Land Use Changes and Implications for Food Production Planning in Peri-Urban Ruiru Sub-County, Kenya

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Abstract

Despite the critical role of agriculture in Kenya's economic development, conversion of prime agricultural land to concrete landscapes is increasing at a worrying trend, thus putting national food sovereignty and overall environmental quality at risk. This study investigated this dimension using Ruiru Sub-County as a case study. The aim was to trigger land use planning and policy changes towards a balanced approach between emerging real estate markets and saving agricultural land for posterity. Geographic Information System procedures were used to map land use and land cover changes from 1988 to 2024. Results showed that by 2024, land under agriculture had reduced by 45.62% while urban land use had increased by 509%. Similarly, bare and rocky area increased by 133%, which was indicative of increasing land loss to abandoned stone mining quarries. Decline in land sizes also means reduced area under industrial crops like coffee and tea, and hence the shift to leafy vegetables and annual crops demanded by the increasing urban market. Further, expected increase in intensive peri-urban farming systems, will likely be accompanied with heavy use of agro-chemicals. Therefore, there is need for policy interventions to save agricultural land from unregulated competing uses and also to integrate environmental management best practices in County land use master plans.

Keywords: *Land Use Changes, Food Sovereignty Planning, Peri-Urban Ecosystems*

Introduction

According to the World Bank Group (2025), 70% of the world population will be living in urban areas by 2050. Similarly, UN Habitat (2021-2025) projects that more than 50% of Kenya's population, currently estimated at 47.6 million (Republic of Kenya, 2019a) will be living in urban areas by 2050. With a population growth rate of 3.75% (Trading Economies, 2025), the pressure on available land can only increase resulting into more shifts in land use away from agriculture and directly impacting potential food production. As extensive agriculture declines, intensive agriculture becomes the norm and with it heavy use of agro-chemicals. This land use system will dominate urban and peri-urban areas as a response to expanded food markets from increasing population (Luggen-Hölscher, 2023). But whether intensive peri-urban agriculture will be accompanied with requisite environmental management like greening strategies and pollution prevention remains a moot question. Further, declining farmland will incentivise encroachment on sensitive ecosystems like wetlands and steep lands, thus triggering risks of soil degradation and loss of unique biodiversity and other negative environmental changes like land use conflicts that ultimately undermine human well-being (Kiio & Achola 2015; Siro & Sichangi, 2017; Mbungu & Kashaigili, 2017). Kenya and other countries experiencing land use changes away from agriculture need to be aware of this reality and plan for appropriate mitigation measures toward sustainable land management, here-in understood as use, care and improvement of land to meet intra and inter-generation needs therefrom.

Although conversion of prime agricultural land to physical infrastructure is an economic response to the expanded profit-making opportunities, its threat to food and nutrition security cannot be ignored (Salem *et al.*, 2020; FAO *et al.*, 2023). Therefore, understanding the consequences of horizontal expansion of concrete landscapes is essential in land use planning toward more resilient peri-urban agriculture (Republic of Kenya, 2008). By resilience is meant the ability of land as an ecosystem to withstand anthropogenic perturbations and keep itself with inherent thresholds of quality and health, by being able to bounce back to normal state when pressure put on it is eased. The natural resilience of ecosystems has been conventionally assessed by among others the richness of its floral and faunal biodiversity (Vasiliev, 2022). Accordingly, floral biodiversity would be key in peri-urban ecosystems. This position is also supported by the United Nations Environment Management Group (UNEMG, 2024), which affirmed the need to prevent the degradation and destruction of natural habitats in the transformation of urban and peri-urban areas.

At the global level, the United Nations Environment Programme's united for land agenda signifies a united push to prioritize healthy land ecosystems by combating land degradation and desertification (UNEP, 2024) Although aligned to the United Nations decade on ecosystem restoration (2021-2030), this agenda can however be expanded to include saving significant portions of the healthy land ecosystems from becoming concrete landscapes. The role of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in this regard, especially through its education for sustainable development programmes (UNESCO, 2020) remains paramount. In Kenya, significant research has been done on land use land cover changes with most of it focussing on declining area under agriculture. Little attention has however been put on how to mitigate emerging and future challenges like future food insecurity, land degradation and pollution, preservation of pristine ecosystems and safeguarding overall environmental health (Mango *et a.l,* 2011, Musa & Odera, 2015; Njiru, 2016; Abuya *et al*., 2019; Sheate *et al.,* 2012; Kauti & Kieti, 2016). This explains the focus of this paper on exploratory scenarios based on declining prime agricultural land. Exploratory scenarios analysis attempts to plausibly predict the future based on current happenings, in order to mitigate potential negative outcomes and maximise potential positive outcomes. On the other hand, anticipatory scenarios analysis paints a picture of the desired future and deploys strategies and approaches for its realisation. This paper discusses what the future may look like in Ruiru Sub- County as a consequence of changing land use and land cover away from agriculture and in favour of concrete landscapes.

