

Research

The unmet demand of food security in East Africa: review of the triple challenges of climate change, economic crises, and conflicts

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Received: 7 May 2024 / Accepted: 23 July 2024

Published online: 05 September 2024

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Abstract

East Africa struggles with a profound challenge in ensuring food security amidst the convergence of climate change, economic crises, and conflicts. This paper presents a comprehensive review of the interconnected and compounding effects of these three factors on the region's food security landscape. It investigates the complex ways in which shifting climatic patterns disrupt agricultural systems, exacerbating food scarcity and amplifying vulnerabilities among marginalized communities. The study also examines the intertwined impact of economic downturns, which diminish access to resources, disrupt supply chains, and deepen food insecurity. Furthermore, the paper scrutinizes the ramifications of persistent conflicts, which not only displace populations but also destabilize agricultural production, aggravating food shortages. To achieve the objective of this review, the authors have collected the relevant documents through search engines of Web of Science, Google, Google Scholar, Scopus, and Science Direct databases. This review found that climate change, economic instability, and conflict are the primary challenges to food security in East Africa. Climate change exacerbates extreme weather events, rising temperatures, and pest infestations, reducing agricultural productivity and economic growth. Economic instability stems from a lack of industrialization, dependence on foreign aid, and significant investment gaps, resulting in persistent poverty and underdevelopment. Additionally, conflict and instability disrupt agricultural activities, displace populations, and restrict access to essential resources, further aggravating food insecurity. The study emphasizes the necessity for coordinated efforts among governments, international organizations, and local communities to navigate these intersecting crises and establish sustainable pathways toward enhanced food security in the region.

Keywords East Africa · Food security · Climate change · Economic crises · Conflicts · Hunger · Agriculture · Vulnerability

1 Introduction

The United Nations' 2030 Agenda for Sustainable Development, established in 2015, outlines 17 Sustainable Development Goals with 169 corresponding targets to guide international efforts towards sustainable development by 2030 [1]. Specifically, SDG 2 aims to address all forms of hunger and food and nutritional insecurity [1]. Despite significant progress in reducing hunger, combating malnutrition, and enhancing food security, considerable challenges persist. The State of Food Security and Nutrition in the World report reveals that the population experiencing hunger has increased to levels recorded a decade ago [2]. Approximately 1 billion individuals are food- and nutrient-insecure, placing them at

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heightened risk of diet-related non-communicable diseases [3]. The emerging "triple burden" of malnutrition, encompassing obesity, undernutrition, and micronutrient deficiencies, has now become the leading cause of poor health globally [4].

According to Wagler et al., [5], food security is the state in which individuals have reliable access to adequate quantities of safe and nutritious food to support their normal growth, development, and an active, healthy lifestyle. This multi-dimensional concept encompasses the availability, accessibility, utilization, and stability of food supplies [6]. Climate-related risks and food insecurity disproportionately impact the most vulnerable regions globally, including West Africa, East Africa, Southern Africa, and South Asia [7]. This critical issue is projected to persist in the coming decades due to factors such as localized population growth, limited socioeconomic resources, ongoing regional political conflicts and climate crisis, with 40–50% of the world's undernourished population residing in Sub-Saharan Africa [8].

In 2021, the Food and Agriculture Organisation (FAO) stated that around 193 million individuals, equivalent to 21.3% of the world's population, would face heightened food insecurity, a significant increase from 108 million people, or 11.3%, in 2016 [9]. In 2019, 821.6 million people worldwide suffered from hunger, and 2 billion individuals, representing 26.4% of the global population, did not have access to sufficient, safe, and nutritious food [10]. In Africa, between 2000 and 2020, food insecurity was increased from 25 to 37%, with a brief decline in the middle of the years [11].

Africa experiences a markedly elevated level of food insecurity in comparison to other regions globally [12]. Over 50% of the African population is at risk of experiencing extreme food insecurity [13]. East Africa had the highest food insecurity rate in 2018, with 63% of the population affected, followed by Southern Africa at 54%, West Africa at 48%, and North Africa at 48%. Climate change, conflict, and economic issues are the primary reasons leading to increased food insecurity in East Africa [14, 15].

The East African region, frequently designated as Eastern Africa, generally encompasses the countries situated in the eastern segment of the African continent. The precise composition of East Africa can fluctuate depending on the context, but it typically comprises the following nations: Kenya, Tanzania, Uganda, Rwanda, Burundi, Ethiopia, Somalia, Djibouti, Eritrea, South Sudan, and Madagascar [16]. East Africa, home to 370 million people, faces significant food security challenges, with approximately 40 percent of the population having poor access to food [17].

Over 265 million people across East Africa live on less than \$1.90 per day, rendering them particularly susceptible to food insecurity [18]. Recent studies have highlighted the concerning trends in compound extremes of rainfall and temperature across the region. The high occurrence of these events has had many negative impacts on human security, as the population is largely dependent on rain-fed agriculture [19]. Studies between 2015 and 2017 found that around 72.9 million people in the region were undernourished. Additionally, 2.7 million children under 5 had wasting, 14.7 million under 5 s were stunted, and 1.5 million under 5 s were overweight [20].

Recognizing the gravity of this challenge, recent research highlights the complex and interconnected drivers of food insecurity, including the impacts of climate change, increased frequency of extreme weather events, economic shocks, and conflict [21, 22]. Consequently, a comprehensive understanding of these factors is necessary to develop effective policies and interventions to achieve the SDG 2 targets [23]. Climate change is a natural process occurring on Earth. It has become a significant concern due to its widespread impacts on agriculture, water resources, markets, and global natural resources [7]. In developing and developed countries, risks from extreme climate impacts reveal higher levels of vulnerability with higher confidence on projected increases in droughts, heat waves and floods [7].

