COGENT FOOD & AGRICULTURE
2026, VOL. 12, NO. 1, 2673626
https://doi.org/10.1080/23311932.2026.2673626

FOOD SCIENCE & TECHNOLOGY | REVIEW ARTICLE

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Unlocking the potential of a neglected crop: a systematic review of research on okra (*Abelmoschus esculentus* (L.) Moench) in Africa

Hamid El Bilali[a], Iro Dan Guimbo[b], Lawali Dambo[c], Falalou Hamidou[d], Halima Oumarou Diadie[e], Awal Baboussouna[c], Andrea Veronelli[f] and Filippo Acasto[g]

[a]International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM-Bari), Valenzano (Bari), Italy; [b]Department of Rural Engineering, Water and Forests, Faculty of Agronomy, Abdou Moumouni University, Niamey, Niger; [c]Department of Geography, Faculty of Letters and Human Sciences, Abdou Moumouni University, Niamey, Niger; [d]International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Niamey, Niger; [e]Department of Crop Production, Faculty of Agronomy, Abdou Moumouni University, Niamey, Niger; [f]Italian Agency for Development Cooperation (AICS), Niamey, Niger; [g]Italian Agency for Development Cooperation (AICS), Ouagadougou, Burkina Faso

ABSTRACT

While several African countries (viz., Nigeria, Mali, and Sudan) are among the top producers of okra and its potential is widely recognized, a thorough analysis of the research landscape is lacking. Therefore, this systematic review analyses okra research in Africa by integrating bibliometrics, geography, and its contribution to sustainable development (viz., food security, livelihoods, and climate resilience). It draws upon 199 research articles selected out of 359 records retrieved from the Web of Science. The bibliometric analysis suggests that the research field primarily focuses on biological and environmental sciences, while overlooking socio-economics. Moreover, affiliations are dominated by a few countries, such as Nigeria and Ghana. The geographical analysis aligns with the bibliometric one and shows that more than half of the studies have been performed in only four countries, namely Nigeria, Ghana, Cameroon, and Egypt. The content analysis confirms the lack of research on socio-economics (e.g. livelihoods) but also adds that many environmental issues (e.g. climate change) are inadequately addressed. It also shows that, thanks to its nutritional profile, okra can help address food insecurity and malnutrition in Africa. There is a need to address the identified research gaps to unlock the potential contribution of okra to socio-economic development in Africa.

ARTICLE HISTORY
Received 15 January 2026
Revised 20 April 2026
Accepted 10 May 2026

KEYWORDS
African indigenous vegetables; climate change; food security; gumbo; neglected and underutilized species; NUS; opportunity crops

SUBJECTS
Agriculture & Environmental Sciences; Food Laws & Regulations; Sustainable Development

1. Introduction

Okra, scientifically known as *Abelmoschus esculentus* (L.) Moench, and commonly referred to as lady's fingers (BBC Good Food, 2025) or gumbo (Merriam-Webster, 2025a; Texas AgriLife Extension Service, 2005; Vogt, 2009), is a flowering plant belonging to the Malvaceae family. Synonyms for *A. esculentus* include *A. bammia* Webb, *A. longifolius* (Willd.) Kostel., *A. officinalis* (DC.) Endl., *A. praecox* Sickenb., *A. tuberculatus* Pal & Singh, and *Hibiscus esculentus* L. The species is a perennial plant, frequently grown as an annual in temperate climates (Swamy, 2023). Belonging to the Malvaceae family, it is related to plants like cotton, cocoa, and roselle/hibiscus. The fruit is a capsule with a five-sided cross-section that holds many seeds.

Okra originated in East Africa, specifically in Ethiopia, Eritrea, and eastern Sudan (Grubben & Denton, 2004; Muimba-Kankolongo, 2018; Texas AgriLife Extension Service, 2005). From Arabia, the plant gradually spread along the Mediterranean coast and towards the east (Muimba-Kankolongo, 2018). There is evidence indicating that it was grown in Egypt long before arriving in India, possibly brought by the

CONTACT Hamid El Bilali elbilali@iamb.it International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM-Bari), Via Ceglie 9, 70010 Valenzano (Bari), Italy

Supplemental data for this article can be accessed online at https://doi.org/10.1080/23311932.2026.2673626.

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Bantu people who migrated from Egypt around 2000 BCE along with seeds from the Eritrean plateau (Madras Courier, 2022). Arab traders were the ones who brought okra to Europe (Blench, 2006). The plant made its way to the Americas via ships involved in the Atlantic slave trade by 1658, when it was first noted in Brazil; it was also recorded in Suriname in 1686 (Dry, 2020; Internet Public Library, 2009; Merriam-Webster, 2025a, 2025b; Texas AgriLife Extension Service, 2005; Vogt, 2009; Voice of America, 2018). Okra may have been introduced to southeastern North America in the early 18th century. Today, a significant portion of the okra supply in the U.S. is cultivated in southern Florida (Aguiar et al., 2011; Southern Integrated Pest Management Center, 2005). Currently, okra is grown in various tropical and warm temperate regions across the globe (Hamon & Hamon, 1991; Massrie, 2025) for its fibrous fruits or pods that contain round, white seeds. It ranks as one of the most resilient vegetable species to heat and drought (Asante et al., 2024), capable of thriving in heavy clay soils with sporadic moisture, although frost can harm the plant (Snyder & de Melo-Abreu, 2005). As a plant native to tropical climates, it thrives on abundant sunlight and is best grown in soils that are slightly acidic (Boeckmann, 2025). The seed pods quickly turn fibrous and woody, and to be suitable for consumption, they need to be collected while still immature, typically within a week after pollination (Nolte, 2014). The initial harvest is usually ready around two months post-planting (Boeckmann, 2025).

The primary disease that affects the okra plant is verticillium wilt, which typically leads to yellowing and wilting of the foliage (Zhai et al., 2019). Additional diseases that impact okra include powdery mildew in arid tropical areas, leaf spots, okra yellow vein mosaic virus, and root-knot nematodes (Ounis et al., 2024). Significant diseases and pests include fruit worms (*Helicoverpa armigera*) (Ratnadass, Deberdt, et al., 2011) and viruses (Atiri et al., 2000) such as enation leaf curl disease (Kumar et al., 2025).

Okra is an ingredient in the dishes of numerous nations (National Research Council, 2006), including the USA (Gutierrez, 1992), Cuba and Puerto Rico (Whats4eats, 2025), the Dominican Republic (Diario Libre, 2012), Brazil (Brazilian Confederation of Agriculture and Livestock (CNA), 2022), and South Asia (Taylor Sen, 2004; Willis, 2014). Okra is recognized as the national vegetable of Pakistan (Ahmad, 2021). Both the pods and the leaves, along with the seeds of okra, are utilized in cooking. The pods can be prepared in various ways: cooked, pickled, consumed raw, or added to salads. When cooked, the pods produce a mucilaginous texture, resulting in the distinct 'goo' or slime; this mucilage is a source of soluble fiber (Gemede et al., 2016). In developing countries, okra can play a role in combating malnutrition and addressing food insecurity (Gemede et al., 2016). Young leaves of okra are often cooked like beet or dandelion greens, or can be incorporated into salads. The seeds of okra can be roasted and ground to create a caffeine-free coffee substitute (Texas AgriLife Extension Service, 2005). Edible okra oil, which is a greenish-yellow color, is extracted from the seeds (Martin, 1982; Mays et al., 1990) and is rich in unsaturated fats such as oleic acid and linoleic acid (Martin, 1982). Kumar et al. (2010) argue that okra has been considered as a 'perfect villager's vegetable' because of 'its robust nature, dietary fibers and distinct seed protein balanced in both lysine and tryptophan amino acids (unlike the proteins of cereals and pulses) it provides' (p. 3590). Okra has also been reported and studied as a medicinal plant (Fakudze et al., 2023; Gaur et al., 2025; Kwok et al., 2025; Phoswa & Mokgalaboni, 2023; Sereno et al., 2022), especially against diabetes (Ahmad et al., 2025, 2025; Fan et al., 2025; Gaur et al., 2025; Jafari et al., 2026; Kwok et al., 2025; Mokgalaboni et al., 2026; Phoswa & Mokgalaboni, 2023; Rai et al., 2025; Sereno et al., 2022) and cancers (Fakudze et al., 2023; Jafari et al., 2025; Kwok et al., 2025). However, okra has also been reported as a food allergen (Kung et al., 2014).

Okra has various applications in industry. The bast fiber derived from the plant's stem is used for reinforcing polymer composites (De Rosa et al., 2010). Okra is also used as a fat replacer (Khan et al., 2025; Xu et al., 2025). The mucilage generated by the okra plant can help in eliminating turbidity from wastewater due to its flocculant characteristics (Agarwal et al., 2001; Anastasakis et al., 2009). With a structure comparable to a thick polysaccharide film, okra mucilage is being explored as a sustainable option for food packaging (Araújo et al., 2018; Gaur et al., 2025; Khan et al., 2026; Wang et al., 2025; Xu et al., 2025; Zhang et al., 2025). Okra oil is suitable for utilization as a biofuel (Anwar et al., 2010).

