16.731442km<sup>2</sup>. It increased to 36.88km<sup>2</sup> in the year 2000 and 50.29km<sup>2</sup> in 2020. This implies that the level of built-up area has more than triple as most of the area is now used for construction purposes as reflected in the analysis. In 1980, farmland and open spaces occupied a surface area of 67.7094km<sup>2</sup> in 1980, followed by 81.3070km<sup>2</sup> in 2000 and 88.971 km<sup>2</sup> in 2020. The progressive changes in Farmland and open spaces shows that the surface area has seen significant increase due to the growing need of the population to meet up with food and cash crops. In 1980, vegetation occupied a surface area of 182.9750km<sup>2</sup>, followed by 133.8140km<sup>2</sup> in 2000 and 120.9030km<sup>2</sup> in 2020. This explains that the surface area of Mamfe Sub-division that was predominantly occupied by vegetation has reduce tremendously in recent years due to population increase through the conversion of vegetation cover for housing and other infrastructural development.

The spatial extent of land use from 1980-2020 in Mamfe Sub-division shows that built-up land has increase by 32.30% and farmlands has increase by 8.93% in 40years at the expense of vegetation cover that experienced a negative rate of change (-14.18%). The increase in built-up and farmlands are a result of population increase and increase use of land. This is complemented by field evidence in Besongabang and Small Mamfe where a large proportion of the populations are non indigenes that have settled and constructed houses and businesses. This finding agrees with that of Balgah and Maluh (2017) who reported an increase in settlement land from 19.8km<sup>2</sup> to 43.03km<sup>2</sup>, and farmlands from 167.74km<sup>2</sup> to 181.14km<sup>2</sup>, while forest covers decrease from 70.94km<sup>2</sup> to 59.02% and grazing land decrease from 106.89km<sup>2</sup> to 82.18km<sup>2</sup> in Tubah Sub-division from 1983-2013, indicating an increase in farmland and settlement lands at the expense of grazing and forest cover.

### Causes of Land Use Change

From field investigation, the predominant cause of land use change is population increase (87.8%), followed by institutional development (60.3%), socioeconomic organization (51.2%), increase in income and affluence (41.5%) and technological development with 29.9% (Table 3).

Table 3: Causes of Land Use Change

Causes	Frequency	Percentage (%)
Population Increase	144	87.8
Income and Affluence	68	41.5
Technology	49	29.9
Institutional Development	99	60.3
Socio Economic Organization	84	51.2

Fieldwork, 2023

In 1980, the population of Mamfe Sub-division stood at 8,000 inhabitants as per the main miles stone estimate. In 2000, the population was at 31,641 inhabitants with a population density of 9.891 km<sup>2</sup> over an area of 3,199km<sup>2</sup> (National Institute for Statistics, 2005). The population of Mamfe Sub-division according to the 2017 estimate was 36,500 inhabitants with population density of 46 persons per km<sup>2</sup> (Communal Development Plan, 2012). The fast population growth and the high pressure on resources are expected to have an adverse effect on the existing natural resources of the area. Such rapid population growth in the area has exerted pressure on the existing land resources in Mamfe Sub-division through increasing the demand for wood for fuel, construction materials and increase demand for food thereby encroaching on uncultivated areas such as forest and wetlands for crop cultivation and infrastructure development. This is supported by McNeill (2006), who reaffirms that population exerts unprecedented pressure on the natural environment directly or indirectly.

Income is a key driver of land use and changes in land value. An increase in income enables people to purchase land for diverse development reasons be it transport, infrastructure for settlement purposes, commercial and agricultural expansion. Findings revealed that the average income per month is 50,000 to 80,000 francs for inhabitants in Mamfe Sub-division. The respondents revealed that their incomes are generated from the sale of agricultural produce, forest exploitation and trade. The study observes an intensification of income segregation and economic disparities among members in the community. Field investigation reveals that changes in consumption patterns, lifestyle changes, and investment in landed property, leisure and recreation are the reasons that drives land use change among the few high-income earners in Mamfe Sub-division. This results in agricultural intensification and expansion, demand larger homes, land grabbing for speculation purposes, creating resort sites and improvement of transport infrastructure. While the low-income inhabitants drive land use change through informal settlement, subsistence agriculture, resource extraction and land tenure insecurities which end up causing issues of pollution, floods, environmental degradation, lacking basic services and exacerbating poverty.

Table 3 reveals that institutional development causes land use change as represented by 60.3%. Most respondents explained that much of the expansion of crop land and the loss of forest covers took place from 2000-2020 which correspond to the satellites imageries of the period. The growth of institutions such as Government institutions, Non-Governmental Organizations, Private companies and International Organizations influence land use through investments, a variety of policies, regulations and initiatives. The growth of institutions in Mamfe Sub-division such as banks, schools, roads, administrative buildings, and educational institutions just to name a few drives land use change by facilitating access to services and providing opportunity for new socioeconomic activities. In addition, agricultural policies such as agricultural intensification, input subsidies and land tenure reforms has influence land use patterns as it encourage the conversion of land for agricultural uses. This has resulted in land use changes through the conversion of agricultural land and vegetation cover for development purposes.