Beyond the direct impacts of climate change, the East African region has experienced economic shocks and conflict, which have compounded the challenges facing food systems [24]. For example, the COVID-19 pandemic has disrupted supply chains, reduced incomes, and increased food prices, making it more difficult for vulnerable populations to access adequate nutrition [25]. Similarly, ongoing conflicts in countries like Ethiopia, Somalia, Sudan and South Sudan have displaced millions of people, destroyed agricultural infrastructure, and disrupted food production and distribution [26].

The East African region has a long history of political instability and conflict, which have had significant impacts on food security and agricultural production [17]. Political conflict and civil war, which are common in the region, have compounded the challenges facing food systems. This is evidenced by the displacement of over 30% of pastoralists in East Africa due to climate change [27]. The civil war in Sudan and South Sudan, the conflict in the Tigray region of Ethiopia, and the ongoing insecurity in Somalia are all examples of the political instability in the region. These conflicts have displaced millions of people, destroyed farms and livestock, and disrupted trade and food distribution networks, leading to severe food shortages and famine-like conditions in affected areas [15].

The current food security situation in East Africa remains extremely alarming due to the combined effects of climate change [17], economic crises [25], and conflicts [26]. This complex issue requires multifaceted solutions, as no single approach can adequately address the interconnected problems affecting food security in the region [28]. The issue of food security in this region is devastating, exacerbated by political instability, economic hardship, and climate crises

throughout the region's history. Consequently, these factors have worsened food insecurity and significantly reduced the resilience of the local population. However, as far as the authors is aware, no comprehensive review or research has been conducted on this topic specifically in the context of East Africa or individual countries within the region. This indicates a lack of consolidated evidence on the devastating impacts of these threats on food security, hindering the implementation of effective short-term and long-term measures. While prior investigations have focused on individual factors [13, 15, 29], this research offers a comprehensive analysis of how these three interrelated issues—climate change, economic crises, and conflicts—collectively contribute to food insecurity in East Africa. Additionally, it provides practical, evidence-based interventions for achieving zero hunger in the region. Therefore, this review is crucial for informing decisions by governments and international organizations on how best to mitigate the severe impacts of these threats on food security in East Africa.

2 Material and methods

2.1 Review methodology

The study employed a scoping review methodology, which follows the framework developed by Arksey and O'Malley [30], to address the complex and broad nature of the topic and related studies. In addition, the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist was utilized to guide the reporting process [31].

Scoping reviews provides an appropriate methodology when the goal is to map the existing body of literature on a topic, identify key concepts, and explore the range of available [31]. This approach enables the inclusion of diverse research methodologies to more comprehensively and deeply understand the current knowledge on a particular subject [32]. It has been argued that the scoping review approach enhances rigor by reducing biased searches, while also providing focus and boundaries for the review [33].

To achieve the objective of this review, we collected relevant information from various academic databases, including Web of Science, Google Scholar, Scopus, and Science Direct, focusing on peer-reviewed articles published between 2010 and 2024. Additionally, we identified relevant grey literature by reviewing reports from the UN, the United Nations Food and Agriculture Organization, the International Fund for Agricultural Development, and the Intergovernmental Authority on Development, an eight-country trade bloc in East Africa. Our search strategy adhered to the PRISMA-ScR guidelines for scoping reviews [34].

2.1.1 Identification, screening, and inclusion

We selected articles and grey literature according to the following inclusion criteria: focus on food security as the main topic, publication between 2010 and 2024, food security as the setting, and key study terms such as food security, East Africa, climate change, economic crisis, and conflicts. The review process focused on food security in broad terms, without addressing the specific Sustainable Development Goal 2. It also did not identify the particular country within the East African region mentioned in the introduction. Additionally, publications in languages other than English were excluded from the analysis.

Duplicate and outdated articles were manually removed. Then, we screened the articles in a step-wise process: by title, abstract, and full text. We also screened the grey literature sources based on the inclusion and exclusion criteria. Through this process, we identified 34 out of 340 peer-reviewed articles and 24 out of 76 grey literature sources for the scoping review. The reasons for excluding articles and grey literature are provided in Fig. 1. The included publications vary in the depth of their findings.

2.2 Recent studies on the multidimensional food ecosystem in Africa

Food security is attained when individuals have consistent access to a sufficient quantity of nourishing food that aligns with their dietary requirements and choices to support a healthy lifestyle [35]. The world population is expected to reach 8.6 billion by 2030 and 9.8 billion by 2050, with the majority of this increase occurring in Africa [14]. Climate change presents a significant and swiftly growing danger to the food and nutrition security of impoverished small-scale farmers worldwide [36].

