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Research Article

Food Security Under Pressure: Land Use Patterns and Sustainability in the IGAD Region

Mansoor Ali*

Department of Geography and Environmental Studies, Samara University, Afar, Ethiopia

Abstract

The Intergovernmental Authority on Development (IGAD) region in the Horn of Africa faces persistent food insecurity despite significant agricultural potential, largely due to unsustainable land use patterns, rapid population growth, climate variability, and land degradation. This study examines the relationship among land-use dynamics, agricultural productivity, and food security across IGAD member states from 2010 to 2020. A mixed-methods approach is employed, combining quantitative analysis of secondary data from FAO, World Bank, UN agencies, and IGAD reports with qualitative assessment of policy and institutional frameworks. Findings reveal that although total cropland and cereal production have increased across most countries, per capita cropland availability has declined, indicating rising demographic pressure on limited land resources. Ethiopia and South Sudan show notable improvements in cereal yields and production efficiency, while Somalia, Djibouti, and Eritrea continue to experience persistent deficits due to climatic shocks, limited arable land, and weak agricultural systems. Land conversion from forests and rangelands to cropland has improved short-term food supply but raised concerns about long-term environmental sustainability, soil fertility loss, and ecosystem degradation. Overall, the region remains in a fragile state of near food balance, with significant intra-regional disparities. The study concludes that sustainable land management, strengthened land governance, climate-smart agriculture, and regional cooperation are essential to achieving long-term food security and sustainability in the IGAD region.

Keywords

Food Security, Land Use, Sustainability, Cereal Production, Agricultural Productivity

1. Introduction

The Intergovernmental Authority on Development (IGAD) region, comprising Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, and Uganda, occupies a strategically important geographical position in the Horn of Africa. The region is characterized by highly diverse ecological zones ranging from arid and semi-arid lands to highland and tropical environments, alongside uneven socio-economic development and persistent political instability. These structural conditions make the region highly vulnerable to recurring droughts, land degradation, rapid population growth, and conflict-induced displacement. Collectively, these challenges place intense pressure on livelihoods, natural resources, and development systems.

Among the most pressing development challenges in the region are food security and sustainable development, both of which are fundamentally dependent on the management, access,

*Correspondence: Mansoor Ali (ali.mansoor0223@gmail.com)

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and utilization of land resources. Land forms the backbone of agricultural production, ecosystem stability, and rural livelihoods. However, unsustainable land use practices—intensified by demographic expansion, environmental degradation, and climate variability—continue to undermine food security across IGAD member states [12, 20]. According to the FAO, food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life [10]. In contrast, sustainable development refers to development that meets present needs without compromising the ability of future generations to meet their own needs [44].

The IGAD region covers approximately 5.2 million square kilometers and supports a population exceeding 290 million people, the majority of whom reside in rural areas and depend directly or indirectly on agriculture for their livelihoods [43, 47]. More than 80% of the population relies on agriculture, particularly rain-fed farming and pastoralism, both of which are highly sensitive to climatic variability. The expansion of agricultural activities into marginal lands, combined with overgrazing, deforestation, and weak land management systems, has accelerated soil erosion, reduced soil fertility, and lowered agricultural productivity [13, 42]. These environmental pressures are further compounded by widespread food insecurity driven by conflict, displacement, weak governance structures, and inadequate infrastructure [16].

Historical land tenure changes during colonial and post-colonial periods disrupted traditional communal and pastoral systems, often marginalizing smallholder farmers and pastoral communities [7, 27]. More recently, urban expansion, commercial agriculture, and large-scale land investments have intensified competition over land resources and contributed to environmental degradation [18].

Climate change has emerged as a major driver intensifying these challenges. Rising temperatures, erratic rainfall patterns, and increasingly frequent droughts have reduced agricultural viability and triggered migration, livelihood diversification, and conflicts over natural resources [21]. Extreme events such as the 2010–2011 Somalia famine highlighted the fragility of local food systems and the collapse of pastoral livelihoods [11, 14]. Consequently, climate-resilient practices such as agroforestry, conservation agriculture, and sustainable rangeland management are increasingly promoted to enhance food security and restore ecosystem functions. However, their effective implementation requires strong institutions, secure land tenure, coherent policies, and active community participation.