In 2021, the global production of okra reached 10.8 million tons, with India accounting for 60% of that total. The secondary producers included Nigeria, Mali, Sudan, and Pakistan (FAO, 2026). The most recent data from FAOSTAT suggest that India is by far the most productive country, but it is followed by an African country, namely Nigeria. Apart from Nigeria, the top 20 list of producers of okra also included

further eleven African nations, i.e. Mali, Guinea, Sudan, Niger, Côte d'Ivoire, Egypt, Benin, Sierra Leone, Cameroon, Ghana, and Tanzania. When considering the area harvested, Nigeria is the leading country worldwide with 2,094,633 ha. However, yield is generally lower in African countries with respect to India (Table A1). This difference in yield between Africa and India might be due, among others, to a lack of improved varieties (Mangena et al., 2026; Massrie, 2025), pest pressure, and inadequate soil fertility management practices (Massrie, 2025).

Despite its significant potential, okra is frequently considered an underutilized, minor crop (Kumar et al., 2010). Although several African countries are considered among the top producers of okra, and it is among the most important African indigenous vegetables (AIVSs) (Kodzwa et al., 2023; Mativavarira et al., 2024) and considered as an 'opportunity crop' (Rutsaert et al., 2026), it remains uncertain if the research has progressed sufficiently to guarantee the crop's promotion on the continent. Earlier reviews of okra in Africa have either been outdated or have only partially covered the topic from geographical and thematic viewpoints (Table A2). Furthermore, a comprehensive bibliometric and content analysis for the entire African continent has not yet been performed. This highlights a notable research gap, as there has not been a recent systematic review specifically focused on okra on the continent. Consequently, this systematic review aims to provide a comprehensive overview of the research on okra in Africa. The paper presents bibliometric data and explores the geographic dissemination of the studies. It also emphasizes the themes addressed in the academic literature related to okra in Africa, particularly concerning its potential contribution to sustainable development in aspects of food and nutrition security, climate resilience, and livelihoods.

2. Methods

The present review conforms to the PRISMA guidelines (Page et al., 2021). For more information, see the PRISMA checklist in Supplementary Material 1. Nonetheless, being a systematic review on okra, which falls within the field of agri-food and is neither a quantitative review of evidence (cf. intervention studies in the fields of medicine and nutrition) nor a meta-analysis, some items of the PRISMA checklist, referring specifically to quantitative syntheses of evidence, are not applicable.

Peer-reviewed articles were identified through a search carried out in the Web of Science Core Collection on 02 January 2025. The search employed the following query: TS = *('Abelmoschus esculentus' OR 'A. esculentus' OR okra OR 'lady's finger' OR gumbo OR gombo) AND (Africa OR Algeria OR Angola OR Benin OR Botswana OR 'Burkina Faso' OR Burundi OR 'Cabo Verde' OR 'Cape Verde' OR Cameroon OR 'Central African Republic' OR Chad OR Comoros OR Congo OR 'Côte d'Ivoire' OR 'Cote d'Ivoire' OR 'Ivory Coast' OR 'Democratic Republic of the Congo' OR Djibouti OR Egypt OR 'Equatorial Guinea' OR Eritrea OR Ethiopia OR Eswatini OR Gabon OR Gambia OR Ghana OR 'Guinea-Bissau' OR Guinea OR Kenya OR Lesotho OR Liberia OR Libya OR Madagascar OR Malawi OR Mali OR Mauritania OR Mauritius OR Morocco OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR 'São Tomé and Príncipe' OR Senegal OR Seychelles OR 'Sierra Leone' OR Somalia OR 'South Africa' OR 'South Sudan' OR Sudan OR Swaziland OR Tanzania OR Togo OR Tunisia OR Uganda OR Zambia OR Zimbabwe)*. No specific filters (e.g. years, language) were applied during the search. The search in the Web of Science (WoS) resulted in 359 documents. The criteria for selecting eligible documents were informed by the methodology used by El Bilali, Dan Guimbo, et al. (2024), and El Bilali, Kiebre, et al. (2024).

Figure 1 outlines the various phases involved in the selection process. Specifically, three distinct criteria were evaluated for inclusion and eligibility: geographical relevance (i.e. the document pertains to Africa or an African country), thematic relevance (i.e. the document addresses okra), and document type (i.e. only original research articles, book chapters, or conference papers were permitted, while editorial pieces and reviews were not included). No automation was used during the screening and assessment of records. Ninety-three (93) records were excluded after the screening of titles and abstracts. After analyzing the titles, 6 documents were eliminated because they did not relate to African countries. Additionally, 87 documents were discarded upon reviewing their abstracts, as they did not meet at least one of the criteria for eligibility/inclusion: 69 documents did not mention okra, 12 were unrelated to Africa or African countries, and 6 lacked abstracts. In terms of geographical relevance, the term 'Niger' appears in several articles in relation to *Aspergillus Niger*. Other articles refer to Papua New Guinea.

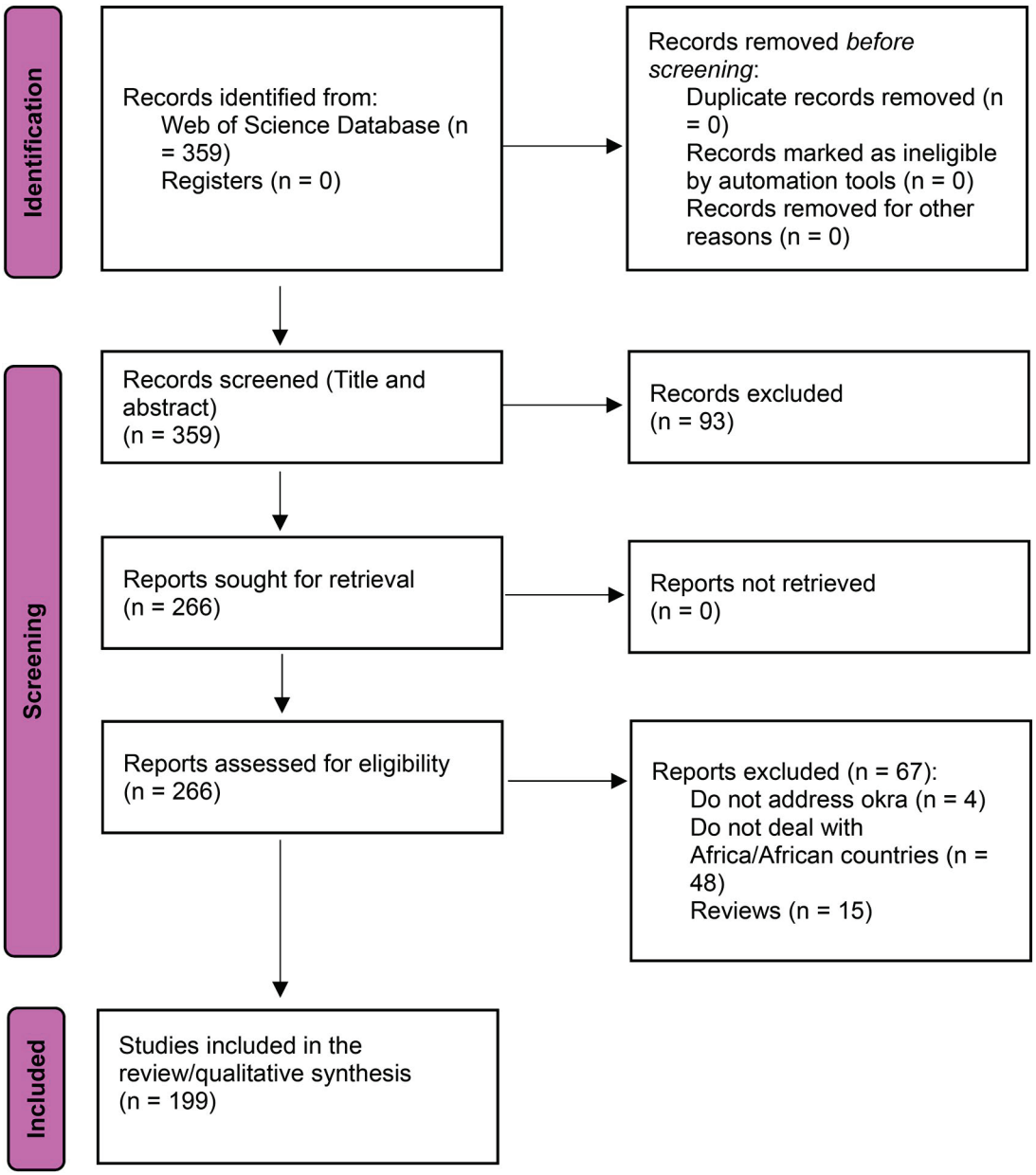


Figure 1. Research on okra in Africa: PRISMA 2020 flow diagram. *Source:* Adapted from Page et al. (2021).

Gari-Gombo is an area in Eastern Cameroun. With regards to the species discussed, some articles mention other crops such as *Astragalus gombo* or *Corchorus olitorius* (also called 'traditional okra', 'Bush okra' or 'wild okra'). Studies referring to okra as *Hibiscus esculentus* were included. Some studies deal with Okra Mosaic Virus (OMV), but on other species, not okra. Since the review draws only upon peer-reviewed articles published in journals indexed in the Web of Science, there were no particular difficulties in retrieving the documents. Indeed, most of them were open access; for the few remaining, they were retrieved by contacting the corresponding author, especially through ResearchGate. Finally, 67 documents were removed after a thorough review of their full texts, which included 15 reviews.

The review systematically examined a total of 199 documents (Table A3). This comprised 188 articles from journals and 11 papers originating from conferences.