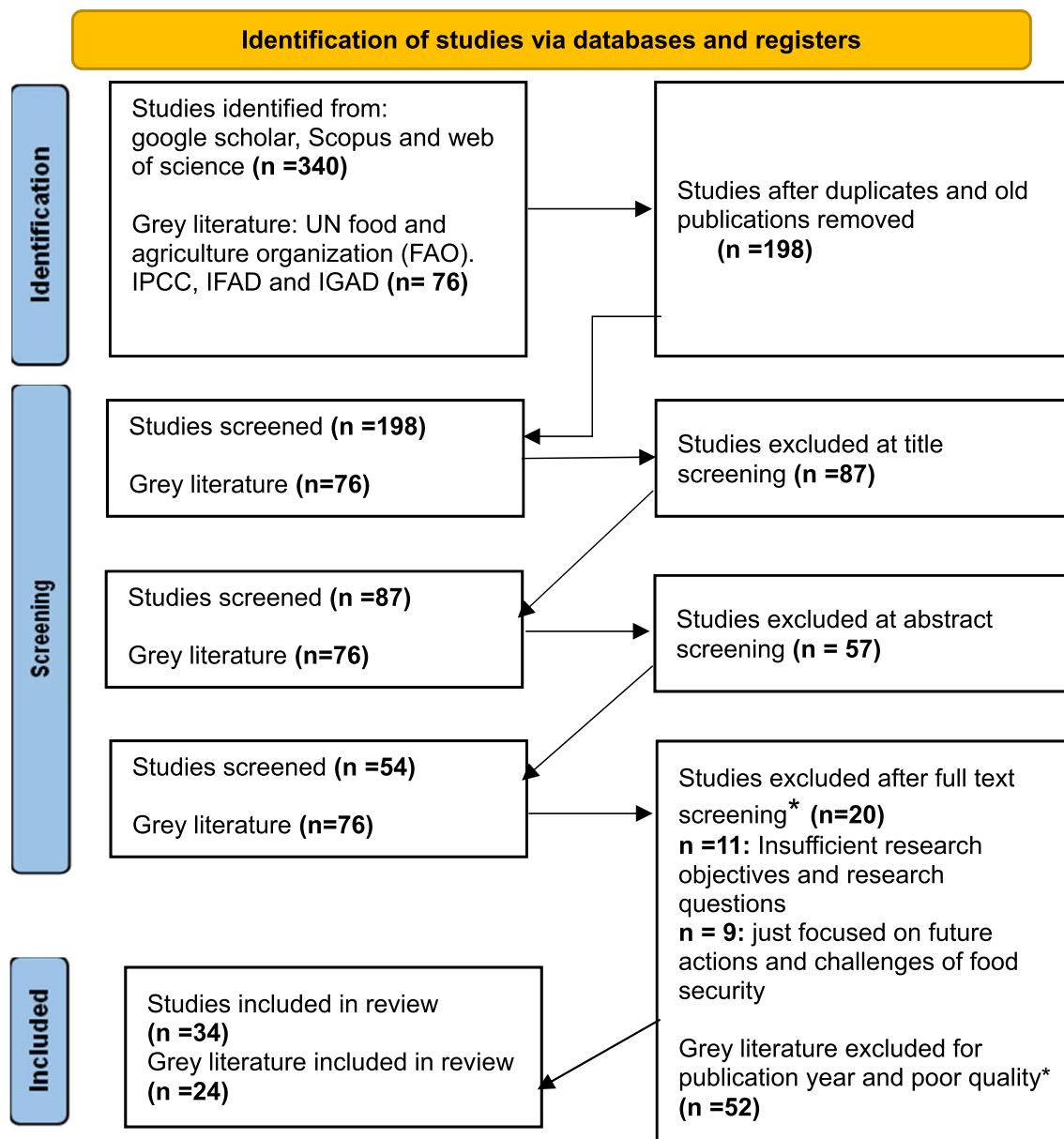


Fig. 1 Prisma flowchart for study selection

Climate change in Africa has led to decreased agricultural output, resulting in around 286 million individuals experiencing hunger and malnutrition due to food insecurity [37]. Sub-Saharan Africa has a higher prevalence of food insecurity and inadequate micronutrient intake [38]. Over-reliance on rainfed agriculture, eating food with low nutritional value and antinutritional solid components, violence, natural disasters linked to climate change, economic downturns, widespread poverty and inequality, and the regular occurrence of crop diseases and pests are the main causes of the problem [39].

Climate change in East Africa has caused a decrease in genetic diversity, resulting in increased food insecurity affecting more than 18 million people [14]. The genetic resources in this region are threatened by factors like population growth, invading species, agricultural changes, and intensified land usage [40].

The agriculture and water sectors are vital for fostering economic change, sustainable livelihoods, and development, particularly in developing nations [41]. The 2014 Malabo Declaration by the African Union highlights the significance of enhancing agricultural productivity to boost economic growth, create jobs, and eliminate hunger and malnutrition in Africa [42]. Agricultural development is essential for economic growth and the attainment of the Sustainable Development Goals (SDGs), as well as for the water sector.

The Food and Agriculture Organisation has recorded extensive damage to pastures and crops in East Africa, particularly in Agro-pastoral areas of Eastern Ethiopia, Central Somalia, and Northern Kenya, due to the Desert Locust infestation [43]. The 2020 IPC study indicates significant food insecurity in the region, impacting around 8.5 million individuals in Ethiopia, 3.1 million in Kenya, and 1.1 million in Somalia. Riaz identified COVID-19, environmental shocks, conflict, DL, and economic crises as the primary causes of food insecurity [44].

According to Pinstrup-Anderson and Cohen [45], currently, 828 million people do not have adequate access to food. 25% of the population lives in sub-Saharan Africa (210 million), 31% in East and Southeast Asia and South Asia (258 and 254 million), 7.6% in Latin America and the Caribbean, and 5% in North Africa and the Near East. The future of Africa appears grim. With the increasing population and its escalating demands on the environment, a rise in food insecurity is anticipated. Approximately 39% of individuals in sub-Saharan Africa experience malnutrition. The Food and Agriculture Organisation (FAO) predicted in 1996 that food insecurity in the region would increase until 2010, contrasting with a global drop, with an estimated 680 million people facing food insecurity by 2010.

As can be observed from Table 1, the prevalence of undernourishment varies greatly across East Africa, with some countries having rates as high as 33%. The Food Security Risk Index, which measures the severity of food insecurity, also varies from country to country. The countries with the highest Food Security Risk Index scores are Burundi, Eritrea, Somalia, and South Sudan.

Multiple causes such as poverty, conflict, climate change, and inadequate infrastructure contribute to food insecurity in East Africa. Poverty significantly contributes to food insecurity by restricting individuals' ability to obtain food. Conflict can also interrupt food production and distribution, resulting in food insecurity. Climate change is hindering agricultural growth in certain regions of East Africa, while inadequate infrastructure complicates the transportation of food from abundant areas to those in need. The global community is addressing the issue of food insecurity in East Africa. The Food and Agriculture Organisation of the United Nations (FAO) is a prominent organisation addressing this matter. FAO offers diverse programmes and initiatives to enhance food security in East African countries.