Therefore, the understanding of food security in the IGAD region requires a comprehensive examination of land use patterns within a sustainability framework. Effective land use planning must balance food production needs, environmental conservation, and equitable access to land. Regional initiatives such as the IGAD Drought Disaster Resilience and Sustainability Initiative and the Regional Food Security and Nutrition Strategy further underscore the importance of coordinated regional responses to these interconnected challenges [19, 20].

2. Objectives of the Study

Food security and sustainable development remain among the most pressing and interconnected challenges facing the IGAD region. Rapid population growth, climate variability, land degradation, and unsustainable agricultural practices continue to place enormous pressure on land resources and food systems across member states. Understanding how land use changes and their dynamics influence food security is, therefore, essential for designing effective policies and development strategies. This study aims to provide a comprehensive analysis of the relationship between land use patterns, agricultural productivity, and sustainable development in the IGAD region. By establishing both general and specific objectives, the research seeks to contribute to academic understanding, policy planning, and practical interventions that can address these interrelated challenges.

The general objective of this study is to examine and analyze the impact of land use changes and their dynamics on food security and sustainable development in the IGAD region, and to propose integrative, evidence-based strategies that can strengthen resilience and promote long-term sustainability. The study seeks to understand how land management practices shape agricultural productivity, food availability, and environmental sustainability across the region.

To achieve this broad objective, several specific objectives are formulated. First, the study aims to examine the current patterns and trends of land use in the IGAD region, with particular emphasis on agricultural systems and their influence on food availability and food security. Second, it seeks to assess the relationship between land use changes and food security outcomes, including production and availability of Foodgrain across IGAD member states. Third, the research intends to analyze the socio-economic drivers of land use change, such as population growth and cropland availability in hectares per capita. Fourth, it investigates the productivity of cereal grains, their requirements, and availability for strengthening food system resilience in ecologically fragile and vulnerable areas. Finally, the study aims to identify best practices in sustainable land management, promote regionally coordinated strategies aligned with IGAD frameworks, and provide policy recommendations that enhance resilience, support sustainable development, and reduce food insecurity.

3. Research Design and Methodology

This study focuses on the IGAD region to examine the complex relationships between land use patterns, food security, and sustainable development across the Horn of Africa. The research is designed as a regional geographical analysis that seeks to understand how changes in land use influence agri-

cultural productivity, food availability, and long-term sustainability. Since these issues are closely interconnected and shaped by environmental, demographic, economic, and institutional factors, the study adopts a mixed-methods research design that combines both quantitative and qualitative approaches.

The quantitative approach is used to analyze statistical data related to population growth, food production, land use changes, cereal grain productivity, and sustainable development indicators. This helps identify measurable trends, patterns, and correlations across the IGAD member states. The qualitative approach complements this by examining policy frameworks, land governance systems, institutional arrangements, and socio-economic conditions that influence food security outcomes. Together, these methods provide a broader understanding of regional dynamics.

The methodology serves descriptive and explanatory. Descriptively, it examines the current conditions of land use, demographic growth, food availability, and development efforts in the region. Explanatorily, it investigates the relationships between land degradation, agricultural productivity, and food insecurity. The study covers the eight IGAD member states with two time intervals, i.e., 2010 to 2020.

The research relies entirely on secondary data collected from reliable international and regional sources such as UN DESA, FAOSTAT, the World Bank, WFP, UNDP, and IGAD reports. Data are analyzed using simple statistical techniques and presented in tabular form. Despite limitations such as data gaps in some countries, the study provides a strong framework for policy recommendations and sustainable development planning in the IGAD region.

4. Literature Review

Food security, sustainable development, and land use are closely interlinked concepts that fundamentally shape livelihoods, environmental integrity, and socio-economic transformation, particularly in the IGAD region, which faces persistent food insecurity despite its considerable agricultural and ecological potential. This situation is driven by rapid population growth, accelerating land degradation, increasing climate variability, expanding urbanization, and weak institutional and governance structures. These combined pressures intensify stress on already fragile food systems. This literature review synthesizes key theoretical and empirical perspectives on food security, sustainable development, and land use dynamics, with particular emphasis on their interrelationships in the IGAD region.