The paper combines bibliometric, geographical, and topical analyses to grasp the landscape of research on okra in Africa. The assessment of the chosen documents began with an examination of bibliographic metrics and the geographical distribution within the research field in Africa. The extraction of data for the bibliometric analysis was done automatically, directly from the Web of Science database (in particular, figures were extracted from the Web of Science), while the geographical and topical analyses were

Table 1. Types of analyses and themes addressed in the systematic review on okra in Africa.

Type of analysis	Item	Description
Bibliometric	Bibliographical metrics	Journals/sources, research/subject areas, SDGs, authors, affiliation institutions/organizations, and countries, and funding agencies
Geographical	Research geography	African countries where studies on okra were performed
Topical/content	Agriculture subsectors and food chain stages	Agriculture subsectors: Crop production, animal production/livestock, and fisheries/aquaculture
		Food chain stages: Production (agronomy), processing, distribution/retail/marketing, and consumption
	Climate and ecosystem resilience	Climate change mitigation/adaptation
		Resilience of farming systems
	Food and nutrition security	Food security dimensions/pillars: availability, access, utilization/use, and stability
	Socio-economic impacts and livelihoods	Contribution to livelihoods and income generation
		Gender issues

performed by the authors without any automation. Following the bibliometric and geographical analyses, all the selected studies were analyzed for various themes, including agriculture subsectors, stages of the food supply chain, and the contribution of okra to enhancing food security and nutrition, improving climate and ecosystem resilience, and supporting livelihoods (Table 1). All evaluations adhered to the methodology used for mapping research on moringa (El Bilali, Dan Guimbo, et al., 2024), roselle (El Bilali, 2024), and Bambara groundnut (El Bilali, Kiebre, et al., 2024) in Africa. Consolidated data extraction forms (El Bilali, 2024; El Bilali, Dan Guimbo, et al., 2024; El Bilali, Kiebre, et al., 2024) were used. Results regarding the bibliometric analysis are presented in narrative and graphical formats, while those regarding geographical and topical analyses are presented in tabular and/or narrative formats.

3. Results and discussion

3.1. Bibliometrics of research on okra in Africa

Africa appears to play a rather marginal role in academic literature concerning okra. A search conducted on 02 January 2025 in WoS, without applying any geographical filters [viz. *'Abelmoschus esculentus' OR 'A. esculentus' OR okra OR 'lady's finger' OR gumbo OR gombo*], resulted in 3,685 records. In contrast, the search that encompassed the African continent yielded 359 documents; this implies that Africa accounts for just about 9.74% of the worldwide literature that might address okra.

The initial research article on okra in Africa that is indexed in WoS was published in 1990 (Oladokun, 1990). Since that time, the *yearly number of publications* on okra in Africa has shown inconsistent and fluctuating interest. From 1990 to 2024, the annual publication counts varied greatly (Table A3), with some years having no publications at all (e.g. 1994, 1997, 2000) and others only having one (1990, 1995, 1996, 1998, 1999, 2002, 2003), while there was a peak of 18 publications in 2023. In 2024, there were 14 papers published on the topic of okra in Africa, suggesting a potential decline in interest when compared to the 18 publications from 2023.

The collection of *sources and journals* (Figure 2) is led by Acta Horticulturae (9 articles, 4.52%), followed by the African Journal of Biotechnology (7 articles, 3.52%) and the Journal of Agricultural Science (6 articles, 3.01%). However, the 199 chosen publications were spread across 135 sources and journals, indicating that research related to okra in Africa does not have a specific publication outlet.

The majority of the publications that fulfill the eligibility criteria are concentrated in the *research areas* of Agriculture (88 articles, 44.22%) and, to a lesser extent, in the areas of Food Science Technology (25 articles, 12.56%), Entomology (23 articles, 11.56%) and Plant Sciences (19 articles, 9.55%) (Figure 3). It is noteworthy that the selected publications encompass 33 different research domains (e.g. Biotechnology – Applied microbiology, Business economics, Chemistry, Ecology, Engineering, Forestry, Genetics, Geochemistry, Geology, Medicine, Meteorology, Microbiology, Nutrition Dietetics, Parasitology, Pharmacology, Physics, Toxicology, Virology, Zoology), indicating a diverse and multidisciplinary research landscape. Nevertheless, it can be deduced that the main focus in this research field is on biological sciences (e.g. agriculture, entomology, plant sciences), with limited representation from economics and social sciences.

The analysis of the evolution of research on okra in Africa over time, on a decadal basis, through the prism of research areas (Table A4) suggests that the research area of agriculture is always the leading one,



Figure 2. Studies on okra in Africa – top ten journals and sources. The various journals/sources are indicated by distinct colours, and the figures above them indicate the number of articles published in each journal/source. *Source:* Authors' analysis based on data obtained from the Web of Science (WoS) database.

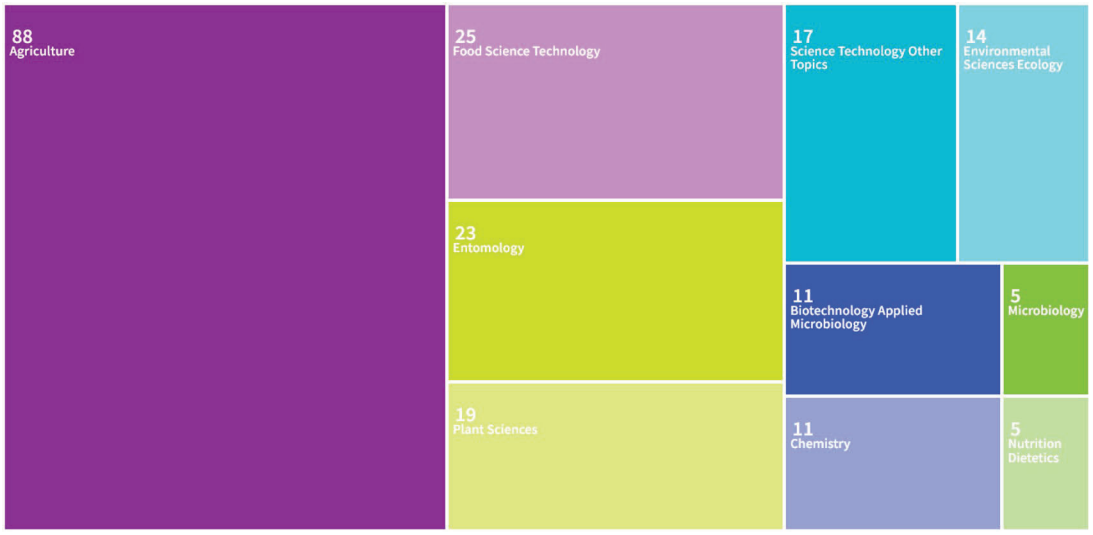


Figure 3. Studies on okra in Africa – top ten research areas. *Source:* Authors based on data from WoS database.

but its share in the publication output is decreasing from one decade to another. Meanwhile, topics such as food science technology are gaining in relevance to the detriment of plant science and entomology. This might denote a change in focus from only production to the valorization of okra and its products.

The wide range of sectors and areas covered by the research on okra is evident from the Sustainable Development Goals (*SDGs*) to which they pertain (Figure 4). The studies reviewed concerning okra are associated with 12 SDGs, with the most significant being 02 – Zero Hunger (129 articles, 64.82%), 13 – Climate Action (104 articles, 52.26%), 15 – Life on Land (78 articles, 39.20%), and 03 – Good Health and Well-being (52 articles, 26.13%). Other SDGs that are of lesser importance include 14 – Life Below Water (18 articles), 06 – Clean Water and Sanitation (11 articles), 12 – Responsible Consumption and Production (7 articles), 01 – No Poverty (4 articles), 09 – Industry, Innovation, and Infrastructure (3 articles), 11 – Sustainable Cities and Communities (3 articles), 05 – Gender Equality (2 articles), and 07 – Affordable and Clean Energy (1 article).

The examination of bibliometric data concerning okra research in Africa reveals that the most prominent and productive *researcher* in this domain is Faucett O. Olasantan (10 articles, 5.02%) – Department of Horticulture, Federal University of Agriculture, Abeokuta, Nigeria (Figure 5). Nonetheless, there is a

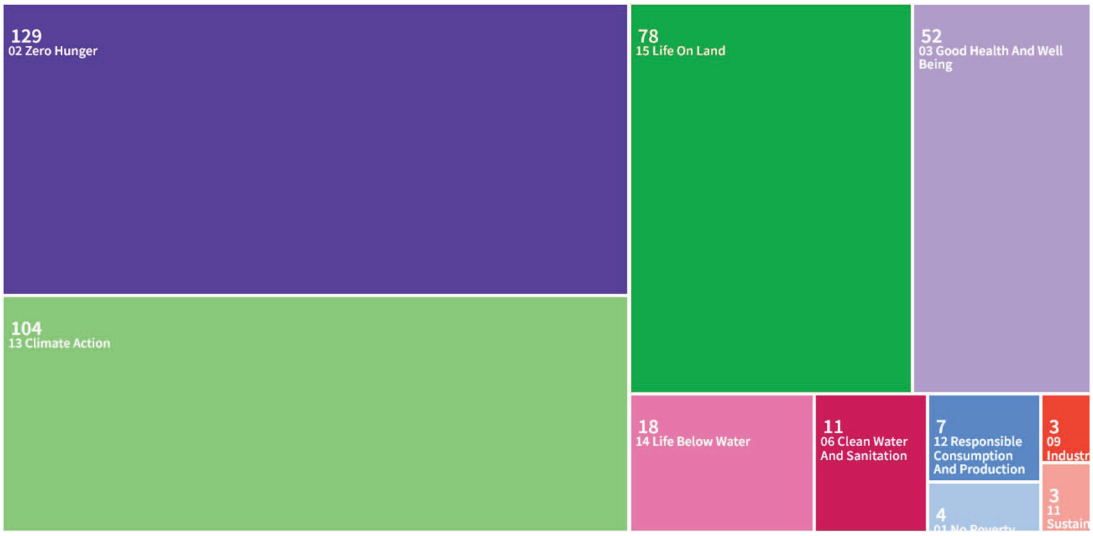


Figure 4. Studies on okra in Africa – main SDGs related to the considered studies. SDG 01: No Poverty; SDG 09 – Industry, Innovation and Infrastructure; SDG 11: Sustainable Cities and Communities. The same article can be associated with different SDGs. *Source:* Authors based on data from WoS.