From a micro-economic perspective, the shift in land use away from agriculture has been largely attributed to potentially higher profits from real estate commensurate with increasing population (National Council for Population and Development, 2018). This explains why this land use trend is particularly rife in spaces where private land tenure and free market economic systems reign. Peri-urban areas are hotspots in this regard. The apparent increased fragmentation of land in these areas makes it impractical and uneconomical for large-scale farming. As a rational response, majority of the farmers tend to convert their diminished farms into residential plots for perceived better incomes. Those who must continue farming equally shift from perennial plantation crops to alternatives that urban population demands on a daily basis. To sustain their supply necessitates maximised yields per unit area, hence heavy use of external inputs like fertilisers and other agro chemicals. The combination of concrete landscapes and intensive agriculture in such spaces increases the risk of biodiversity loss and pollution of land and water resources. This paper provides future scenarios in this regard in order to prepare the ground for timely planning to adapt and mitigate negative impacts of land use changes. While the focus of this paper is not to quantify the extent to which land use changes have impacted various aspects of peri-urban ecosystems, suffice is to say that extensive research around this theme in the context of sustainable solutions. For example key highlights when it comes to the nexus of physical and land use development and urban and peri-urban agriculture include how to retain sufficient green spaces, how to reduce domestic effluent and Garbage Rivers, how to safeguard public health against pollution driven risks, how to transition to environment-friendly practices, how to scale out water and space saving technologies and how to mainstream urban and peri-urban agriculture in formal urban planning (KIPPRA, 2015; Ogendi *et al.*, 2019; Kitulu *et al.*, 2020; Tomno *et al.*, 2020; Waswa *et al.*, 2020; UN Habitat, 2023; Maina & Waiganjo, 2024; Verheyden, 2025). These inter-linked challenges are a clarion call for re-imagined and re-engineered land use planning towards county and national food sovereignty, and environmental management for posterity as observed by among others Waswa (2019) in Kiambu County, Kenya.

According to the Kiambu County government, the average land size for majority small scale farmers is now estimated at 0.36 ha. Similarly, Abuya *et al*. (2019) observed that land use changes resulting into encroachment of development on forest cover and riparian reserves, expose human populations to disasters and calamities in cases of climate change. This emerging threat is fuelled by inadequate inter-agencies, coordination and collaboration when it comes to land use planning, which makes it difficult for the County government to align its development to sustainable development goals as envisaged in its integrated development plan of 2023-2027. All the changes highlighted above, point to a future of declining natural floral biodiversity, increased land and water pollution due to intensification of agriculture and other unintended environmental changes, land loss and degradation caused by quarries (Wangela, 2019). Formerly prime agricultural land converted into quarries are often left un-rehabilitated, thus introducing other socio-economic and environmental challenges whose mitigation are not captured in development plans. Recognizing these challenges, the Kenyan government has initiated efforts to rehabilitate such sites nationwide, with view of creating economic opportunities for local communities (Kenya News Agency, 2025).

Food Security-Food Sovereignty Nexus

In interrogating the potential relationships between land use changes and food production, a paradigm shift from food security to food sovereignty is adopted. According to FAO (2006) food security is a situation where all people (in a defined place) at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The integrated nature of this definition in terms of planning cannot be overemphasised. Its operationalization must this entail both domestic production and food importation, in addition to value addition as captured by pathways ABC and DBC in figure 1.