The concept of food security has evolved significantly from a narrow concern with food supply to a broader, multidimensional framework. Early understandings of food security were shaped by major global famines such as the Bengal Famine (1943), the Chinese famine (1959–1961), and African famines in the 1970s, which highlighted the devastating consequences of food shortages and triggered international concern [8, 35]. During the 1940s and 1950s, food security was largely equated with aggregate food availability, emphasizing increased production through agricultural modernization, a perspective reinforced by the establishment of the Food and Agriculture Organization (FAO) in 1945 [9].

A major shift occurred following the 1972–1974 global food crisis and the World Food Conference, which defined food security in terms of adequate global food supplies and stability of production and prices [40]. However, this approach was criticized for ignoring access and distributional inequalities. Sen's entitlement theory [35] revolutionized the field by arguing that famine is often caused not by food scarcity but by failures in access and entitlements, shifting focus toward household-level food security.

By the 1990s, food security had become widely defined through four pillars: availability, access, utilization, and stability [9]. Availability refers to sufficient food supply; access concerns economic and physical affordability; utilization focuses on nutritional and health outcomes; and stability emphasizes consistency over time [31]. Since the 2000s, additional dimensions such as food sovereignty, sustainability, and resilience have emerged, reflecting concerns about local control, environmental limits, and system shocks such as droughts and economic crises [28, 38].

Food security is also deeply technical, involving agricultural systems, infrastructure, markets, nutrition, and climate resilience. Food availability is largely determined by agricultural productivity, supported by technological innovations such as improved seeds, irrigation systems, mechanization, and biotechnology, which have significantly increased global food output since the Green Revolution [17, 30]. However, these advances have also contributed to environmental degradation, including soil depletion, biodiversity loss, and inequalities among smallholder farmers [1, 39].

Food access depends heavily on infrastructure, market integration, and income levels. Poor transport systems, weak storage facilities, and price volatility often limit access in developing regions [2, 46]. Food utilization is shaped by nutrition, health services, and sanitation, with persistent micronutrient deficiencies remaining a major challenge in developing countries [3]. Food stability is increasingly threatened by climate change, requiring adaptation strategies such as climate-smart agriculture, agroforestry, and early warning systems [21, 25]. Emerging technologies such as GIS, remote sensing, artificial intelligence, and mobile-based agricultural services are also improving food system monitoring and efficiency [45].

Sustainable development provides the overarching framework for understanding food security. Defined by the Brundtland Commission as development that meets present needs without compromising future generations [44], it integrates economic, social, and environmental dimensions. Economic sustainability emphasizes efficiency and growth; social sustainability focuses on equity, inclusion, and well-being; while environmental sustainability prioritizes ecosystem integrity and resource conservation [34, 37].

Food systems are central to all three pillars. Ecological economics further argues that economic systems must operate within ecological limits, recognizing natural capital and carrying capacity constraints [5]. The Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger), reinforce the integration of food security with broader development objectives [41]. However, debates persist regarding whether continuous economic growth is compatible with environmental sustainability [22, 23].

Land use is a critical determinant of food security and sustainability. It reflects human decisions regarding the allocation of land for agriculture, settlements, forestry, and conservation [26]. Agricultural expansion often occurs at the expense of forests and ecosystems, leading to environmental degradation and biodiversity loss [15]. Intensification increases productivity on existing land, while extensification expands cultivation into fragile ecosystems [33].

Land degradation—through soil erosion, nutrient loss, and overgrazing—significantly reduces agricultural productivity [29]. Insecure land tenure systems further discourage long-term investment in sustainable land management [32]. Land use also influences food access, as agricultural livelihoods determine household income and purchasing power. Inequitable land distribution and large-scale land acquisitions often marginalize smallholders and weaken food sovereignty [6].

Empirical studies in the IGAD region confirm strong linkages between land use change and food insecurity. Rapid population growth has driven the expansion of croplands into forests and rangelands, often without sustainable management practices [18]. In Ethiopia and Kenya, land conversion has contributed to soil degradation and declining ecosystem services [36].