Figure 5. Research on okra in Africa – top ten authors and scholars. *Source:* Authors based on data from WoS.

noticeable inconsistency and lack of specialization within the field, as a multitude of authors have published only a few articles. In fact, out of the 720 scholars and researchers who contributed to the 199 selected publications, a considerable 701 scholars (viz. 97.36%) have two or fewer articles related to okra. This suggests that even those who focus on okra do so infrequently rather than consistently, likely due to the absence of organized research initiatives, programs, and projects centered on okra in Africa.

The 199 articles on okra in Africa have been authored by researchers from 260 various institutions and research centers. At the forefront of the *affiliation institutions* (Figure 6) is the University of Agriculture Abeokuta in Nigeria (25 articles, 12.56%). Further prominent institutions in Africa are the Egyptian Knowledge Bank, the University of Ibadan (Nigeria), the Federal University of Technology Akure (Nigeria), the University of Ghana, the University of Nigeria, the National Horticultural Research Institute (Nigeria), Obafemi Awolowo University (Nigeria), and the University of Yaounde I (Cameroon). Furthermore, organizations involved in okra research in Africa are also present beyond the continent, including CIRAD (Agricultural Research Centre for International Development, France) and CGIAR (Consultative Group for International Agricultural Research).



Figure 6. Studies on okra in Africa – top ten affiliations. *Source:* Authors based on data from WoS.



Figure 7. Studies on okra in Africa – top ten countries. *Source:* Authors based on data from WoS.

The results regarding institutional affiliations align with the affiliation *countries* (Figure 7). Specifically, the top countries are Nigeria (90 articles, 45.23%), followed by Ghana (21 articles, 10.55%) and Cameroon (19 articles, 9.55%). Other prominent African nations in the research area include Egypt and South Africa (13 articles each), Ethiopia (12 articles), Burkina Faso (9 articles), Kenya (8 articles), and, to a lesser extent, Tanzania and Uganda (5 articles each), Benin and Niger (4 articles each), and Côte d'Ivoire (3 articles). Additionally, many authors are affiliated with institutions located outside Africa, including Asia (e.g. Taiwan), Europe (e.g. France, Germany, England), and North America (e.g. USA, Canada). The 199 chosen publications have been written by scholars and researchers from 53 different countries and regions.

The examination of bibliographic information reveals that the main sources of funding originate from outside Africa, particularly the European Union and international research institutions (e.g. CGIAR and CIRAD). As a result, the findings highlight the lack of adequate domestic funding for okra research in Africa, posing a risk and potentially obstructing the advancement of sustainable local research initiatives on the crop.

3.2. Geography of the research on okra in Africa

Research on okra shows significant differences across Africa (Table 2). A small number of countries—particularly Nigeria and, to a lesser extent, Ghana, Cameroon, and Egypt—which rank highest in affiliation,

Table 2. Geography of studies on okra in Africa.

Country or region (articles number)	Documents
Benin (2)	Kobta et al. (2023); Salako et al. (2014)
Burkina Faso (10)	Avallone et al. (2007); Avallone et al. (2008); Bayili et al. (2011); Clair-Caliot et al. (2021); Dabiré-Binso et al. (2009); Konaté et al. (1995); Mertz et al. (2001); Ouattara et al. (2020); Tiendrébéogo, Lefeuvre, et al. (2010); Tiendrébéogo, Traoré et al. (2010)
Cameroon (15)	Abang et al. (2014); Abang et al. (2018); Abang et al. (2021); Abang et al. (2024); Birka et al. (2024); Farsia Djidjonri et al. (2021); Irma et al. (2023); Jacobsen et al. (2009); Leke et al. (2013); Leke et al. (2020); Nchang et al. (2023); Nkongho et al. (2022); Singh et al. (2016); Singh et al. (2017); Tsopzong et al. (2024)
Chad (1)	Guedeungbe et al. (2024)
Congo (1)	Nzikou et al. (2006)
Côte d'Ivoire (3)	Aasa et al. (2022); Burban et al. (1992); Nguessan et al. (1992)
Egypt (14)	Abd El-Fattah et al. (2020); Abdel-Motaal et al. (2022); Ahmed et al. (2022); Bakry and Fathipour (2023); Basha et al. (2021); Magdy et al. (2021); Malhat et al. (2024); Marrez et al. (2021); Osman et al. (2021); Salem et al. (2008); Sami et al. (2014); Sechser et al. (2002); Shehata et al. (2022); Zaki (1996)
Ethiopia (10)	Gemede et al. (2018); Kenaw et al. (2023); Kushi et al. (2023a); Kushi et al. (2023b); Kushi et al. (2023c); Mohammed et al. (2024); Mohammed et al. (2022a); Mohammed et al. (2022b); Sheferie et al. (2023); Temam et al. (2021)
Gabon (1)	Ondo et al. (2013)
Ghana (16)	Aflakpui et al. (2008); Agbaglo et al. (2020); Agbenorhevi et al. (2020); Akoto et al. (2015); Amiteye et al. (2021); Appiah et al. (2020); Avicor et al. (2014); Baah et al. (2024); Danso et al. (2015); Dwomoh and Boakye (2003); Essumang et al. (2013); Frimpong et al. (2021); Mbatchou et al. (2024); Omondi et al. (2005); Owusu, Boakye-Gyasi, Agbenorhevi, et al. (2021); Owusu, Boakye-Gyasi, Entsie, et al. (2021)
Kenya (2)	Bayissa et al. (2017); Waceke and Waudo (1993)
Mali (1)	Kon et al. (2009)
Mauritius (1)	Gungoosingh-Bunwaree et al. (2011)
Morocco (1)	Hachi et al. (2016)
Mozambique (1)	Dimande et al. (2023)
Niger (4)	Bakasso et al. (2014); Ratnadass, Ryckewaert, et al. (2011); Ratnadass et al. (2014); Woltering et al. (2011)
Nigeria (90)	Aboyeji et al. (2021); Adebanjo and Shopeju (1993); Adedoyin et al. (2024); Adegbite et al. (2005); Adejonwo et al. (1991); Adejumo et al. (2020); Adekunle (2009); Adelakun et al. (2009); Adelodun et al. (2021); Adeniyi (2001); Adewole and Ilesanmi (2011); Adeyemi et al. (2024); Adigbo et al. (2007); Agahiu et al. (2011); Aiyelaagbe and Jolaoso (1992); Akande et al. (2008); Akinyele and Osekita (2006); Akpan-Idiok et al. (2012); Akpor et al. (2022); Aladesanwa (2005); Alegbejo et al. (2011); Alegbejo et al. (2008); Aliku et al. (2022); Amalu and Okon (2015); Ameh et al. (2019); Anoliefo et al. (2020); Anyaoha et al. (2023); Atawodi et al. (2009); Awodoyin and Olubode (2011); Ayeni et al. (2023); Babatunde (2008); Borokini, Oladipo, Komolafe, and Ajongbolo (2022); Borokini, Oladipo, Komolafe, Ajongbolo, and Oladipo (2022); Dare et al. (2014); Dauda et al. (2009); Echezona and Offordile (2011); Egedigwe et al. (2024); Ekoja and Pitan (2022); Fapohunda (1992); Gemede et al. (2016); Ibitoye and Kolawole (2022); Ikeorgu (1991); Ikeorgu and Ezumah (1991); Imoloame et al. (2024); Ishola et al. (2023); Kehinde et al. (2015); Komolafe et al. (2021); Mafulul et al. (2022); Makinde et al. (2012); Makinde et al. (2022); Mbah et al. (2024); Mohammed et al. (2013); Moyin-Jesu and Ojeniyi (2007); Muoneke and Mbah (2007); Muoneke and Udeogalanya (1991); Njoku et al. (2007); Nkakini and Akor (2013); Nwangburuka et al. (2011); Nwangburuka et al. (2012); Obasi et al. (2023); Obebe et al. (2020); Odeleye et al. (2007); Okeji et al. (2012); Okon et al. (2005); Okonji et al. (2020); Olabode et al. (2007); Oladele et al. (2023); Oladokun (1990); Olajide-Taiwo et al. (2014); Olasantan (1991); Olasantan (2005); Olasantan (1998); Olasantan (1999); Olasantan and Bello (2004); Olasantan and Salau (2008); Olasantan (2001a); Olowokere et al. (2021); Olubode (2012); Olubode et al. (2012a); Olubode et al. (2012b); Omonkhua et al. (2020); Onyeneke et al. (2023); Oshunsanya (2013); Palada et al. (1992); Pitan and Olatunde (2006); Salau et al. (2015); Uaboi-Egbenni et al. (2009); Umoren et al. (2024); Uwah et al. (2012); Wammanda et al. (2010)
Senegal (1)	de Bon et al. (2015)
South Africa (5)	Gerrano et al. (2020); Mokgalabone et al. (2025); Motis et al. (2017); Murovhi et al. (2020); Ugwu and Enweremadu (2019)
Sudan (2)	Dawoud and Sauerborn (2015); Müller et al. (2019)
Tanzania (2)	Kacholi and Sahu (2018); Ndunguru and Rajabu (2004)
Tunisia (2)	Aloui et al. (2017); Mahmoudi et al. (2022)
Uganda (6)	Bighaghire et al. (2021); Kumi et al. (2023); Lutoti et al. (2023); Sseruwagi et al. (2005); Sseruwagi et al. (2006); Taffner et al. (2020)
Zimbabwe (1)	Meck et al. (2020)
Africa* (7)	Chadha and Olouch (2007) – Southern Sudan, Zambia, Tanzania, Kenya, Mozambique, Uganda, Malawi and Rwanda; Chadha et al. (2007); Hell et al. (2009) – Benin, Mali and Togo; Mkiga et al. (2019) – Kenya and Tanzania; Pasquini et al. (2014) – Benin and Cote d'Ivoire; Stenchly et al. (2017) – Burkina Faso and Ghana; Woldetsadik et al. (2022) – Ethiopia and Uganda