From field investigation 51.2% of the respondents revealed the increase demand for socio-economic amenities such as markets, road networks, schools, hospitals, recreational facilities, utility networks and public facilities have resulted in land use change in Mamfe Sub-division. As population increases, there is the continuous demand for social amenities to improve upon the living conditions of the inhabitants and foster socio economic development. This services further drive changes as it attract residents and businesses, increase property values, promote infrastructural development and promote tourism. This implies that the rate of conversions of farmland and forests for socio-economic development reduces the land available for food production, timber production, open space and environmental amenities for the local residents. These findings agree with Geist & Lambin (2002) who subdivided the drivers of land use change into two groups: proximate causes and underlying causes. Where proximate causes are the activities and actions that directly affect land use, such as wood extraction or road building while underlying causes are the 'fundamental forces' that fortify the proximate causes, including demographic, economic, technological, institutional and cultural factors.

### **Implications of Land Use Changes in Mamfe Sub-division**

The study assessed both the positive and negative implications of land use changes since they are crucial for making informed decisions and promoting sustainable development practices.



## Developmental Changes

The findings revealed that a good number of developmental changes connecting to land use changes have been observed in Mamfe Sub-division. These changes include the construction of thermal plan, tarred roads, modern houses and increase in food production as shown in Table 4.

Table 4: Developmental Changes in Mamfe Sub-division

Developmental Change	Frequency	Percentage (%)
Road Construction	104	63.4
Construction of Modern Houses	94	57.3
Increase in Food Production	84	51.2
Construction of Thermal Plan	30	18.3

Source: Field work, 2023

The findings revealed that 63.4% of respondents cited the construction of new roads as one of the positive implications of land use change in Mamfe Sub-division. Transport infrastructural development is essential in shaping cities, enabling economic activities and ensures safe accessibility at various levels for all individuals. The construction of new roads and the upgrading of existing roads in Mamfe Sub-division has enhance accessibility to jobs, education, healthcare services and to market for agricultural goods. The Kumba-Mamfe, Mamfe-Bamenda, Mamfe Ekok roads have improve greater connectivity with other regions especially those who are engaged in commercial activities thereby fostering economic growth and development and enhancing their welfare. This results agrees with Aderamo (2003) that road network constitutes an important element in urban development as roads provide accessibility required by different land-uses and the proper functioning of such urban areas depends on efficient transport network, which is a backbone to their very existence.

In addition, 57.3% of respondents revealed that the construction of modern houses is another impact of land use change in Mamfe Sub-division. The improvement in road network has made the town to become an economic hub resulting to the influx of people and increase demand for accommodation. The construction of new houses has helped in alleviating housing shortages. A majority of the new houses constructed in Mamfe Sub-division meets modern standards and are increasingly high rise buildings (Figure 3a). This has improved the living conditions of residents via access to modern amenities; improve safety and the aesthetics of the town.

Increase in food production is another positive implication of land use changes as reported by 51.2% of respondents. The expansion of agricultural land for the enhancements of food production has contributes to economic growth and greater food security since agriculture is the main economic activity Mamfe. This has also lead to a corresponding expansion of other related sectors such as food processing and distribution sectors in Mamfe Sub-division.

The findings revealed that 18.3% of respondents acknowledge that the construction of the Thermal Plan has impacted the lives of inhabitants in Mamfe Sub-division. Its construction and operation stimulates economic activities and create job opportunities in the energy sector (Figure 3b). The thermal power plants generate electricity production which contributes to meeting the energy demands of households and the manufacturing sectors. Energy is required for providing the inhabitants with water, heating and cooling, and other community functions such as powering homes with communication networks.