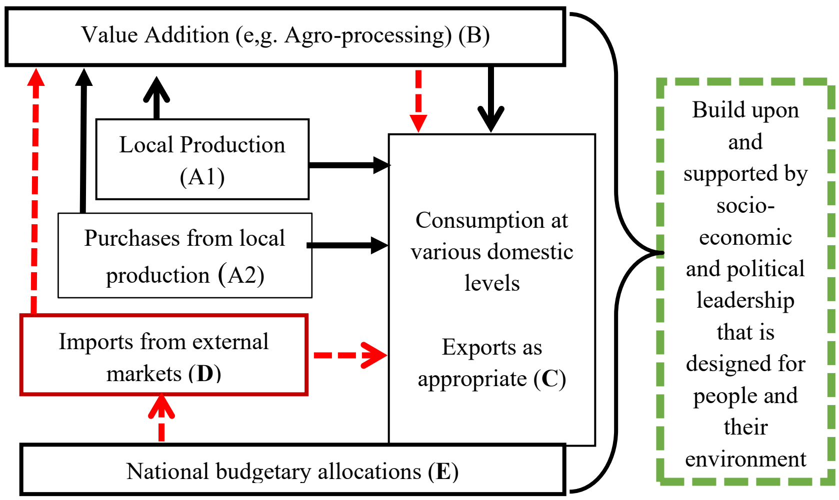

Figure 1: Food security-food sovereignty a conceptual framework

Although this definition remains a conventional planning tool, its superiority is often undermined when governments begin to emphasise the dimension of food imports at the expense of domestic production. This is particularly true for example in Kenya, where food commodities that can be produced locally are often imported (KNBS, 2023). This is no doubt a key disincentive against local production with the net effect of undermining livelihoods of majority rural households that depend on agriculture. It is therefore no wonder that de Jong *et al* (2024) observed that more than 70% of Kenya's population was severely or moderately food insecure in 2023. Further to import food nationally and purchase food locally, the nation and its people must have income from whichever sources. Besides other factors, income poverty is widely acknowledged as a key driver of food insecurity among majority rural and slum households in Kenya (Indepth Research Institute, 2023). As such, to empower such households to produce their own food in sufficient quantities would lessen the indignity caused by food scarcity. The role of political leadership in this regard cannot be overemphasised.

On the other hand, food sovereignty paradigm emphasises local production and zero food imports. It support people's rights to define their own food and agricultural systems, which thus makes them sovereign in that regard (Wittman, 2023). Ultimately, such a nation becomes a net food exporter, but may import food commodities that cannot be produced locally. Accordingly in conceptualising food sovereignty, only pathway ABC in figure 1 above applies. This would call for deliberate effort (policy and practice) to save as much agricultural land as possible from conversion to non-agricultural use, and instead through technology maximise local production therefrom. In a scenario where a nation has income but cannot access import markets, food security becomes an illusion. Consequently, a country that is food sovereign is more likely to be food secure. However, in both paradigms, people and environment based policy frameworks are needed to guarantee intra and inter-generation equity within the possible food systems and their value chains.

The preference of using food sovereignty to food security in this paper is meant to re-invigorate a new debate in development policy that questions why the long held food security paradigm has also been consistently associated with food scarcity and serious hunger levels in Kenya (Farm Africa, 2019; Global Hunger Index, 2024). Addressing these challenge and other complex relationships in the context of land use changes will also help particularly in the realization of United Nations sustainable development goals 1, 2 and 15 on eradication of poverty, eradication of hunger and food insecurity, and appropriate use of terrestrial ecosystems like land, respectively.

Methodology

Study Area

This study was done in Ruiru Sub-County, which is part of the Kiambu County in central Kenya (Figure 2). This area is generally classified as the coffee zone, which is representative of prime agricultural land that can support a variety of crops. Its proximity to Nairobi, Kenya's capital city has necessitated rapid changes in land use as owners seek to maximise their income levels from the high demand for housing. With increasing population currently estimated at over 299,000 in 2019 (County Government of Kiambu, 2016), loss of agricultural land to physical infrastructure is a policy question that demands urgent solutions in the interest of food and income security.

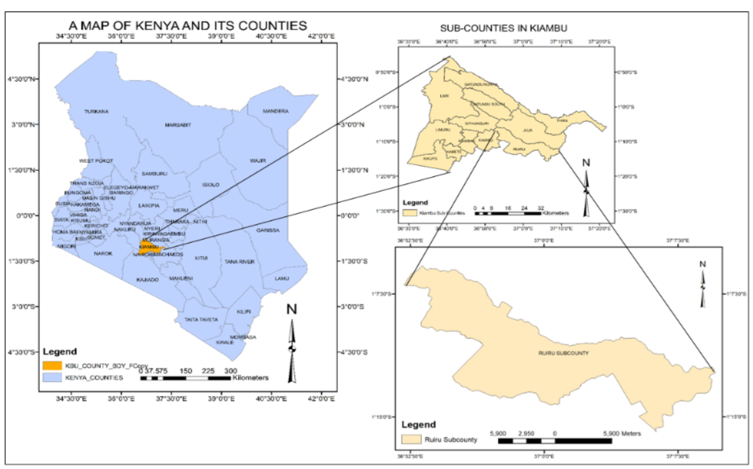

Figure 2: Location of Ruiru Sub-County in Kenya (Source: Yego, 2019)

Research Design and Data Collection Methods

The overall research plan that guided this study is as shown in Figure 3. Standard geographical information system (GIS) procedures as described by Lillesand and Kiefer (2008), Kausar (2016) were used to collect and analyse spatial data obtained from geo-referenced Landsat TM and ETM+ Multi-temporal images specific to this study. Multi-temporal sets of Landsat images for the years 1988, 1999, 2010, 2016, 2000 and 2024 were used to track land use land cover changes. The spatial scope and degree of land use and land cover changes were then analysed and quantified. The data was verified by on-ground reality checks and through interviewing land users on key variables that were essential to this study. The final product was land cover maps and tabulated changes across the said time period.