Gibson, [46] in his book "The Feeding of Nations: Redefining Food Security for the 21st Century", classifies many forms of vulnerability. FIVIMS classifies groups based on occupation (fishermen and pastoralists), geographical location (marginal urban or forest residents), culture (bushmen and nomads), demography (children under 5), social status (refugees and the displaced), and physical condition (the disabled and severely ill). The complexity of many possible divisions presents a challenge. Elderly relatives of Kalahari bus drivers and sedentary indigenous children under five in Mauritania experience distinct food security challenges.

The following provides a succinct review of four of the most vulnerable categories, starting from the macro to the micro, to simplify the fundamentals. Firstly, Vulnerable locations: These locations have delicate, well-balanced ecosystems or significantly depend on the supply and production of food and food-related components. These could become subject to resource mismanagement, degradation, and catastrophic weather events like floods or droughts. Although primarily rural, such susceptible places can also be urban, which has an impact when many people, families, or entire communities depend on a specific location or region.

Table 1 Table indicating the prevalence of undernourishment and food security risk index in East Africa (countries and regions, family farming knowledge platform; FAO, 2022)

Country	Population (millions)	Prevalence of under-nourishment (%)	Food security risk index	References
Burundi	11.8	27	4.1	FAO, 2022: https://www.fao.org/africa/countries/burundi
Djibouti	1	12	3.2	FAO, 2022: https://www.fao.org/africa/countries/djibouti
Eritrea	3.5	24	4.3	FAO, 2022: https://www.fao.org/africa/countries/eritrea
Ethiopia	115	33	3.9	FAO, 2022: https://www.fao.org/africa/countries/ethiopia
Kenya	53.8	23	3.8	FAO, 2022: https://www.fao.org/africa/countries/kenya
Madagascar	27.2	28	4.6	FAO, 2022: https://www.fao.org/africa/countries/madagascar
Rwanda	12.6	23	4.2	FAO, 2022: https://www.fao.org/africa/countries/rwanda
Somalia	15.8	32	4.6	FAO, 2022: https://www.fao.org/africa/countries/somalia
South Sudan	11.3	26	4.3	FAO, 2022: https://www.fao.org/africa/countries/south-sudan
Tanzania	63	33	4.5	FAO, 2022: https://www.fao.org/africa/countries/tanzania
Uganda	44.3	23	3.9	FAO, 2022: https://www.fao.org/africa/countries/uganda

Thus, these people will suffer from any significant changes to the land's sustainability, productivity, or supply. Second, Vulnerable Groups: These are typically homogeneous groups, including women, children under five, the impoverished, seasonal agricultural workers, recent immigrants, and nomadic or transhumant populations (whose seasonal migration usually takes place between high pastures in the summer and lower valleys in the winter). These communities rarely have significant control over food security in terms of continuity, either material or financial. The third category is called "vulnerable households," which refers to family units that are frequently grouped together by vulnerable typologies. Examples of these include households headed by women or those that are large or have a high prevalence of diseases like tuberculosis or AIDS. Finally, vulnerable individuals are typically those members of the community who are particularly at risk of food insecurity and who require additional care or attention. Infants and kids under five, expectant or nursing moms, the sick, the elderly, people with disabilities, etc. are among them.

This review of the literature discovers that climate change, conflict, and economic crises are the main challenges to achieving food security in East Africa. However, what is lacking in the current literature is a proper categorization of how and in which capacities the triple challenges hinder food security in East Africa. This paper, therefore, puts forward a set of categories by which climate change, conflict, and economic crises obstruct the path of achieving food security in the region.

2.3 The current hunger crisis in East Africa

In developing economies, agricultural production is the primary source of food security for millions of people. The vulnerability is notably serious in Africa, where agricultural output provides 66 per cent of the active population with their principal source of income [47]. Food security is a significant problem for many East African households. There is evidence that households with the lowest food security, particularly those led by women, are less inclined to adopt innovative agricultural technology and practices that may enhance their farm's productivity and make them more resilient to climate change [48]. Food security Conditions in Uganda have rather worsened by the previous Covid 19, They used to at least go to town, bring some food, and also give them at least a substantial uptick of about 1USD for home use to maybe buy them milk for their children's nutritional demands. However, because of the coronavirus disease outbreak, they are no longer receiving money [49].

Rural households face various constraints such as limited investment capital, inadequate access to natural resources, lack of inputs like labour, and insufficient knowledge, which hinder their ability to try out new agricultural technologies related to crops, livestock, water, soil, and agroforestry knowledge [50]. The Malabo Declaration of 2014 highlights the essential role of food security and nutrition in the growth of the continent [13]. Africa has the greatest prevalence of undernourishment, despite the Malabo agenda [51]. Progress in reducing hunger has been sluggish over the past twenty years, with the number of hungry individuals in East Africa rising by 20% in 1990. Between 2000 and 2002, the percentage of malnourished individuals in Kenya was 33%, in Uganda it was 19%, and in Tanzania it was 44% [52].

The frequency of undernourishment in Sub-Saharan Africa rose from 20.8% to 22.7% during 2015 and 2016. In 2016, the number of undernourished individuals increased from 200 to 224 million, accounting for 25% of the 815 million undernourished people globally [48]. The proportion of the population experiencing acute food insecurity due to limited access to food has risen in the area [53]. Other than Djibouti, the selected East African states have a greater prevalence of undernourishment compared to sub-Saharan African countries, where it stands at 20.8 percent. The World Bank claimed that in 2015, the prevalence of undernourishment in Ethiopia was 28.8%, in Kenya 19.1%, in Rwanda 41.1%, in Uganda 39%, and in Tanzania 32.3% [54]. Factors contributing to the widespread undernourishment in the regions are poverty, conflict, climate change, environmental degradation, and political instability [51].