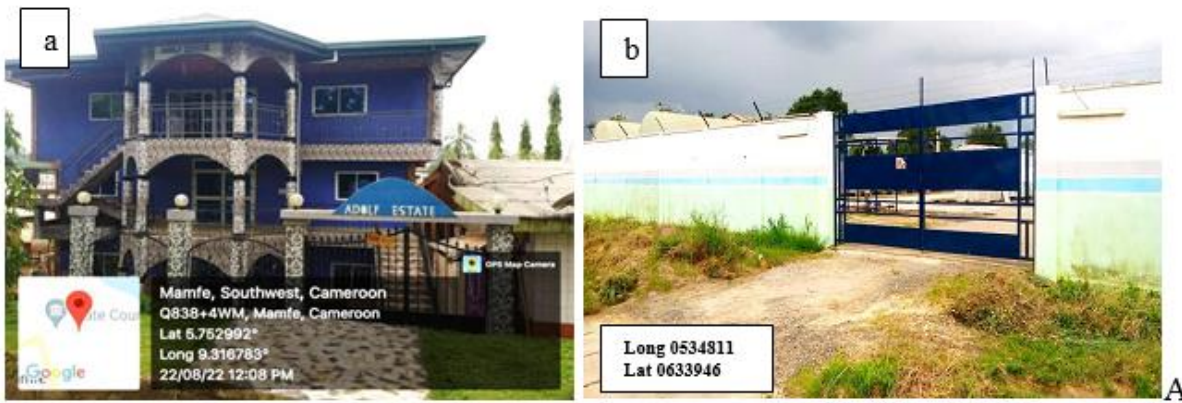


Figure 3: Infrastructural development in Mamfe Sub-division

- a) Shows a Newly constructed modern structure
- b) Newly Constructed Thermal Plan

Source: Field work, 2023

### Environmental Implications of Land Use Change

The land use changes in Mamfe Sub-division have resulted to environmental impacts such as loss of biodiversity, environmental degradation, climate change, and air and water pollution (Table 5). Since man do not only need food but also shelter and other socio-economic amenities to survive, the demand for forest products, agricultural land and built-up land has increased. Field investigations revealed that there is high exploitation of timber and Non Timber Forest Products including wild life within Mamfe municipality. These resources are exploited for home use and a substantial quantity is illegally exploited for commercial purposes resulting in habitat loss, reduction in the capacity of forests to store carbon, expose soils to erosion, and loss of livelihood and ecosystem services. This is in line with the findings of Maitima *et al.* (2004) who observed that deforestation is one of the most critical environmental problems faced by nearly all sub-Saharan African countries, with one of the major causes being the exploitation of wood for fuel use.

In addition, the expansion and the unsustainable management of farmlands such as over cultivation, insufficient crop rotation, excessive use of agrochemicals has resulted in soil degradation, depleting land productivity and threatening food security. The poor farming practices and techniques like burning of crop residues, improper application of fertilizers and pesticides has increased crop pest and disease, crop damage, water pollution, impacting aquatic ecosystems and human health. Furthermore, increase population and changes in land use has disrupted the traditional waste management practices that were previously effective in the small Sub-division. The increase generation of waste has overwhelm the existing waste management systems leading to inadequate disposal methods, poor sewage disposal, poorly managed swamps, poorly constructed toilets in Mamfe Sub-division resulting in air and water pollution with unpleasant smell and prevalence of diseases like Typhoid and Malaria. This supporting this finding, Junjie (2008) reported that the conversion of forest to agricultural land or for infrastructural development is linked to many environmental problems including loss of biodiversity, increase greenhouse effects, change in water cycle, soil erosion and degradation, air and water pollution, flooding and landslide.

Table 5: Summary statistics on the environmental implications of land use change

Variables	Obs.	Mean	Std. Dev	Min	Max
Land degradation	65	0.66	0.15	0.66	0.66
Climate change	26	0.27	0.12	0.27	0.27
Poor sewage disposal	7	0.07	0.1	0.07	0.07
Poor waste management	98	1	0.05	1	1

Poorly constructed toilets	65	0.66	0.14	0.66	0.66
Poorly managed swamps	31	0.32	0.2	0.32	0.32
Loss of biodiversity	2	0.02	0.1	0.02	0.02
Loss of wildlife	14	0.11	0.13	0.11	0.11

Fieldwork, 2023

Table 5, the high mean of 0.66 for land degradation suggests a strong concern (scale of 0-1) regarding potential loss of soil fertility, erosion, or deforestation. The perfect score (1.00) for waste management signifies a very high concern for inadequate waste collection facilities, leading to pollution and potential health risks. Also, the high mean (0.66) for poorly constructed toilets indicates a major concern for sanitation issues and potential health problems. The moderate mean value for of 0.27 for climate change effects indicates a fair concern to pollution and potential health risks. The low mean (0.07) reflects less concern for sewage disposal issues compared to other factors. The moderate to high mean (0.32) suggests concern regarding improperly managed swamps resulting to loss of habitat, biodiversity decline, or increased mosquito breeding grounds while the low mean (0.02) suggests minimal concern for biodiversity loss based.