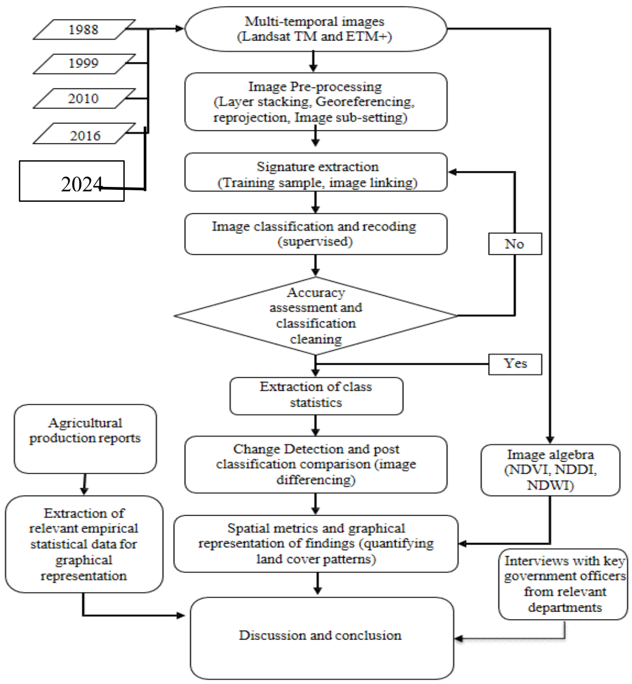

Figure 3: Overall research plan used

Accuracy Assessment

With a range of 83.75% to 90.63%, accuracy of assessment was considered as generally high (Table 1). The error matrix also indicated a significant overlap between urban and bare land classes, which was even more evident in the 1988 as no difference in spectral reflectance was evident even after 36 classes were re-coded. Around this period, area under urban use was also not expansive. Change detection indicated a significant correlation between agriculture and vegetation, which implied that the two land covers have close spectral reflectance, and classification could not in essence separate their overlaps. This also meant that the conditions that support crop farming also support vegetation cover. The overall classification accuracy showed that the total number of correctly classified pixels was high and that the land cover types chosen were correct. Consequently, the statistics generated from the images can be relied upon for scientific inferences.

Table 1: Landsat imagery classification accuracy assessment (%) – 1988-2016

	1988		**1999**		**2010**		**2016**	
Land Cover	Accuracy	Kappa	Accuracy	Kappa	Accuracy	Kappa	Accuracy	Kappa
Agriculture	89.13	0.82	90.91	0.93	89.74	0.82	86.84	0.8360
Urban	0	0	80.00	0.85	82.76	0.80	83.33	0.80
Bare land and rocks	84.62	0.78	90.32	0.85	83.87	0.84	85.29	0.82
Vegetation	85.71	0.79	90.63	0.89	87.88	0.79	84.85	0.85

Water	83.33	0.80	83.33	0.82	81.48	0.82	87.50	0.78
Herbaceous grassland	84.38	0.77	90.32	0.85	84.85	0.85	84.85	0.85
Overall	83.75	0.7950	90.63	0.8894	85.42	0.82	85.42	0.82

Target Population and Sample Size

The target population consisted of ordinary land users the sub-county, whose projected population as at 2017 stood at 299,067 people (County Government of Kiambu, 2016). The sample size calculated based on Slovin's formula (Sciencing,2024) for random sampling, thus:

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

Where: n is sample size, N is study population, and e is coefficient (α=0.05).
Accordingly n was given as:

$$n = \left\lfloor \frac{299067}{1+(299067\times 0.05^2)} \right\rfloor = 399.4657 = 399 \text{ people}$$

The effective sample size based on the number of questionnaires that were returned was 243 (61%). This was considered adequate for generalised deductions and thus used in this study. The key informants included the County Planning Officers, Agriculture Officers, Local administration and local opinion leaders. Trends in crop yields were obtained from County agricultural statistics. These data sets were used to perform an exploratory scenarios analysis on food production and environmental changes to be expected.

Findings and Discussion

Normalized Difference Vegetation Index

From the Normalized Difference Vegetation Index (NDVI) analysis, the main part of the area having higher NDVI value is in the lower southeastern slopes of Aberdare ranges where coffee is grown (Figure 4 and 5). The negative NDVI values indicate bare lands and rock cover. In many cases, bare land had patches of grassland and shrub resulting in values close to zero. The lower values of NDVI were found to the southeastern parts of the sub-county, which borders Juja Sub- County and Ruai town in Nairobi County. These areas have generally poorly drained soils. The northwestern vegetated part of the area was characterised by a reduction in concentration of the high value pixels, which was indicative of loss of vegetation cover. This loss of vegetation cover was attributed to deforestation and the decline in plantation coffee farming in favour of land fragmentation and construction of homes to accommodate the growing population.