In line with the above background and by using secondary literature, the following section of this paper answers the question of how and in which capacities the triple challenges (climate change, conflict, and economic crises) hinder food security in East Africa. By focusing on climate change, conflict, and economic crises as the core obstacle to food security in the region, we will also explain three strategic solutions (A. Addressing Climate Change; B. Conflict Resolution and Peacebuilding; C. Sustainable Agricultural Development) that we can use to address the challenges.

3 Results and discussion

3.1 Challenges of achieving food security in East Africa

3.1.1 Climate change

The challenge of achieving the SDGs is further compounded by the complexities brought about by climate change SDGs [55]. Africa has been recognized as one of the continents most affected by climate change due to two primary factors: its geographical location within the warming tropics and its limited human, social, and economic resilience to cope with the impacts of climate change [56].

The East African region is now experiencing recurrent obstacles to food production, which could exacerbate owing to climate change without proper adaptation measures [57]. Dell et al.'s research shows that a one-degree Celsius increase in temperature in developing nations is linked to a 3% reduction in agricultural production, resulting in a 1.3% fall in economic growth [58]. In East Africa, increasing populations will raise the demand for water and food. Prolonged extreme climate events, such as higher temperatures, rising sea levels, droughts, floods, storms, and acidification, will negatively affect agricultural yields, putting additional pressure on already scarce water resources and reducing crop yields [59].

The East African region is experiencing an influx of insects and weed seeds due to the increasing temperatures and water levels [15, 60]. The infestation of locusts in Ethiopia, Kenya, and Somalia during 2019–2020 resulted in the damage of 1.25 million hectares of land, leading to a financial requirement increase by nearly \$70 million for response efforts [61]. The current drought in East Africa has already led to the loss of over 1.5 million animals and a significant reduction in maize production [62].

An estimated 20.3 million individuals are experiencing food insecurity in Sudan, with similar situations affecting approximately 20.1 million people in Ethiopia, 7.4 million people in South Sudan, 6.5 million people in Somalia, and 5.4 million people in Kenya due to conflict and instability, economic difficulties, and climate-related challenges [63]. However, the nutritional status remains concerning across Eastern Africa where over 4.3 million children as well as an additional 743,000 pregnant and breastfeeding mothers are forecasted to be affected by severe malnutrition in Kenya, Somalia, and Ethiopia [63]. The Horn of Africa region has experienced three consecutive below-average rainy seasons [64].

Addressing the impacts of climate change on food security is crucial as global temperatures increase. This involves decreasing greenhouse gas emissions, supporting climate-adaptive farming methods, and enhancing social support systems for individuals facing challenges in obtaining food [65].

The Intergovernmental Panel on Climate Change [66], reported that climate change is impacting food security in various ways, such as:

- **Reduced crop yields:** climate variability is causing increasingly severe weather phenomena, such as prolonged dry spells, excessive rainfall, and high temperatures. These conditions have the potential to harm crops and diminish their productivity.
- **Increased pests and diseases:** climate fluctuations are leading to more extreme weather events, including extended periods of drought, heavy rainfall, and elevated temperatures. These circumstances could negatively impact agricultural yields and reduce overall crop output.
- **Disruptions to food supply chains:** climate change has the potential to interrupt food supply chains by causing harm to infrastructure, including roads and bridges, as well as complicating the transportation of food.
- **Rising food prices:** rising food costs can result from a combination of factors such as lower crop yields, heightened pest and disease presence, and disturbances in food distribution networks. This may pose challenges for individuals in purchasing affordable food.

The effects of climate change on food security are most keenly experienced by the most impoverished and susceptible individuals worldwide. These individuals frequently reside in regions that are already susceptible to extreme climates and have scarce resources to manage the extra difficulties brought about by climate change [67].

3.1.2 Economic challenges

East Africa consists of thirteen nations with diverse characteristics. The region is generally characterized by a weak economy and low levels of human development, with most nations being low-income except for Kenya and Djibouti, which fall into the lower-middle-income category [15]. In 2018, the anticipated real GDP growth rate for East Africa was 5.7%, slightly lower than the previous year's rate but still the highest among all African regions. It is expected to maintain a robust growth rate, expanding by 5.9% in 2019 and reaching 6.1% in 2020. However, there is significant diversity across countries within the region; for example, South Sudan experienced a contraction of -3.8%, while Rwanda and Ethiopia saw impressive growth rates of 7.2% and 7.7% respectively in that same period. Ethiopia, Rwanda, Kenya, and Djibouti have strong agricultural, services, and industrial sectors driving their rapid economic expansion. However, South Sudan (-3.8%), Burundi (1.4%), and Somalia (2.9%) experienced negative or low growth due to instability affecting economic activity [68].

Moreover, the economic framework and growth patterns in East Africa are characterized by a lack of industrialization, resulting in insufficient job opportunities, economic variety, and product distinction [15, 69]. Despite this overall underwhelming performance, Ethiopia, Kenya, Tanzania, and Uganda have recently made progress in the field of industrialization. All East African countries import manufactured goods while primarily exporting raw materials. The regulatory structure sets out the terms for exchanging manufactured products for essential commodities. Until 2003–2013 when global commodity prices began to rise again after almost a century-long decline [70].

East Africa faces a variety of challenging risks that could hinder economic growth and development prospects. Some nations have specific economic and social traits, such as being landlocked or small island states, relying on a few export products, and experiencing volatile export revenues. They are also vulnerable to natural disasters due to heavy reliance on agriculture and its unstable output. Persistent deficits in the current account and increasing foreign debt are other significant concerns. State fragility poses potential threats to Burundi, Somalia, South Sudan, and Ethiopia to some extent. The decline in global commodity prices has negatively affected the terms of trade for almost all nations heavily reliant on basic commodities for exports.