*Contains articles that address at least two countries in Africa.

have carried out the majority of studies. In fact, more than half of all research on okra in Africa comes from Nigeria, Ghana, Cameroon, and Egypt. Nigeria leads with the most research articles on okra (90 articles, representing 45.2% of the total), followed by Ghana (16 articles, or 8.0%), Cameroon (15 articles,

or 7.5%), and Egypt (14 articles, or 7.0%). The high number of studies from Nigeria is somewhat expected due to its large population and status as one of the leading okra producers globally, while the research activity in Ghana may indicate a dynamic research environment. Other African nations that have made notable contributions include Burkina Faso (10 articles), Ethiopia (10 articles), Uganda (6 articles), and South Africa (5 articles). Many top producers of okra in Africa (Table A1) lag in research on the crop; this is the case of countries such as Mali, Sudan, Côte d'Ivoire, Benin, Niger, Tanzania, and Senegal. Furthermore, several African countries show insufficient research on the crop. For instance, some countries—such as Chad, Congo, Gabon, Mali, Mauritius, Morocco, Mozambique, Senegal, Zimbabwe—have conducted only one study on okra. Moreover, more than half of the African nations—viz. Angola, Burundi, Cabo Verde, Comoros, Djibouti, Equatorial Guinea, Eritrea, Gambia, Guinea, Guinea-Bissau, Lesotho, Liberia, Mauritania, Namibia, São Tomé and Príncipe, Seychelles, Somalia, and Zambia—have not been specifically examined in relation to okra, highlighting a significant research gap in this area.

There is a widespread lack of comprehensive research on okra across Africa, with only a few notable studies focused on regions or multiple countries. For example, Woldetsadik et al. (2022) analyzed the mineral composition of okra and its role in meeting adequate intake or recommended dietary allowances for young children and pregnant and lactating women across four refugee camps and settlements in Ethiopia and Uganda. Mkiga et al. (2019) evaluated the occurrence, egg-laying preferences, and offspring success of the false codling moth (*Thaumatotibia leucotreta*) on oranges and various vegetables (okra, African eggplant, chili, and sweet peppers) in Kenya and Tanzania. Pasquini et al. (2014) analyzed the production systems for African indigenous vegetables (AIVs), including okra, in urban and peri-urban agriculture (UPA) in Benin and Côte d'Ivoire. Meanwhile, Hell et al. (2009) evaluated fungal infection and aflatoxin contamination in dried vegetables (e.g. okra, Baobab leaves, hot chilli peppers) in West Africa (Benin, Mali, and Togo). Furthermore, there is no global study that addresses okra in African and non-African countries.

3.3. Content analysis

3.3.1. Agriculture subsectors and food chain stages

In terms of the *agricultural subsectors*, it is anticipated that the majority of the chosen studies will focus on crop production, given that okra is a crop/plant. No articles deal with animal production/livestock or fisheries/aquaculture. This finding might imply that okra is not usually used for animal or fish feed or, on the other hand, that there is insufficient research on this subject.

The production stage is by far the most talked-about aspect of the *food chain*, with consumption and processing following closely behind; in comparison, intermediate phases, especially marketing and distribution, tend to be overlooked in academic studies (Table 3).

Research on *production* includes multiple studies that have investigated the variety of okra cultivars and their performance in different countries, including Nigeria (Adedoyin et al., 2024; Ibitoye & Kolawole, 2022; Nwangburuka et al., 2011, 2012; Wammanda et al., 2010), Cameroon (Abang et al., 2024; Anyaoha et al., 2023; Komolafe et al., 2021), Ethiopia (Kenaw et al., 2023; Mohammed et al., 2022a, 2022b; Temam et al., 2021), Egypt (Abd El-Fattah et al., 2020), and South Africa (Gerrano et al., 2020). For example, Kenaw et al. (2023) evaluated the morpho-agronomic variability of 21 okra genotypes in Dire Dawa, eastern Ethiopia. Anyaoha et al. (2023) assessed seventy accessions of okra in Southwestern Nigeria through phenotypic observations, evaluation of traits, and analysis of resistance to virus vectors and diseases.

Several studies have looked into the *processing* of okra. Processing and preparation techniques include drying/sun drying (Anoliefo et al., 2020; Bighaghire et al., 2021; Kumi et al., 2023), boiling and sun drying (Bighaghire et al., 2021), and salting and sun drying (Bighaghire et al., 2021). Okra has been used, inter alia, to produce flour (Adelakun et al., 2009). Tsopzong et al. (2024) evaluated mucilage from edible plants, such as okra, in West Cameroon for developing enhanced protein-polysaccharide conjugates. Kumi et al. (2023) assessed the acceptance of solar drying technology among okra producers in northern Uganda. Shehata et al. (2022) explored the impact of mucilages derived from certain vegetable plant residues, such as okra, as an edible coating on preserving the quality and extending the shelf life of

Table 3. Stages of the food chain.