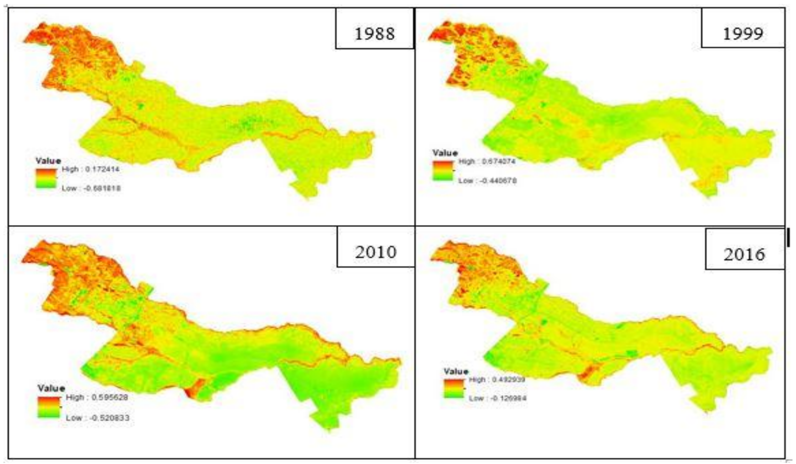

Figure 4: NDVI maps indicating indices distribution for the different time epochs

Further, there was a consistent increase in area under bare land and urban settlements. It was evident that the south-eastern part of the study area which borders Juja Sub- County and Ruai town was fast changing from agriculture and grassland cover to bare and rocky landscape (Figure 6 and 7).

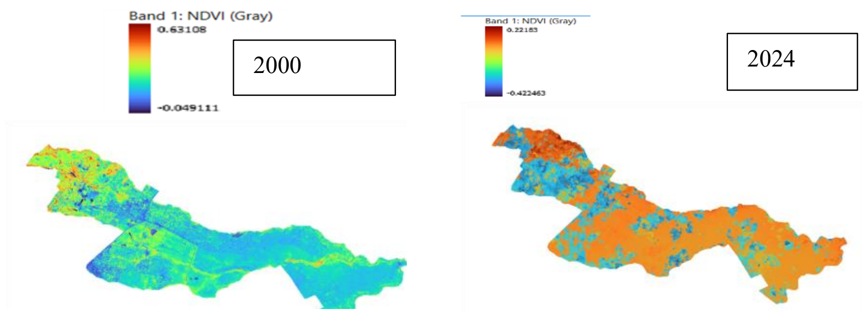

Figure 5: NDVI maps indicating indices distribution for the different time epochs

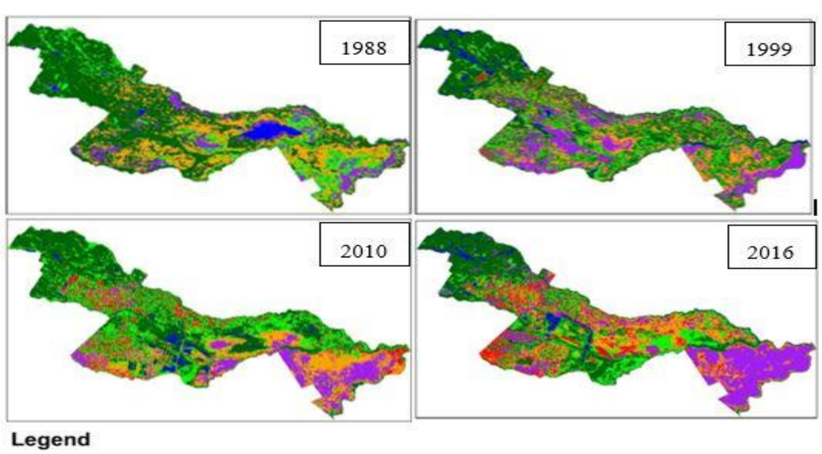

Figure 6: Classified land use land cover types mapped in mapped in 2018

Water and Marshes | **Vegetation** | **Bare land and rocks**
Agriculture | **Urban area and settlement** | **Herbaceous grassland**

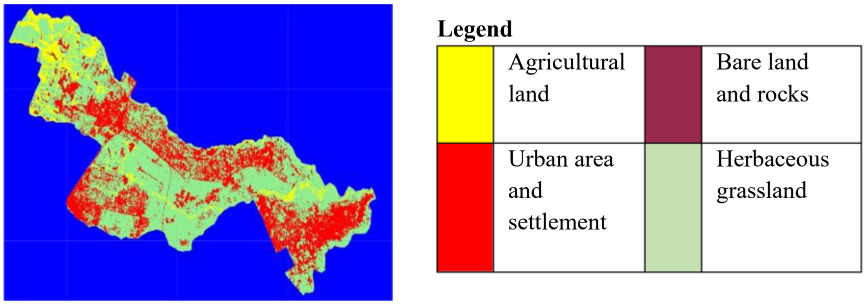

Figure 7: Classified land use land cover types mapped in 2024.