Additionally, the significant growth of the region has been driven by considerable investment that exceeds domestic savings. The persistent current account deficit is closely connected with the gap between domestic investment and savings (or external gap). Moreover, economic challenges in Ethiopia, Burundi, and South Sudan including high inflation, currency devaluation, shortages of gasoline and dollars continue to hinder economic progress. Despite noticeable economic expansion in most nations recently, a large part of the population still grapples with food insecurity, poverty levels are high and there's insufficient human development. Except for Kenya, all East African countries have low human development classification. Eritrea, Burundi, Djibouti, and South Sudan have subsequent lowest human development. Widespread poverty also prevails especially in rural areas; regions where South Sudan, Burundi, Eritrea, and Somalia are situated as per Africa [70].

3.1.3 Conflict and instability

Conflict and instability are closely related to food insecurity, and this relationship has been extensively studied and documented in academic literature. Here is an overview of how conflict and instability contribute to food insecurity, along with some key references to include:

According to Dube Vargas, [71], conflict and instability have disrupted agricultural activities and food production in several ways. Armed conflicts often lead to the displacement of populations, which can result in abandoned fields, destroyed infrastructure, and a lack of access to agricultural resources. This disruption can significantly reduce food production and availability, as shown in the study by Collier Hoeffler [72] on Greed and Grievance in the Civil War. *Oxford Economic Papers*, 56(4), 563–595, the findings revealed that conflict and instability often lead to losing livelihoods, making it difficult for people to afford or access food. This can result in destroying businesses, markets, and job opportunities, leaving individuals and communities economically vulnerable.

Conflict-induced displacement can result in the loss of land and assets, making it challenging for affected populations to produce their food. Internally displaced persons (IDPs) and refugees often rely on aid, and their limited resources make them susceptible to food insecurity [73]. Conflict and instability can disrupt food distribution systems, making transporting and delivering food to affected areas difficult. This can lead to food shortages and price spikes, further exacerbating food insecurity [74]. Conflict zones are often dangerous for humanitarian organizations

to operate in. Limited access can hinder aid and relief efforts, leaving vulnerable populations without the necessary assistance to meet their food needs [75].

3.2 The way forward: strategies and solutions

3.2.1 Addressing climate change (adaptation and mitigation strategies)

Climate change has significant impacts on food security. It is crucial to explore options beyond agriculture to address climate change impacts and enhance food security for disadvantaged populations [76]. Dealing with climate change adaptation, mitigation, and food supply requires multi-level decision-makers to navigate a network of interconnected concerns.

There is a wealth of literature on how climate change affects food security in underprivileged nations. Employing adaptation strategies like using heat-resistant crop varieties, adopting improved crops, adjusting cropping patterns, and diversifying agricultural produce can significantly mitigate the effects of climate change and reduce the risk of hunger to as low as 28% [77]. In hot and arid areas, anticipated agricultural income may decline by 43%. Farmers and experts recommend various adaptation measures, including crop diversification, improved germplasm utilization, enhancements in soil and water management, and better access to fertilizers and equipment [78].

Multiple empirical studies have examined how farmers have adapted to the negative consequences of shifting climate conditions and their influence on food security [79–81]. Notably, Di Falco et al., [82] found that Ethiopian farmers' adaptation tactics to climate change were most influenced by knowledge, extension services, and access to loans. Webber et al. [83] discovered that farmers' capacity to adjust to climate change was impeded by characteristics such as their socioeconomic level, perception of climate change, labour availability, and access to financing. In 2016, Douxchamps and colleagues found that applying adaptation methods such as crop diversification, soil and water conservation, improved crop varieties, and fertilisers increased food security for certain households in different African countries ([80] Below et al. (2015) identify the main challenges impeding adaptation efforts in Tanzania as a lack of financial resources, including land, manpower, money, and equipment, as well as insufficient cooperation and conflicts between traditional agricultural systems, such as cassava farming and grazing [79].

On the other hand, while in our gathered literature from multi-perspective sources, we found the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), specifically the Working Group III (WG III) conclusions helpful in explaining how to address food insecurity through many categories in the literature we collected from multiple sources [84]. The IPCC AR5 WG III emphasises the need of decreasing emissions from agriculture, forestry, and land use (AFOLU) to mitigate climate change in the twenty-first century, as these sectors are the primary sources of most non-CO₂ greenhouse gas emissions and carbon storage on land. Dittmer et al. [85] stressed the importance of clearly incorporating agricultural emissions into national mitigation targets and strategies to achieve the Paris Agreement's two-degree Celsius goal [85].

This research review elaborates on how implementing mitigation strategies across the entire food system, from production to consumption, can aid in reaching global mitigation goals and improving food security and nutrition. To understand the spectrum of mitigation potential of food systems, it is crucial to consider scenarios where efficiency gains and dietary changes due to increasing income per capita are included in business-as-usual projections [86].

The AR5 classified mitigation measures ranging from fundamental ways like as improving agricultural and animal management to more sophisticated techniques like afforestation, soil carbon storage, and BECCS projects. P. Smith et al. [84] highlighted two main groups of mitigation pathways from the food system.

Supply-side: Agricultural emissions can be decreased by improving production efficiencies and increasing carbon sequestration in soils and biomass. Energy-related emissions in the food system can be lowered by enhancing energy efficiency and substituting fossil fuels with carbon-free sources like biomass.

Demand side: Greenhouse gas emissions could be reduced by altering diets, decreasing food waste, and using wood for cooking.

Changes in food habits that reduce production-related GHG emissions and adjustments to land use that absorb carbon are examples of demand-side mitigation techniques. On both the supply and demand sides, reducing food loss and waste can help reduce GHG emissions.

3.2.2 Sustainable agricultural development

In this section, we identified some key strategies and approaches that East African countries can adopt to achieve their full potential for food security:

Government decisions to invest in research and innovation are crucial to achieving Sustainable Agricultural Development [87]. This could include promoting research and development in agriculture to improve crop varieties, pest resistance, and productivity, as well as promoting innovation in farming techniques, such as drought-resistant crops, organic farming, and precision agriculture. Over the past two decades, agricultural production, food, and nutrition security have been under significant stress [88]. On the other hand, the need for access to land, water, and seeds for smallholder farmers, particularly women, as well as developing and enforcing land tenure systems that protect the rights of small-scale farmers could be a great way to ensure sustainable agriculture [89].