Severe land degradation is evident in Sudan and Kenya, where overgrazing and monoculture farming have reduced productivity [24]. Climate change further exacerbates these challenges by increasing drought frequency and rainfall variability, negatively affecting both crop and pastoral systems [21]. Although initiatives such as Ethiopia's Sustainable Land Management Programme have shown positive outcomes, their scalability remains constrained by weak institutions and financial limitations [4].

5. Result and Discussions

5.1. Area and Population Distribution

The distribution of land area and population among IGAD member states is revealing significant spatial and demographic imbalances with direct implications for food security and sustainable land use. Sudan possesses the largest share of land area (36.01%), followed by Ethiopia (21.08%), South Sudan (12.30%), and Somalia (12.17%), while Djibouti has the smallest territorial share (0.44%). However, land size does not correspond proportionally with population distribution. Ethiopia accounts for the largest population share, increasing slightly from 40.09% in 2010 to 40.43% in 2020, despite holding only 21.08% of the total land area. This indicates intense population pressure on land resources, which may accelerate land fragmentation, soil degradation, and declining agricultural productivity.

Kenya and Uganda also show relatively high population shares compared to their land area. Uganda, for instance, holds only 4.60% of the land area, but its population share increased from 14.34% in 2010 to 15.12% in 2020, suggesting growing pressure on arable land and food systems. In contrast, Sudan and South Sudan possess large land shares but comparatively lower population proportions, indicating greater land availability per capita, although conflict, weak infrastructure, and climate vulnerability often limit productive use.

Djibouti and Eritrea maintain both low land and population shares, reflecting limited agricultural capacity and dependence on food imports. Overall, the data demonstrate that unequal land-population distribution across IGAD intensifies food security challenges, requiring context-specific land use planning, sustainable agricultural intensification, and regional cooperation to balance demographic pressure with available natural resources.

Table 1. *Share in Area and Population (%) by IGAD Member States.*

Items	Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Share in Area		0.44	2.31	21.08	11.08	12.17	12.30	36.01	4.60
Share in Population	2010	0.41	1.31	40.09	18.42	5.43	4.32	15.68	14.34
	2020	0.38	1.12	40.43	17.75	5.66	3.64	15.91	15.12

5.2. Landuse Pattern and Distribution

The land use patterns of IGAD member states in 2010 and 2020 reveal significant shifts in agricultural land, cropland, and forest cover with important implications for food security and sustainability. Across the region, agricultural land occu-

pies a dominant share of total land area, particularly in Djibouti (73.44% to 73.51%), Somalia (70.34% unchanged), and Uganda (71.14% to 71.89%). This indicates the heavy dependence of IGAD economies on agriculture as the primary livelihood source and food production base.

Table 2. Landuse Pattern (%) to Total Land Area in IGAD Member States- 2010.

Item	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Agricultural land	73.44	62.71	31.62	48.26	70.34	41.95	59.28	71.14
Cropland	0.10	5.72	13.90	10.83	1.79	3.31	9.60	44.63
Arable land	0.07	5.70	12.91	9.76	1.75	3.07	9.60	33.66
Temporary crops	0.05	4.26	10.85	7.06	1.31	3.08	9.22	25.14
Temporary meadows and pastures	0.01	0.69	1.51	1.42	0.21	0.35	0.05	4.08
Temporary fallow	0.01	0.75	0.54	1.28	0.23	0.42	0.23	4.45
Permanent crops	0.03	0.02	0.99	1.08	0.04	0.06	0.05	10.97
Permanent meadows and pastures	73.34	56.99	17.72	37.42	68.54	40.02	49.22	26.51
Forest	0.24	8.98	15.77	6.35	10.76	11.76	10.60	13.72

Table 3. Landuse Pattern (%) to Total Land Area in IGAD Member States- 2020.