Trends in Land Use Land Cover Changes

The highest single land use in the study area in 1988 was crop farming, while urban area was insignificant. By 2024, land under agriculture had reduced by 45.62% while urban land use had increased significantly by 509% (Table 2).

Table 2: Area in hectares for each land use class for the year 1988-2024

Land cover	1988	1999	2010	2016	2024
Agriculture	10,731.20	9,239.58	7,153.20	6,174.85	5835.47
Urban	--	453.33	1,815.30	2,316.40	2763.45
Bare land & rocks areas	2,124.36	3,716.10	2,732.85	4,640.24	4951.53
Vegetation	2,812.32	2,845.89	4,874.76	3,282.07	2520.63
Water	533.16	591.57	542.43	541.32	526.70
Herbaceous grassland	4,438.80	3,641.49	3,366.72	3,465.45	3170.67

This significant decline in agricultural land translates into potentially reduced crop yields ceteris paribus. The expected human response to maintain high productivity will be intensive use of land, with agrochemicals playing a key role. The risks of land and water pollution and loss of biodiversity become obvious outcomes. In some cases responses to declining land may be encroachment on protected areas and or sensitive ecosystems like wetlands, which further reduce their health and resilience. The decline of land under water from 533 ha in 1988 to 526 in 2024 is indicative of such an outcome. Increase in urban land area equally implies decline in the natural biodiversity and resilience of urban and peri-urban ecosystems. Without a concurrent greening policy, the overall natural aesthetics would be lost.

The increase in area of bare land and rock by 133% from 1988 to 2024, and reduction in herbaceous grassland by 28.6% in the same period was also attributed to increased urban growth and support physical infrastructure including concomitant changes in land conditions due to earth movement and quarry formation. In most cases, new buildings were constructed on prime agricultural land, which translated into a loss of other ecosystem services essential for human well-being. If this trend continues uncontrolled, environmental resilience and hence performance will be compromised through declining floral biodiversity, thus undermining sustainable development goals 15 on protecting, restoring and promoting sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt loss of biodiversity. The policy dilemma is how to balance private property rights to land use and saving prime agricultural land for food production and nature conservation for enhanced ecosystem health.

Trends In Cropped Land and Yields in Ruiru Sub-County (2013-2016)

Results from the questionnaire survey showed that up to about 2016, the proportion of people with farmlands smaller than 10 acres increased from 95% to 97.5%. Similarly, land covering between 10-20 acres declined by more than half in the same period, which was indicative of declining large-scale commercial agriculture, in favour of a combination of agriculture and commercial (rental flats) or residential use which are perceived to be more profitable than farming alone in the current national economic dispensation. Beans (*Phaseolus vulgaris* L.), and maize (*Zea mays* L), though on a declining trend, have remained by far the most popular field crops (Figure 8 and Table 3). This may suggest a shift to alternative high value crops like vegetable and tomatoes (*Solanum lycopersicum* L), that are on high demand from the increasing urban and peri-urban population.

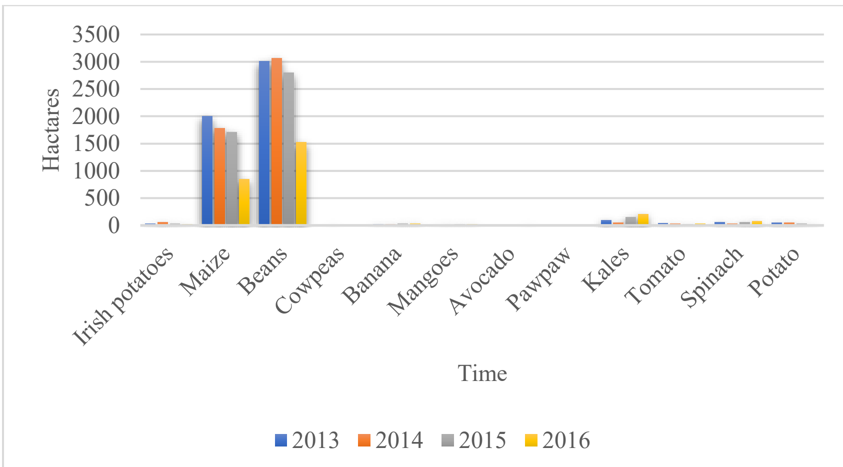

Figure 8: Trends in land area for popular crops in Ruiru (2013-2016)