Food chain stage*	Documents
Primary production	Abang et al. (2014); Abang et al. (2018); Abang et al. (2021); Abang et al. (2024); Abd El-Fattah et al. (2020); Abdel-Motaal et al. (2022); Aboyeji et al. (2021); Adedoyin et al. (2024); Adegbite et al. (2005); Adejonwo et al. (1991); Adekunle (2009); Adelodun et al. (2021); Adeniyi (2001); Adewole and Ilesanmi (2011); Adeyemi et al. (2024); Adigbo et al. (2007); Aflakpui et al. (2008); Agahiu et al. (2011); Agbaglo et al. (2020); Ahmed et al. (2022); Akande et al. (2008); Akinyele and Osekita (2006); Akpan-Idiok et al. (2012); Akpor et al. (2022); Aladesanwa (2005); Alegbejo et al. (2008); Aliku et al. (2022); Amalu and Okon (2015); Ameh et al. (2019); Amiteye et al. (2021); Anyaoha et al. (2023); Appiah et al. (2020); Atawodi et al. (2009); Avicor et al. (2014); Awodoyin and Olubode (2011); Ayeni et al. (2023); Baah et al. (2024); Babatunde (2008); Bakasso et al. (2014); Bakry and Fathipour (2023); Basha et al. (2021); Bayissa et al. (2017); Birka et al. (2024); Chadha and Olouch (2007); Chadha et al. (2007); Clair-Caliot et al. (2021); Dabiré-Binso et al. (2009); Danso et al. (2015); Dare et al. (2014); Dawoud and Sauerborn (2015) ; de Bon et al. (2015); Dimande et al. (2023); Dwomoh and Boakye (2003); Echezona and Offordile (2011); Egedigwe et al. (2024); Ekoja and Pitan (2022); Fapohunda (1992); Farsia Djidjonri et al. (2021); Frimpong et al. (2021); Gerrano et al. (2020); Ibitoye and Kolawole (2022); Ikeorgu (1991); Ikeorgu and Ezumah (1991); Ishola et al. (2023); Kacholi and Sahu (2018); Kenaw et al. (2023); Komolafe et al. (2021); Mafulul et al. (2022); Mahmoudi et al. (2022); Makinde et al. (2012); Makinde et al. (2022); Marrez et al. (2021); Mbah et al. (2024); Mbatchou et al. (2024); Meck et al. (2020); Mkiga et al. (2019); Mohammed et al. (2013); Mohammed et al. (2022a); Mohammed et al. (2022b); Mokgalabone et al. (2025); Motis et al. (2017); Moyin-Jesu and Ojeniyi (2007); Müller et al. (2019); Muoneke and Mbah (2007); Muoneke and Udeogalanya (1991); Murovhi et al. (2020); Nchang et al. (2023); Ndunguru and Rajabu (2004); Njoku et al. (2007); Nkakini and Akor (2013); Nkongho et al. (2022); Nwangburuka et al. (2011); Nwangburuka et al. (2012); Odeleye et al. (2007); Okeji et al. (2012); Okon et al. (2005); Okonji et al. (2020); Olabode et al. (2007); Oladele et al. (2023); Oladokun (1990); Olajide-Taiwo et al. (2014); Olasantan (1991); Olasantan (2005); Olasantan (1998); Olasantan (1999); Olasantan and Bello (2004); Olasantan and Salau (2008); Olasantan et al. (2001a); Olowokere et al. (2021); Olubode (2012); Olubode et al. (2012a); Olubode et al. (2012b); Omondi et al. (2005); Ondo et al. (2013); Onyeneke et al. (2023); Oshunsanya (2013); Osman et al. (2021); Palada et al. (1992); Pasquini et al. (2014); Pitan and Olatunde (2006); Ratnadass, Ryckewaert, et al. (2011); Ratnadass et al. (2014); Salako et al. (2014); Salau et al. (2015); Salem et al. (2008); Sechser et al. (2002); Sheferie et al. (2023); Singh et al. (2016); Singh et al. (2017); Sseruwagi et al. (2006); Stenchly et al. (2017); Taffner et al. (2020); Temam et al. (2021); Tiendrébéogo, Traoré et al. (2010); Uaboi-Egbenni et al. (2009); Umoren et al. (2024); Uwah et al. (2012); Waceke and Waudo (1993); Wammanda et al. (2010); Woldetsadik et al. (2022); Woltering et al. (2011); Zaki (1996)
Processing (including post-harvest storage)	Adejumo et al. (2020); Adelakun et al. (2009); Agbenorhevi et al. (2020); Aloui et al. (2017); Anoliefo et al. (2020); Gemede et al. (2018); Kumi et al. (2023); Owusu, Boakye-Gyasi, Agbenorhevi, et al. (2021); Shehata et al. (2022); Ugwu and Enweremadu (2019)
Marketing	Irma et al. (2023); Mertz et al. (2001); Olajide-Taiwo et al. (2014); Tsopzong et al. (2024)
Consumption	Aasa et al. (2022); Adebanjo and Shopeju (1993); Ahmed et al. (2022); Akoto et al. (2015); Alegbejo et al. (2011); Anoliefo et al. (2020); Atawodi et al. (2009); Avallone et al. (2007); Avallone et al. (2008); Bayili et al. (2011); Borokini, Oladipo, Komolafe, and Ajongbolo (2022); Chadha and Olouch (2007); Chadha et al. (2007); Clair-Caliot et al. (2021); Essumang et al. (2013); Gemede et al. (2016); Guedeungbe et al. (2024); Hachi et al. (2016); Hell et al. (2009); Imoloame et al. (2024); Irma et al. (2023); Ishola et al. (2023); Kacholi and Sahu (2018); Kehinde et al. (2015); Kobta et al. (2023); Kushi et al. (2023a); Kushi et al. (2023b); Kushi et al. (2023c); Lutoti et al. (2023); Mafulul et al. (2022); Malhat et al. (2024); Marrez et al. (2021); Meck et al. (2020); Mertz et al. (2001); Mohammed et al. (2024); Nzikou et al. (2006); Obasi et al. (2023); Obebe et al. (2020); Okeji et al. (2012); Olajide-Taiwo et al. (2014); Omonkhua et al. (2020); Ondo et al. (2013); Osman et al. (2021); Sami et al. (2014); Taffner et al. (2020); Umoren et al. (2024); Woldetsadik et al. (2022)

*A number of articles discuss different stages of the food chain.

sweet pepper fruits. In particular, okra has been used for the production of pectin (Agbenorhevi et al., 2020; Owusu, Boakye-Gyasi, Entsie, et al., 2021). Indeed, Owusu, Boakye-Gyasi, Entsie, et al. (2021) tested the use of pectin derived from okra as a binding agent in tablets designed for immediate release in Ghana.

Research focusing on the *marketing* of okra and its products is limited. An example is the work by Mertz et al. (2001), who analysed the consumption and marketing of vegetables (including okra) in Burkina Faso.

In terms of *consumption*, studies have centered on okra as a food item and its potential health benefits. Most articles in this area examine the role of okra in food and nutrition security. For instance, Kushi et al. (2023b) analysed the effects of okra intake on the nutritional health of expectant mothers in western Ethiopia. The studies on consumption also cover aspects related to food safety as well as the application of okra in food fortification.

Only a few researchers adopted a wider view, analyzing various stages of the *value chain* (Olajide-Taiwo et al., 2014). For instance, Olajide-Taiwo et al. (2014) analysed the value chain of vegetables (including okra) in Ibadan City of Nigeria.

Table 4. Agronomic practices explored in research related to okra production.

Agronomic practice*	Documents
Fertilisation and soil fertility management	Aboyeji et al. (2021); Adewole and Ilesanmi (2011); Akande et al. (2008); Akpan-Idiok et al. (2012); Amalu and Okon (2015); Babatunde (2008); Danso et al. (2015); Dimande et al. (2023); Mbah et al. (2024); Moyin-Jesu and Ojeniyi (2007); Okon et al. (2005); Olasantan (1999); Olowokere et al. (2021); Onyeneke et al. (2023); Palada et al. (1992); Uwah et al. (2012); Waceke and Waudo (1993)
Pest management (including weeds)	Abang et al. (2014); Abang et al. (2018); Abang et al. (2021); Abang et al. (2024); Abdel-Motaal et al. (2022); Adegbite et al. (2005); Adejonwo et al. (1991); Adekunle (2009); Adeyemi et al. (2024); Agbaglo et al. (2020); Akpor et al. (2022); Alegbejo et al. (2008); Anyaoha et al. (2023); Appiah et al. (2020); Avicor et al. (2014); Awodoyin and Olubode (2011); Baah et al. (2024); Bakry and Fathipour (2023); Basha et al. (2021); Bayissa et al. (2017); Burban et al. (1992); Dabiré-Binso et al. (2009); Dawoud and Sauerborn (2015); Dwomoh and Boakye (2003); Echezona and Offordile (2011); Egedigwe et al. (2024); Ekoja and Pitan (2022); Farsia Djidjonri et al. (2021); Gungoosingh-Bunwaree et al. (2011); Imoloame et al. (2024); Jacobsen et al. (2009); Kon et al. (2009); Konaté et al. (1995); Leke et al. (2013); Leke et al. (2020); Makinde et al. (2022); Mkiga et al. (2019); Mohammed et al. (2013); Murovhi et al. (2020); Nchang et al. (2023); Ndunguru and Rajabu (2004); Nguessan et al. (1992); Olabode et al. (2007); Omondi et al. (2005); Ouattara et al. (2020); Owusu, Boakye-Gyasi, Entsie, et al. (2021); Ratnadass, Ryckewaert, et al. (2011); Ratnadass et al. (2014); Salem et al. (2008); Sechser et al. (2002); Singh et al. (2016); Sseruwagi et al. (2006); Stenchly et al. (2017); Tiendrébéogo, Lefeuvre, et al. (2010); Tiendrébéogo, Traoré et al. (2010); Waceke and Waudo (1993); Zaki (1996)
Irrigation	Adelodun et al. (2021); Ahmed et al. (2022); Birka et al. (2024); Clair-Caliot et al. (2021); Danso et al. (2015); Dauda et al. (2009); Fapohunda (1992); Mahmoudi et al. (2022); Woltering et al. (2011)

*Several articles discuss different agronomic practices.

Okra is grown in different *agricultural systems*, utilizing both monocropping and intercropping techniques, including agroforestry (Aiyelaagbe & Jolaoso, 1992; Oladokun, 1990). It has been intercropped with various crops, such as maize in Cameroon (Farsia Djidjonri et al., 2021; Singh et al., 2017) and Nigeria (Akande et al., 2008; Dare et al., 2014; Ikeorgu, 1991), rice in Nigeria (Okonji et al., 2020), maize and cowpea in Cameroon (Farsia Djidjonri et al., 2021), cowpea in Cameroon (Farsia Djidjonri et al., 2021) and Nigeria (Olasantan, 1991), bean in Cameroon (Singh et al., 2017), cassava in Nigeria (Agahiu et al., 2011; Ikeorgu, 1991; Ikeorgu & Ezumah, 1991; Muoneke & Mbah, 2007; Olasantan, 1999; 2001a; 2005; Olasantan & Bello, 2004; Salau et al., 2015), bean and maize in Cameroon (Singh et al., 2017), sorghum in Nigeria (Makinde et al., 2012), pawpaw in Nigeria (Olubode, 2012; Olubode et al., 2012a, 2012b), sweet potato in Nigeria (Njoku et al., 2007), tomato in Nigeria (Adeniyi, 2001; Pitan & Olatunde, 2006), yam in Nigeria (Adegbite et al., 2005), and papaya in Nigeria (Aiyelaagbe & Jolaoso, 1992). This demonstrates the crop's adaptability in intercropping across a range of environments and farming methods.

Regarding *production*, some studies concentrate on pest management and fertilization, while irrigation is usually neglected (Table 4). Additional agronomic practices that were evaluated included pruning (Olasantan & Salau, 2008).