Item	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Agricultural land	73.51	62.71	34.09	49.85	70.34	44.71	60.31	71.89
Cropland	0.17	5.72	16.37	12.43	1.80	3.92	11.35	45.38
Arable land	0.13	5.70	14.35	11.21	1.75	3.79	11.24	34.41
Temporary crops	0.10	4.40	12.41	8.36	1.35	2.93	10.95	26.57
Temporary meadows and pastures	0.01	0.62	1.52	1.63	0.19	0.41	0.03	3.77
Temporary fallow	0.02	0.68	0.42	1.21	0.21	0.45	0.26	4.08
Permanent crops	0.04	0.02	2.02	1.22	0.04	0.13	0.12	10.97
Permanent meadows and pastures	73.34	56.99	17.72	37.42	68.54	40.78	48.96	26.51
Forest	0.25	8.72	15.12	6.34	9.53	11.33	9.83	11.66

A notable trend between 2010 and 2020 is the increase in cropland and arable land in most countries, especially Ethiopia, where cropland rose from 13.90% to 16.37% and arable land from 12.91% to 14.35%. Kenya also experienced an increase in cropland from 10.83% to 12.43%, while Sudan rose from 9.60% to 11.35%. These changes suggest agricultural expansion aimed at meeting rising food demand caused by rapid population growth and urbanization. South Sudan also showed growth in agricultural land from 41.95% to 44.71%, reflecting efforts to utilize its large land resources for food production.

However, the expansion of cropland has often occurred alongside declining forest cover. Ethiopia's forest area declined from 15.77% to 15.12%, Uganda from 13.72% to 11.66%, Somalia from 10.76% to 9.53%, and Sudan from 10.60% to 9.83%. This indicates land conversion from forests to agriculture, which may improve short-term food availability but threatens long-term sustainability through biodiversity loss, soil degradation, and reduced climate resilience.

Permanent meadows and pastures remain extensive in Somalia, Djibouti, Sudan, and Eritrea, highlighting the continued importance of pastoralism and livestock-based livelihoods. Uganda stands out with exceptionally high cropland (45.38%) and permanent crops (10.97%), reflecting more intensive agricultural utilization.

5.3. Pattern of Agricultural Land and Population Distribution

Table 4. Distribution of Agricultural Land and Population in the IGAD Member States.

Item	Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda
Agricultural land (MN Ha.)	2010	1.70	7.59	35.68	27.47	44.13	26.51	110.73	14.27
	2020	1.70	7.59	38.48	28.37	44.13	28.25	112.66	14.42
Population (MN)	2010	0.93	2.95	90.54	41.6	12.26	9.75	35.41	32.39
	2020	1.11	3.29	118.92	52.22	16.65	10.7	46.79	44.46

Table 5. Total Crop Land (000 ha.).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	2.3	692.0	15683.0	6166.4	1126.0	2089.6	17929.6	8950.0	52638.9
2020	3.9	692.0	18476.1	7073.3	1128.0	2477.7	21210.8	9100.0	60161.8

The relationship between agricultural land availability, population growth, and cropland expansion across IGAD member states between 2010 and 2020 highlights increasing pressure on land resources and its implications for food security. Agricultural land increased modestly in most countries, while population growth was significantly higher, indicating rising competition for productive land.

Sudan maintained the largest agricultural land area, increasing from 110.73 million hectares in 2010 to 112.66 million hectares in 2020, followed by Somalia (44.13 million ha.) and Ethiopia (35.68 to 38.48 million ha.). However, Ethiopia experienced the most dramatic population growth, rising from 90.54 million to 118.92 million people within a decade. This rapid demographic expansion, combined with relatively limited agricultural land growth, suggests increasing land fragmentation, pressure on smallholder farming systems, and intensified risks of food insecurity. Kenya and Uganda show similar patterns, where population growth outpaced land expansion, increasing stress on arable land and agricultural productivity.

Djibouti and Eritrea recorded very limited agricultural land growth, while their populations continued to rise, implying stronger dependence on food imports and reduced domestic food production capacity. South Sudan, despite its relatively large agricultural land base, faces constraints in effectively utilizing land due to instability and weak infrastructure.

Table 5 further confirms the expansion of cropland across the region. Total cropland in IGAD increased from 52.64 million hectares in 2010 to 60.16 million hectares in 2020, reflecting efforts to boost food production. Ethiopia recorded a major increase from 15.68 million ha to 18.48 million ha, while Sudan expanded from 17.93 million ha to 21.21 million ha, remaining the largest cropland holder. Kenya and South Sudan also showed notable increases, indicating agricultural intensification and land conversion to meet growing food demand. While cropland expansion may improve short-term food availability, it also raises sustainability concerns, particularly where expansion occurs at the expense of forests, rangelands, and soil quality.