On the other hand, banana (*Musa paradisiaca* L) production exhibited a continuous growth through the four years both in hectare and yields at 55.56% in area and 113.88% in tonnage, respectively. The incentive was likely the ready market both locally and in the neighbouring Nairobi County. The area under fruits and vegetable kept fluctuating but the general trend indicates a decline. Yield on the other hand appear to have been increasing with time, which is a response to strategic and better crop husbandry to take advantage of the ready and increasing market from the ballooning urban population. The performance of Kales (*Brassica oleracea* L var *acephala)* in particular is indicative of the special role of this vegetable on every dinner plate in Kenya's urban population. The trend at the County level indicates a steady increase in land under maize and bean production. Yields however show fluctuations that could be attributed to a myriad of factors such as pests and diseases, market forces and crop husbandry challenges (Figures 9 and 10).

Table 3: Trends in yields of popular crops in Ruiru (2013-2016)

Crops	Yields in tons			
	2013	2014	2015	2016
Irish potatoes	210	560	268	123
Maize	120,000	89,375	89,000	47,650
Beans	5392	6060	5000	2945
Cowpeas	61	182	156	59
Banana	117	138	250	251
Mangoes	44	70	118	104
Avocado	47	44	238	240
Pawpaw	14	24	33	27
Kales	711	637	1,674	1,864
Tomato	450	440	339	389
Spinach	198	152	215	234
Potato	316	114	195	60

Source: Kiambu County Agriculture Office, 2019

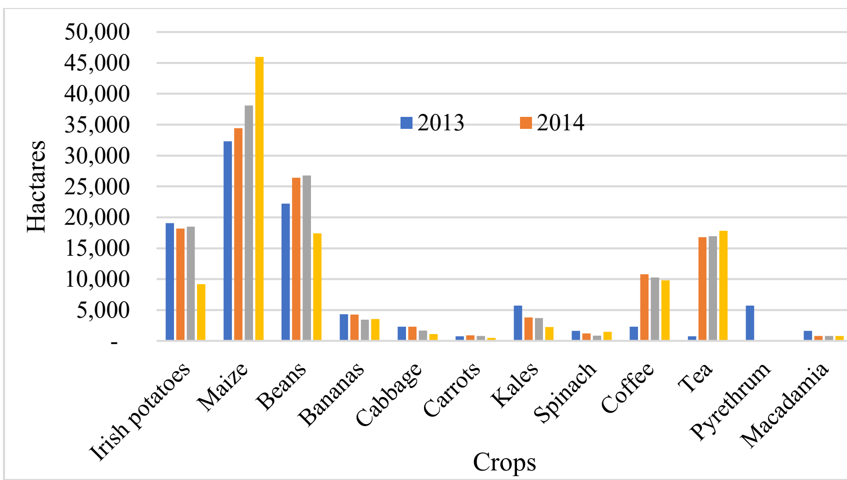

Figure 9:Trends in land area for popular crops in grown in Kiambu County (2013-2016). Source: Kiambu County Integrated Development Plan 2018-2022

Of particular importance is the apparent reduction in area under coffee *Coffea arabica* L., a trend attributed to the increasing demand for commercial housing that is being actualised by private developers. Given that less than 30% of Kenya is arable land, the sum total of prime land taken out of agriculture by all land buying and real estate companies is significant. Recent statistics (World Bank Group, 2024) estimates arable land at 10.2% of the total land area with potential to further decline due a myriad of factors like land degradation and effects of climate change. The future well-being of populations in such emerging concrete landscapes will be at risk in the absence of integrated, inter-agency approaches and strategies that pro-actively balance profiteering, social welfare and environmental conservation.

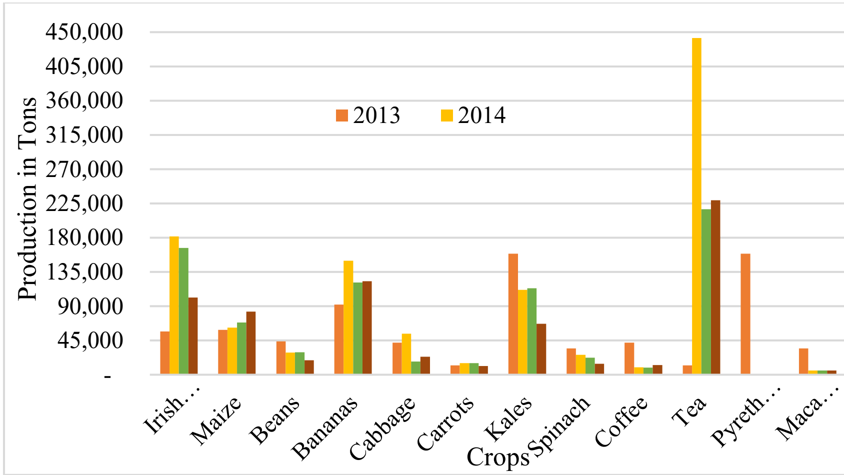

Figure 10: Trends in yields of popular crops grown in Kiambu County (2013-2016). Source: Kiambu County Integrated Development Plan 2018-2022