Enhancing agricultural extension services is also important regarding knowledge and information sharing [89]. This involves strengthening extension services to provide farmers with the knowledge and skills needed to adopt modern and sustainable farming practices and use technology, such as mobile apps and SMS, to disseminate information to remote areas. In many regions of the globe, it is advised to apply smart practices and technology for climate-resilient agriculture. There is a dire need to bring forth climate-smart agricultural alternatives, such as drought-resistant crops and conservation farming, as well as developing and implementing early warning systems to help farmers prepare for extreme weather events [90]. Smallholder farmers who do not have access to credit and financial services in the East Africa region require support to invest in their farms and develop farmer cooperatives and associations to enable collective marketing and bargaining power [62].

In sub-Saharan Africa, postharvest losses (PHL) have been recognized as a major obstacle to attaining food and nutrition security [91]. They are investing in infrastructure and technology to improve agricultural products' storage, transportation, and processing and promoting good agricultural practices crucial to minimize losses [92]. Developing rural infrastructure is essential to connect remote areas to markets and expand access to electricity and reliable energy sources for processing and value addition, which means achieving sustainable food security. Strengthening the value chain can also increase the value addition of agricultural products by developing and supporting agribusinesses [93]. In addition, promoting local and regional trade significantly reduces dependence on imports [94].

In order to create and implement policies that support sustainable agriculture, protect natural resources, and enhance food security, sustainable agricultural development must have both governance and policy. This involves ensuring transparent and equitable land and resource management as well as fighting corruption [95]. Likewise, it is impossible to overlook the need to offer access to market data and information. This means a lot to provide farmers with insights into pricing and market trends by supporting e-commerce and online marketing platforms, information-sharing networks, and market data systems.

On the other hand, risk mitigation approaches can play a crucial role in enhancing the resilience of farmers. This includes establishing insurance and social safety nets to assist farmers in coping with setbacks and losses and fostering agricultural diversification [96]. It is believed that vocational training in agriculture and agribusiness, as well as funding educational and training initiatives that increase the capabilities of the agricultural workforce, particularly young people, can help the resilience of the farmers [97]. On the other hand, public-private partnerships are essential for promoting cooperation between NGOs, the business sector, and governments to pool resources and expertise to advance sustainable agriculture [98].

Promote regional integration; this involves promoting regional cooperation and trade agreements to enhance food security by reducing access to resources and markets [94]. To ensure all intended goals are achieved, an effective monitoring and evaluation system must assess the impact of agricultural development programs [96]. In addition, long-term planning and investment should be implemented by encouraging government institutions to commit to long-term planning and investment in agriculture to ensure sustainability and food security [98]. Sustainable agricultural development requires a multi-faceted approach, and the specific strategies adopted should be tailored to each country's unique circumstances and challenges. It is essential for East African governments, in partnership with international organizations and stakeholders, to work together to prioritize and implement these strategies to curb food insecurity and promote sustainable agricultural development on the continent.

3.2.3 Conflict resolution and peacebuilding

Conflict, violence, and fragility are acknowledged as obstacles to attaining universal food security in the 2030 Agenda for Sustainable Development. Given the propensity of conflict to impede sustainable development, one of the objectives is to substantially diminish the prevalence of violence by collaborating with member states and communities to identify enduring resolutions to issues of insecurity and conflict. The 2030 Agenda considers the elimination of hunger and poverty (Sustainable Development Goals [SDGs] 1 and 2) as prerequisites for the establishment of peaceful and inclusive societies (SDG 16); the prevention of violence and conflict is considered indispensable to the attainment of each of the remaining SDGs.

Despite the frequent association between armed conflict and severe hunger, historical patterns indicate that hunger may be prevented and does not always ensue from war. To develop effective responses and treatments, a comprehensive understanding of the supposed correlation between conflict and food poverty is necessary. Despite the apparent correlation between conflict, severe food insecurity, and chronic hunger, the available data is limited and inconsistent, and the precise processes at play remain poorly understood. In contrast, hunger, encompassing various forms such as chronic malnutrition, famine, and general deprivation, is frequently regarded as a potential catalyst for conflict. However, the precise mechanisms underlying its differential applicability as a contributing factor or catalyst in different contexts remain obscure. The objective of the current investigation is to provide more insight into these pathways of causality.

4 A positive assets-based model of agricultural systems solution

The arrows in Fig. 2 illustrate the various ways in which human capital and social capital interact with each other. For example, people with high levels of human capital are more likely to have strong social networks, and people with strong social networks are more likely to have access to opportunities for economic and social advancement.

According to Fig. 2, the following are some specific examples of the interactions between human capital and social capital:

Economic: People with high levels of human capital (such as education and skills) are more likely to get high-paying jobs. They are also more likely to start their businesses. Social networks can help people find jobs, learn about new business opportunities, and get access to capital.