5.4. Area Under Cereal Grain Crops and Crop Land Availability

Table 6. Area under Cereal Grain Crops (000 ha.).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	8 ha.	451.6	10368.1	2540.2	618.6	946.3	6940.1	1698.0	23562.9

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2020	9 ha.	477.7	10548.0	2647.8	353.7	987.5	9592.1	2716.3	27323.0

Table 7. Crop Land Available (Hectare/Capita).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	0.0025	0.2198	0.1757	0.1485	0.0936	0.2143	0.4533	0.2767	0.1043
2020	0.0036	0.1946	0.1577	0.1361	0.0682	0.2336	0.4773	0.2049	0.0929

Table 6 shows a general increase in the area under cereal grain crops across most IGAD countries, rising from 23.56 million hectares in 2010 to 27.32 million hectares in 2020. Sudan experienced the most significant expansion, increasing from 6.94 million hectares to 9.59 million hectares, reflecting its role as a major cereal producer in the region. Ethiopia also maintained the largest share of cereal cultivation, growing modestly from 10.37 to 10.55 million hectares, indicating a relatively stable but intensively utilized cereal production base. Kenya, Uganda, Eritrea, and South Sudan also recorded gradual increases in cereal cultivation, suggesting ongoing efforts to enhance staple food production in response to population growth and food demand pressures.

However, Somalia shows a notable decline from 618.6 thousand hectares to 353.7 thousand hectares, indicating reduced cereal production capacity, likely linked to climatic shocks, conflict, and land degradation. Djibouti remains negligible in cereal production due to its arid conditions and limited arable land.

Table 7 further highlights a declining trend in cropland availability per capita across most IGAD countries, falling from a regional average of 0.1043 hectares per capita in 2010 to 0.0929 in 2020. Ethiopia, Kenya, Somalia, Eritrea, and Uganda all show reductions in cropland per capita, reflecting strong population growth outpacing land expansion. For instance, Ethiopia declined from 0.1757 to 0.1577 ha/capita, while Kenya decreased from 0.1485 to 0.1361 ha/capita, signaling increasing land scarcity for agricultural use.

In contrast, Sudan and South Sudan show relatively higher and increasing cropland availability per capita (0.4533 to 0.4773 and 0.2143 to 0.2336, respectively), reflecting lower population pressure relative to land size. Djibouti shows a slight increase but remains extremely low due to limited land resources.

The data indicate a dual challenge in the IGAD region: while cereal cultivation is expanding in absolute terms, declining cropland per capita highlights rising land pressure. This imbalance underscores the urgency of improving agricultural productivity, promoting sustainable intensification, and addressing population-land mismatches to ensure long-term food security.

5.5. Yield, Production, Standard Requirement, Surplus, and Deficit Scenario

Table 8. Yield Cereal Grains (Kg/ha).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	1757.5	511.7	1768.5	1710.8	575.2	451.7	451.7	1941.9	1278.6
2020	1924.4	639.1	2840.0	1843.0	503.5	885.5	595.2	1535.2	1686.2

Table 9. Cereal Grains Production (Kg) on Available Crop Land (Ha/Capita).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	4.39	112.46	310.72	254.05	53.84	96.81	204.76	537.33	133.36

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2020	6.93	124.38	447.86	250.84	34.34	206.85	284.08	314.56	156.65

Table 10. Standard Requirement of Cereal Grains (Kg/Capita/Year).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	155	165	180	160	158	165	180	165	166
2020	155	165	185	165	160	170	185	170	169

Table 11. Deficit / Surplus of Cereal Grains (Kg/Capita/Year).

Year	Djibouti	Eritrea	Ethiopia	Kenya	Somalia	South Sudan	Sudan	Uganda	IGAD
2010	-150.61	-52.54	130.72	94.05	-104.16	-68.19	24.76	372.33	-32.64
2020	-148.07	-40.62	262.86	85.84	-125.66	36.85	99.08	144.56	-12.35

Tables 8–11 jointly provide a comprehensive picture of cereal grain productivity, production efficiency, consumption requirements, and net food balance across IGAD member states between 2010 and 2020. The data reveal both important productivity gains and persistent structural inequalities in regional food security outcomes.