Scenario for Future

That about 88 % of the respondents pointed to a situation of future severe food insecurity in Ruiru Sub-county is a pointer to the potential effects of reducing land area for forming. The response by only 5.8% on sufficiency of supply from external sources is indicative of fear and worry about meeting food demands especially for low income urban households. The 3.3% who were confident that the future holds plenty is premised on their financial security and ability to profit from the expanding urban food market. While food security may be achieved through purchases from external sources, accessing food by those handicapped by finances will be difficult. This gives credence to the shift in policy paradigm from food security to food sovereignty. As mitigation measures 57% of the respondents indicated the need to invest in modern farming methods – herein meaning sustainable intensification that would guarantees increasing demand for food (Table 4).

Table 4: Respondents' opinions on how to secure future food security

Interventions	Frequency	% Frequency
Reduce land fragmentation	39	16.0
Adopt modern farming methods	139	57.2
Educate farmers on modern farming methods	16	6.6
Government should allocate more land to farmers	12	4.9
Reduce land sale	5	2.1
Others	17	6.9
Missing	15	6.2

Inherent in the opinions to reduce land fragmentation and the need for government to reduce land sales, are hidden concerns against conversion of prime agricultural land to real estate development. Since more than half of Kenya's population will be living in urban area by 2050, sustainable urban and peri-agriculture needs to be mainstreamed in land use master plans across counties. By implication, policy frameworks that invigorate agricultural extension and regulate changes in land use would add value to desired land productivity and environmental performance indicators.

Already, policies, strategies and measures necessary to optimize opportunities and potentials and resolve challenges relating to physical and land use development planning in Kenya are envisaged at both the national and county levels (Republic of Kenya, 2019 b). By stipulating environmental management best practices in its master land use plan, the County Government of Kiambu appears to have noticed the danger of ad hoc and unregulated land use planning (County Government of Kiambu, 2023). However, without specifying the need to save prime agricultural land, enforcing conservation measures against land loss and degradation will remain a key governance challenge. Beyond saving prime agricultural land and enhancing food production, the resilience of increasing peri-urban ecosystems needs to be enhanced through appropriate policy and practical measures against de-vegetation, deforestation and water pollution among other environmental performance indicators (FAO, 2001). Most critical, the absence of a national policy on urban agriculture in Kenya (Omondi, 2020) will only add to the challenges of enforcing people and environment friendly land use practices in such ecosystems.

Conclusions and Recommendations

Conclusions

Ruiru Sub-County is undergoing rapid and significant land use changes away from large scale agriculture in favour of real estate and its support infrastructure. This has been attributed to the perceived superior and predictable profits associated with investments in human settlement. Agricultural land is also being lost to un-rehabilitated quarries. The apparent net loss in prime land will likely undermine future county food production and investment in agro industrialization due to the shift from plantation crops like coffee and tea to leafy vegetables and annual crops. Further, intensive production systems will dominate the declining peri-urban farmland, with the high likelihood of heavy use of agro-chemicals and hence concomitant risks like water and land pollution.

Recommendations

To save agricultural land for posterity, there is need to regulate land use changes, the sanctity of the title deed notwithstanding. The county government of Kiambu should acquire much of the prime land regularly advertised for sale and convert it into County green belts for food production and nature conservation. Further, there is need for pro-active policy interventions to save agricultural land from unregulated competing uses and also to integrate environmental management best practices in physical and land use planning. This should be followed by pro-active monitoring and enforcement of long-term County land use master plans that are aligned to sustainable development agenda. Private developers should thus be expected to integrate environmental management strategies like greening orders, soil and water conservation measures, pollution prevention orders and rehabilitation of quarries within their real estate development plans. The challenge of quarries can be solved by re-shaping and converting them into water reservoirs to receive and store runoff for irrigation agriculture or depending on their location, be landfills and later be turned into recreation parks. This calls for multi-stakeholder integrated approaches that give room for synergistic partnerships for concrete action plans in the context of sustainable land management (use, care and improvement of available land).

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Conflict of Interest

The authors confirm no conflict of interest on this paper

Author Contributions

Author 1 prepared the draft paper and was in charge of overall quality control of the paper
Author 2 did the spatial survey and mapped the land use changes through time
Author 3 provided extra proof reading of the manuscript for quality control.

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