**Socio- economic Impacts of Land Use Change in Memfe Sub-division**

Land use changes in Mamfe Sub-division has social and economic impacts on the livelihoods, wellbeing of the local communities, poverty and inequality, migration, limited access to social services and land use conflicts (Table 6). Field investigation revealed that a majority of the inhabitants end up migrating in search of employment and better opportunities leaving their homes and livelihoods due to the conversion of agricultural land for other developmental projects, land fragmentation and low output. This alters their local economic conditions, making it difficult for residents to sustain their livelihoods, thereby forcing some to migrate. In addition, land use changes have exacerbate poverty and inequality depriving the vulnerable group access to resources like land, water, energy among other natural resources. The limited access to potable water due to irregular supply of water, poor maintenance of existing water schemes, insufficient public taps/water points, drying up of water sources, and contamination of water sources has result in the prevalence of water borne diseases and high expenditures on drugs. In addition, the dispute over land rights and access to resources has resulted in the displacement of vulnerable groups, loss of livelihoods and heightened tensions between the different groups involve (Table 6).

Table 6: Summary statistics on socioeconomic implications of land use change

Variable	Obs.	Mean	Std. Dev	Min	Max
Limited livelihood opportunities	100	0.72	0.15	0.5	1
Poverty and inequality	80	0.65	0.2	0.4	0.9
Limited access to social services	50	0.42	0.25	0.1	0.8
Displacement and migration	120	0.88	0.18	0.6	1
Increased demand for services	90	0.75	0.19	0.5	1
Land use conflict	65	0.58	0.22	0.3	0.9

Fieldwork, 2023

Table 6 presents the different social and economic concerns of land use changes in the study area. Firstly, the high mean value of 0.72 for limited livelihood opportunities indicates significant concern as land use changes reduces the opportunities to earn a living leading to displacement, loss of traditional resources, or changes in agricultural practices. Also the high mean of 0.65 reveals increased poverty and inequality. Land

dispossession, limited access to resources, and job losses could exacerbate existing inequalities. The moderate mean (0.42) of limited access to social services shows concern on access to essential services like healthcare and education. The high mean of 0.88 signifies a very high level of concern regarding displacement and migration caused by land use changes. This could be due to factors like large-scale development projects, resource scarcity, or environmental degradation. The high mean (0.75) for increased demand for services reflects concerns for increased need for resources like water, sanitation, and healthcare due to changing land use patterns. Land use conflicts mean (0.58) indicates a concern for disputes arising from changes in land use. This could involve competition for resources, disagreements over ownership rights, or conflicts between different user groups.

## CONCLUSION AND PLANNING IMPLICATIONS

The study examines land use changes and implications on urban planning in Mamfe Sub-division. This is a valuable effort because the environmental degradation occurring from improper land use is becoming a serious problem and a challenge to the Sub-divisional authorities and the local population. Land use change is indispensable and essential for economic development and social progress. The economic cost on infrastructural development are often factored into land use decisions as they have direct impact on the profitability and feasibility of the project such as the construction of tarred roads, modern houses, the thermal plan and increase in food production in Mamfe Sub-division. While the environmental impacts of such projects are not fully considered leading to loss of biodiversity, land degradation, climate change, and air and water pollution. In addition, the socioeconomic implications of land use changes has limited livelihood opportunity, increase poverty and inequality, limited access to social services, displacement and migration, increase demand for services and land use conflicts. Therefore, land conservation is a very vital in achieving long-term socio-economic growth and sustainable development. Land use policy, however, must strike a balance between land use changes for developmental purposes and environmental sustainability and the well-being of the inhabitants.

Addressing these negative impacts requires a holistic, integrated land use planning and participatory approach that incorporates social, economic and environmental considerations as well as a meaningful engagement with affected communities and stakeholders. This can be done through the development of a comprehensive land use plan that incorporate ecosystem based approaches such as conservation and restoration of natural habitats, green infrastructure and sustainable planning principles. In addition, Environmental Impact Assessments should be conducted before any major land use change to identify potential environmental risks and develop mitigation measures. It is also very important to engage the inhabitants of Mamfe Sub-division and the stakeholders in land use planning and decision-making processes to ensure that their knowledge, experiences and concerns are incorporated. This will help to prevent land use conflicts and promote social equity. Furthermore, sustainable land management can be achieved through practices like agro forestry, conservation agriculture, integrated water resource management to minimize environmental impacts and increase productivity. Strengthening land tenure security, particularly among vulnerable groups encourages long term stewardship of the land and natural resources thereby reducing the risk of environmentally damaging practices. Educative seminars on the importance of sustainable land use practices and the role in maintaining ecosystem services and human well-being should be enhanced. In addition, the need for the development and enforcement of environmental policies, laws and regulations to guide land use change such as zoning regulations, environmental protection laws and green infrastructure is required. Lastly, to establish a system to monitor and evaluate impacts of land use changes, assess the effectiveness of mitigation measures and adapt plans when necessary. The implementation of these strategies, will lead to better plan for land use changes and minimize their potential impacts, ensuring a more sustainable and resilient future for the inhabitants of Mamfe Sub-division and the natural environment.

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