There is generally a lack of research dedicated to *irrigation* techniques for okra, with only a few significant exceptions (Adelodun et al., 2021; Danso et al., 2015; Fapohunda, 1992; Mahmoudi et al., 2022; Woltering et al., 2011). For instance, Mahmoudi et al. (2022) analyzed the effects of surface and subsurface drip irrigation using treated wastewater on the productivity of okra in Tunisia. Adelodun et al. (2021) analysed technical efficiencies of irrigated crop production in the Kampe-Omi irrigation scheme, Nigeria. Danso et al. (2015) analyzed the effects of different irrigation methods (sprinkler irrigation and drip irrigation) on the yield of okra in the Keta Sand Spit of Southeast Ghana. Woltering et al. (2011) provided an analysis of the economic and financial aspects of low-pressure drip irrigation and manual watering for growing vegetables (including okra) in Niger. Fapohunda (1992) investigated the effects of irrigation frequency and amount on yields of okra at Ile-Ife, Nigeria.

Research pertaining to *pest management* involves a variety of pests and diseases, such as nematodes (*Meloidogyne incognita*) in Nigeria (Adekunle, 2009; Egedigwe et al., 2024) and Ghana (Adegbite et al., 2005; Agbaglo et al., 2020; Baah et al., 2024), aphids in South Africa (Murovhi et al., 2020), Egypt (Sechser et al., 2002), Kenya (Bayissa et al., 2017) and Cameroon (Abang et al., 2014, 2018, 2021, 2024), cotton mealybug in Egypt (Bakry & Fathipour, 2023), flea beetles in Nigeria (Echezona & Offordile, 2011; Ekoja & Pitan, 2022; Mohammed et al., 2013), rot disease (*Cochliobolus spicifer*) in Egypt (Abdel-Motaal et al., 2022), insect pests in Cameroon (Farsia Djidjonri et al., 2021), mite pests in Egypt (Basha et al., 2021), wilt disease (*Fusarium oxysporum* f. sp. vasinfectum) in Ghana (Agbaglo et al., 2020), false codling moth (*Thaumatotibia Leucotreta*) in Kenya and Tanzania (Mkiga et al., 2019), fruit worm in Niger (Ratnadass et al., 2014), *Bemisia tabaci* in Ghana (Avicor et al., 2014; Omondi et al., 2005), phytoplasma in Mauritius

(Gungoosingh-Bunwaree et al., 2011), and the defoliator *Xanthodes graellsii* (Lepidoptera: Nactuidae) in Ghana (Dwomoh & Boakye, 2003). The analyzed literature also addresses different viruses such as okra mosaic virus in Ghana (Appiah et al., 2020), Tanzania (Ndunguru & Rajabu, 2004) and Nigeria (Alegbejo et al., 2008), okra yellow vein mosaic virus in Ghana (Appiah et al., 2020), cotton leaf curl Gezira virus (CLCuGeV) in Burkina Faso (Ouattara et al., 2020), okra leaf curl disease in Cameroon (Leke et al., 2013) and Burkina Faso (Tiendrébéogo, Lefeuvre, et al. 2010; Tiendrébéogo, Traoré et al., 2010), and okra leaf curl virus in Côte D'Ivoire (Nguessan et al., 1992). For example, Baah et al. (2024) evaluated the effects of seed protectants on the growth and establishment of okra plants and their effectiveness in reducing nematode populations in the soil in Ghana. Agbaglo et al. (2020) analyzed the effects of the pathogenicity of nematode (*Meloidogyne incognita*) and wilt disease (*Fusarium oxysporum* f. sp. vasinfectum) on the growth and yield of two okra varieties in Ghana. Moreover, some studies have looked into weed management in places like Nigeria (Adejonwo et al., 1991; Adeyemi et al., 2024; Agahiu et al., 2011; Akande et al., 2008; Awodoyin & Olubode, 2011; Makinde et al., 2022; Olabode et al., 2007), Burkina Faso and Ghana (Stenchly et al., 2017), and Sudan (Dawoud & Sauerborn, 2015).

Numerous publications investigate the *fertilization* of okra and the management of soil fertility for this crop. Indeed, research on this subject has taken place across Africa, including countries such as Nigeria (Aboyeji et al., 2021; Adewole & Ilesanmi, 2011; Akpan-Idiok et al., 2012; Amalu & Okon, 2015; Babatunde, 2008; Moyin-Jesu & Ojeniyi, 2007; Okon et al., 2005; Olasantan, 1998, 1999; Olasantan, 1991; Olowokere et al., 2021; Onyeneke et al., 2023; Palada et al., 1992; Uwah et al., 2012), Mozambique (Dimande et al., 2023), and Ghana (Danso et al., 2015). For example, Dimande et al. (2023) investigated the effects of bat guano (an available local organic resource) and biochar on okra yield and soil properties in VilanKulo (Mozambique). Fertilization also regards the use of green manure (Mbah et al., 2024). Aboyeji et al. (2021) analyzed the performance and quality of okra cultivated with the application of soil Zn-fertilizer, green biomass, and poultry manure.

3.3.2. Climate and ecosystem resilience

A limited number of studies examine the relationships between okra and various environmental challenges in Africa, such as climate change and land degradation.

Overall, the academic research on okra in Africa insufficiently focuses on climate change and variability. Some studies have explored the relationship between okra and climate change on the continent (Abd El-Fattah et al., 2020; Birka et al., 2024; Egedigwe et al., 2024; Onyeneke et al., 2023). For example, Onyeneke et al. (2023) indicate that climate change, especially the increase in temperature, negatively affects the yield and production of okra in Nigeria. Consequently, they suggest the breeding and distribution of climate-resilient varieties of okra to assist farmers in adapting to higher temperatures. In the context of a changing climate, supplementary irrigation with harvested rainwater can be crucial to get good productions in arid and semi-arid regions such as the Far North region in Cameroon (Birka et al., 2024). Okra has also been tested as an organic feedstock to produce biodiesel, especially biomethane (Ugwu & Enweremadu, 2019); Ugwu and Enweremadu (2019) found that okra waste can be an effective resource for generating biogas.

Some studies analyse the drought tolerance of okra in various countries within Africa, such as Nigeria (Egedigwe et al., 2024) and Egypt (Abd El-Fattah et al., 2020). Abd El-Fattah et al. (2020) screened six varieties of okra (e.g. 'Pusa Sawani', 'Iraqi', and 'Hala') for drought, salinity, and heat stress in Assiut (Egypt). Okra growers in Ibadan (Nigeria) identified drought and pests among the important constraints affecting okra productivity (Ibitoye & Kolawole, 2022). In this context, Egedigwe et al. (2024) stress that understanding the effects of combined biotic and abiotic stresses (pests and drought) offers important perspectives on improving crop resilience amid various stress situations, especially significant for farming methods in sub-Saharan Africa that are encountering escalating climate-related difficulties.

Similarly, the significance of okra in mitigating land degradation has generally been overlooked in current literature. However, Stenchly et al. (2017) stress that management practices used by okra growers in Burkina Faso and Ghana can lead to changes in soil properties and affect weed assemblages and communities, with negative consequences in terms of the provision of ecosystem services (e.g. pollination, pest management).

There is a significant lack of research regarding the relationship between okra and water and soil contamination and pollution. Nevertheless, okra has been identified by Ameh et al. (2019) as an indigenous accumulator and translocator plant species that is suitable as a phytoextractor of Cu, Zn, and Mo in northern Anambra Basin, Nigeria (Ameh et al., 2019). Moreover, growing okra in soils contaminated with heavy metals (Mafulul et al., 2022; Obasi et al., 2023) or using untreated wastewater (Ahmed et al., 2022) or contaminated groundwater (Clair-Caliot et al., 2021) for irrigation can determine the accumulation of heavy metals and contaminants in okra, which can represent a risk to consumers.

3.3.3. Food and nutrition security

Examined studies suggest that okra has significant potential to boost food security and nutritional health in Africa by enhancing the availability, accessibility, and diversity and quality of food.

The current research on okra in Africa only briefly touches upon the issue of *food availability*. Nonetheless, the few studies that exist suggest that okra is an important food source for households throughout Africa. The availability of okra and its products is dependent on the crop's yield. In this regard, various studies show that okra yields are affected by factors such as cultivars/accessions/genotypes (Abang et al., 2024; Adedoyin et al., 2024; Anyaoha et al., 2023; Kenaw et al., 2023; Mohammed et al., 2022a, 2022b; Nwangburuka et al., 2011; Sheferie et al., 2023), plant density (Muoneke & Udeogalanya, 1991), intercropping (Farsia Djidjonri et al., 2021; Okonji et al., 2020; Olubode et al., 2012b; Singh et al., 2017), sowing/planting date (Abd El-Fattah et al., 2020; Olasantan & Bello, 2004), and agricultural practices (e.g. fertilization/soil nutrient management, pest control, weeding, irrigation) (Aboyeji et al., 2021; Adeyemi et al., 2024; Agbaglo et al., 2020; Awodoyin & Olubode, 2011; Babatunde, 2008; Birka et al., 2024; Danso et al., 2015; Dimande et al., 2023; Frimpong et al., 2021; Mahmoudi et al., 2022; Makinde et al., 2022; Mbah et al., 2024; Mokgalabone et al., 2025; Moyin-Jesu & Ojeniyi, 2007; Nchang et al., 2023; Nkakini & Akor, 2013; Odeleye et al., 2007; Okon et al., 2005; Olabode et al., 2007; Olasantan, 1998; Olasantan & Salau, 2008; Olowokere et al., 2021; Oshunsanya, 2013; Tiendrébéogo, Traoré et al. (2010); Uwah et al., 2012). Besides yield, the market availability of okra also depends on the effective management of postharvest and storage losses (Aloui et al., 2017).