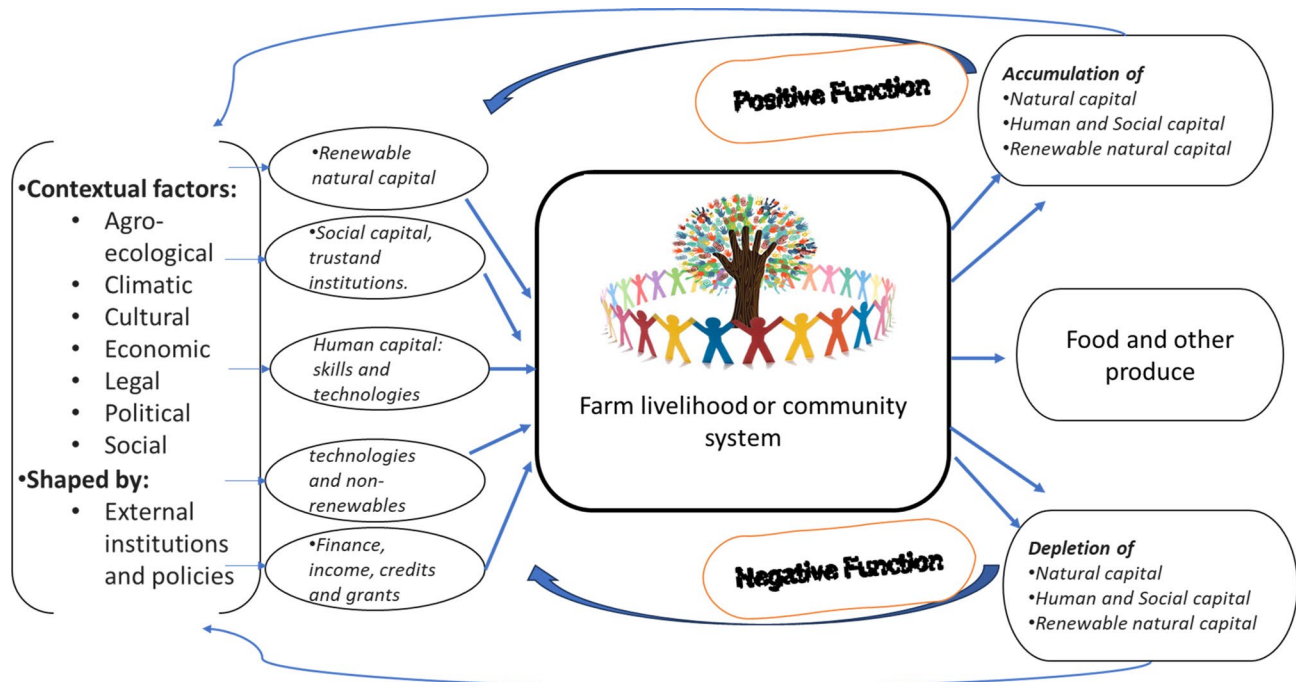


Fig. 2 According to J. Pretty [99], the above figure is illustrating the role of a positive Assets-based model and social capital in the sustainable livelihood framework: modified from J. Pretty's asset-based model of agricultural systems—flows and outcomes in sustainable systems

Political: People with high levels of human capital are more likely to be politically engaged. They are more likely to vote, run for office, and participate in civic activities. Social networks can help people mobilize for political action and build coalitions.

Social: People with high levels of human capital are more likely to have strong social ties. They are also more likely to be involved in social organizations. Social networks can provide people with support, companionship, and a sense of belonging.

Cultural: People with high levels of human capital are more likely to be involved in cultural activities, such as attending museums, concerts, and plays. They are also more likely to volunteer their time to cultural organizations. Social networks can help people connect with others who share their cultural interests.

Overall, human capital and social capital are complementary resources that could improve people's involvement in sustainable agriculture and resolve conflicts. Investing in human capital can help people develop the skills and knowledge they need to succeed. Investing in social capital can help people build networks and relationships that can support their economic, political, social, and cultural well-being.

5 Conclusion and policy recommendation

This article has explored the complex relationship between food insecurity and the ripple challenges of climate change, economic crisis and conflict in East Africa, with a specific focus on the Horn of Africa. It has highlighted the devastating impact of climate-related stressors, such as erratic rainfall and extreme weather events, on agricultural production and food availability. This, coupled with pre-existing vulnerabilities, has exacerbated food insecurity in the region, leaving millions vulnerable to hunger and malnutrition. However, the article has also emphasized the resilience and potential of East African communities. By embracing innovative agricultural practices, strengthening social safety nets, and promoting regional cooperation contribute to achieving food security and ending hunger in the Horn of Africa.

Achieving zero hunger is not just a humanitarian imperative but also an economic and social necessity. Food insecurity stifles economic growth, hinders development, and weakens national security. Conversely, a food-secure region fosters economic prosperity, promotes social stability, and empowers communities to thrive. In the specific context of the Horn of Africa, achieving zero hunger holds particular significance. The region is home to some of the world's most vulnerable populations, and the consequences of inaction are severe. Ensuring food security for all is not only crucial for saving lives but also for building a stronger, more resilient future for the region.

Tackling food insecurity and climate change in the East Africa requires a multi-pronged approach that involves collective action from various stakeholders. Here are some key action points:

- **Investing in climate-smart agriculture:** It is essential to promote the use of climate-resilient agricultural methods, such as drought-resistant crops and water conservation techniques, to maintain food security in response to changing climate conditions.
- **Strengthening social safety nets:** Implementing safety nets like food assistance programmes and social protection systems can aid vulnerable communities in managing food insecurity and weather shocks.
- **Fostering regional cooperation:** Collaboration between countries in the East Africa is crucial for sharing resources, knowledge, and best practices in tackling food insecurity and climate change.
- **Engaging international community:** International donors and organizations have a vital role to play in providing financial and technical assistance to support regional efforts towards food security and climate resilience.
- **Empowering local communities:** Actively engaging local communities in decision-making processes and ensuring their access to resources and knowledge are essential for building long-term solutions to food insecurity and climate change.

The time for action is now. By working together and implementing concrete solutions, we can create a future where food insecurity is a relic of the past, and East Africa stands tall as a region where all its people have access to safe, nutritious, and sustainable food. Let us rise to the challenge and make zero hunger a reality in the Horn of Africa.

Author contributions Abdulkadir Mohamed Abdullahi: Introduction, Material and Methods Roice Kalengyo Bwambale: Results and Discussion Abdimalik Ali Warsame: Revising it critically for intellectual content and the final approval of the version to be submitted

Funding This study is supported by SIMAD University.

Data availability Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate This article reports analysis of secondary sources.

Competing interests The authors declare no competing interests.

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