Table 8 shows a significant increase in cereal grain yields at the regional level, rising from 1278.6 kg/ha in 2010 to 1686.2 kg/ha in 2020. Ethiopia demonstrates the most remarkable improvement, increasing from 1768.5 kg/ha to 2840.0 kg/ha, reflecting advances in agricultural intensification, improved seed varieties, and extension services. South Sudan also shows a substantial increase from 451.7 kg/ha to 885.5 kg/ha, indicating post-conflict recovery in agricultural productivity. Eritrea and Sudan record moderate gains, while Kenya shows slight improvement.

In contrast, Uganda experiences a notable decline from 1941.9 kg/ha to 1535.2 kg/ha, suggesting possible land degradation, declining soil fertility, or inefficiencies in farming systems. Somalia also declines from 575.2 kg/ha to 503.5 kg/ha, reflecting the continued impact of climatic shocks, insecurity, and weak agricultural infrastructure. Djibouti shows a slight increase but remains constrained due to limited arable land.

Table 9 reinforces the trend of improved cereal production efficiency per capita cropland, with the IGAD average rising from 133.36 kg to 156.65 kg. Ethiopia again leads with strong gains (310.72 kg to 447.86 kg), while South Sudan and Sudan also show marked improvements. However, Uganda declines significantly from 537.33 kg to 314.56 kg, indicating weakening productivity despite relatively high land availability.

Table 10 shows a gradual increase in standard cereal requirements per capita across all countries, reflecting rising nutritional needs and demographic changes. Despite productivity improvements, Table 11 reveals persistent food insecurity in several countries. Ethiopia, Kenya, Uganda, and Sudan maintain or improve surplus levels, with Ethiopia showing a strong increase from 130.72 to 262.86 kg/capita/year. South Sudan transitions from a deficit (-68.19 kg) to a surplus (36.85 kg), indicating significant recovery.

However, Somalia, Djibouti, and Eritrea continue to face chronic deficits, with Somalia worsening further (-104.16 to -125.66 kg), highlighting extreme vulnerability. At the regional level, IGAD moves from a deficit (-32.64 kg) to a near-balanced situation (-12.35 kg), but still fails to achieve overall food sufficiency.

The findings demonstrate that while cereal productivity is improving in parts of the IGAD region, food security remains uneven, driven by disparities in land productivity, climate vulnerability, and structural agricultural constraints.

6. Conclusion and Recommendations

The study on Food Security under Pressure: Land Use Patterns and Sustainability in the IGAD Region reveals that food security in the region is increasingly shaped by the imbalance between rapid population growth, uneven land distribution, and changing land use patterns. Although total cropland and cereal production have expanded between 2010 and 2020, per capita land availability has declined in most member states, indicating rising demographic pressure on limited productive land. This structural constraint is most severe in countries such as Ethiopia, Kenya, Uganda, and Somalia, where population

growth outpaces land expansion and intensifies land fragmentation and environmental stress.

Despite improvements in cereal yields—particularly in Ethiopia and South Sudan—the benefits remain uneven across the region. Several countries, including Somalia, Djibouti, and Eritrea, continue to experience persistent food deficits due to climatic shocks, limited arable land, and weak agricultural systems. Meanwhile, land conversion from forests and rangelands to cropland raises concerns about long-term sustainability, soil fertility decline, and ecosystem degradation. Overall, the IGAD region remains in a fragile state of near food balance, but not food security stability.

To address these challenges, the study recommends promoting sustainable land management practices such as conservation agriculture, agroforestry, and climate-smart farming to restore soil health and improve productivity. Strengthening land governance and tenure security is essential to encourage long-term investment in land improvement. Regional cooperation under IGAD frameworks should be enhanced to manage transboundary food security risks and support drought resilience. Furthermore, investments in agricultural technology, irrigation, and rural infrastructure are necessary to close productivity gaps. Finally, population-sensitive planning and livelihood diversification should be prioritized to reduce pressure on land resources and ensure sustainable food systems in the IGAD region.

Abbreviations

FAO	Food and Agriculture Organization
IGAD	Intergovernmental Authority on Development

Author Contributions

Mansoor Ali: Conceptualization, Data curation, Formal Analysis, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing

Conflicts of Interest

The author declares no conflicts of interest.

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