While there has been limited research on okra related to *food access* in Africa, existing studies indicate that households with access to okra enjoy improved food and nutrition security (Kushi et al., 2023a, 2023b, 2023c), especially among households with lower incomes. Cultivating okra in urban and peri-urban areas of countries, such as Burkina Faso and Ghana (Stenchly et al., 2017), Benin and Côte d'Ivoire (Pasquini et al., 2014), and Nigeria (Olajide-Taiwo et al., 2014), promotes better access to nutritious diets for urban dwellers. Okra processing and value addition activities (Chadha et al., 2007; Kumi et al., 2023) can boost the income of farmers, providing them with extra financial resources and improving their food access. The role of okra in food security and access is influenced by the level of market access (Stenchly et al., 2017).

Many articles that address food security in relation to okra focus primarily on its nutritional contribution to people's diets, emphasizing *food utilization*. The consumption of okra improves the dietary diversity among populations (Kushi et al., 2023a, 2023b, 2023c). Many authors highlight the outstanding nutritional composition, quality, and profile of okra (Atawodi et al., 2009; Gemede et al., 2016, 2018; Gerrano et al., 2020; Kehinde et al., 2015; Mohammed et al., 2024; Sami et al., 2014; Woldetsadik et al., 2022) to advocate for its use as a solution to tackle nutrition-related challenges, including micronutrient deficiencies. Mohammed et al. (2024) argued that 'Despite being an undervalued native vegetable crop in Ethiopia, the study's findings show that okra is a multipurpose vegetable for promoting human health and ensuring food and nutritional security' (p. 2537). Interventions and projects utilizing okra to combat food insecurity and malnutrition have been documented in various African nations, such as Ethiopia and Uganda (Woldetsadik et al., 2022), and Southern Sudan, Zambia, Tanzania, Kenya, Mozambique, Uganda, Malawi, and Rwanda (Chadha & Olouch, 2007). These efforts primarily targeted women (Chadha & Olouch, 2007; Woldetsadik et al., 2022) and infants and children (Woldetsadik et al., 2022). The nutritional value and nutrient composition of okra can be influenced by several factors, including varieties/cultivars (Gerrano et al., 2020; Mohammed et al., 2024), soil quality and properties (Aboyeji et al., 2021; Olowokere et al., 2021; Ondo et al., 2013), agronomic and postharvest practices (Aboyeji et al., 2021; Adewole & Ilesanmi, 2011;

Mokgalabone et al., 2025), as well as techniques for processing, cooking, and preparation (Bighaghire et al., 2021; Mohammed et al., 2024). The implementation of okra in *fortification* and *supplementation* initiatives across numerous African countries is credited to its remarkable nutritional characteristics. Okra has been used in sauces with cereal-based diets (Avallone et al., 2007, 2008; Kehinde et al., 2015).

Guaranteeing *food safety* is vital for enhancing and optimizing food use. Certain research has suggested that okra and its products could contain heavy metals (Ahmed et al., 2022; Clair-Caliot et al., 2021; Ishola et al., 2023; Kacholi & Sahu, 2018; Kobta et al., 2023; Mafulul et al., 2022; Meck et al., 2020; Obasi et al., 2023; Ondo et al., 2013; Osman et al., 2021; Umoren et al., 2024), residues from pesticides (Akoto et al., 2015; Essumang et al., 2013; Imoloame et al., 2024; Kobta et al., 2023; Malhat et al., 2024; Marrez et al., 2021), and mycotoxins (Hell et al., 2009), which might pose risks to human health and well-being. Investigations highlighting these health dangers have been conducted in nations such as Egypt (Ahmed et al., 2022; Malhat et al., 2024; Marrez et al., 2021; Osman et al., 2021), Nigeria (Adebanjo & Shopeju, 1993; Imoloame et al., 2024; Ishola et al., 2023; Mafulul et al., 2022; Obasi et al., 2023; Obebe et al., 2020; Umoren et al., 2024), Cameroon (Irma et al., 2023), Benin (Kobta et al., 2023), Ivory Coast (Aasa et al., 2022), Benin (Hell et al., 2009), Burkina Faso (Clair-Caliot et al., 2021), Zimbabwe (Meck et al., 2020), Tanzania (Kacholi & Sahu, 2018), Mali (Hell et al., 2009), Ghana (Akoto et al., 2015; Essumang et al., 2013), Gabon (Ondo et al., 2013), and Togo (Hell et al., 2009). Imoloame et al. (2024) found that the occurrence of pesticide residues in okra in Kwara state (Nigeria) is affected by integrated pest management practices.

Only a small portion of the chosen articles discuss claims about the *health* benefits of okra. Research or reports on okra have been linked to various illnesses and diseases, such as breast cancer in Uganda (Lutoti et al., 2023) and diabetes in Morocco (Hachi et al., 2016). There are also some claims that okra consumption might be linked to the high dizygotic twinning rate in Igbo-Ora, Oyo State, Nigeria (Borokini, Oladipo, Komolafe, & Ajongbolo, 2022; Borokini, Oladipo, Komolafe, Ajongbolo, & Oladipo, 2022); Omonkhua et al., 2020, 2020).

There is no dedicated article that addresses the connection between okra and the *stability* dimension of food security. However, okra production is affected by climate change (Onyeneke et al., 2023). Onyeneke et al. (2023) concluded that climate change, particularly rising temperature, impacts okra and tomato production in Nigeria. Techniques such as irrigation can contribute to the stability of production in the face of climate change (Birka et al., 2024; Dauda et al., 2009). Furthermore, the instability of yield and production, so food availability, can affect the stability dimension of food security.

3.3.4. Socio-economic impacts and livelihoods

The research indicates that literature regarding okra in Africa encompasses a range of social and economic dimensions. The results from the bibliometric analysis reinforce the idea that the primary focus in this area of research is on biological, agricultural, and environmental sciences, while social sciences and economics have been insufficiently explored. Nevertheless, the examination of academic works on okra in Africa in relation to the SDGs revealed that SDG 2 (Zero Hunger) and SDG 3 (Good Health and Well-Being), which are associated with the socio-economic domain, are among the most frequently discussed goals. In contrast, other SDGs connected to socio-economic concerns, such as SDG 1 (No Poverty) and SDG 5 (Gender Equality), have only been minimally addressed.

Some studies suggest that okra can positively impact local communities, especially among smallholder farmers, by contributing to income generation, empowering women, and improving rural livelihoods. However, the quantity and breadth of these investigations are relatively limited.

Okra is regarded as a crucial source of income and livelihood in various African countries. In fact, some researchers believe that okra has significant economic value in the local economies of multiple African nations, such as Cameroon (Singh et al., 2016), Ghana (Agbenorhevi et al., 2020; Mbatchou et al., 2024), Ethiopia (Kushi et al., 2023c), Nigeria (Ibitoye & Kolawole, 2022), South Africa (Gerrano et al., 2020; Murovhi et al., 2020), and Benin and Côte d'Ivoire (Pasquini et al., 2014). Pasquini et al. (2014) concluded that okra is among the African indigenous vegetables (AIVs) that contribute most to the income of urban and peri-urban farmers in big cities in Benin (Cotonou and Lokossa) and Côte d'Ivoire (Abidjan and Yamoussoukro).

Numerous studies have indicated the profitability of okra cultivation (Ayeni et al., 2023; Dauda et al., 2009; Singh et al., 2017; Woltering et al., 2011). However, profit is influenced by irrigation and crop management practices (Woltering et al., 2011). Ayeni et al. (2023) showed the profitability of dry-season okra production in Adamawa State, Nigeria. Dauda et al. (2009) underlined that irrigated okra is a profitable venture in the South-Western region of Nigeria. Profitability is also affected by diseases, which reduce the marketable yield, such as the okra leaf curl disease (Tiendrébéogo, Traoré et al. (2010). Okra seems profitable both in monocropping and intercropping systems. Singh et al. (2017) found that okra intercropped with beans at a high density proved to be the most financially profitable combination in Cameroon. Olubode et al. (2012a, 2012b) concluded that intercropping okra with pawpaw (*Carica papaya* L.) increases profitability in Abeokuta (Southwestern Nigeria), especially when sown simultaneously (Olubode et al., 2012a, 2012b). Intercropping cassava with okra resulted in an increase of fresh pod yield and economic returns with respect to monoculture in Nigeria (Olasantan, 2005; Olasantan & Bello, 2004), but the economic results depend on the cassava cultivar (Olasantan, 2005) and the sowing date of okra (Olasantan & Bello, 2004). Palada et al. (1992) indicated that alley cropping of okra with *Leucaena leucocephala* (Lam.) can be profitable in southwestern Nigeria; indeed, alley cropping with Leucaena reduces fertilizer requirement for okra production. Nevertheless, in their analysis of the suitability of intercropping tomato with okra using different agro-economic indicators (viz. yield, net returns, and cost-benefit ratio), Adeniyi (2001) concluded that the most profitable practice is the sole cropping of tomato. Meanwhile, Olasantan (1991) found that intercropping okra and tomato with cowpea (*Vigna unguiculata*) caused up to 55% loss in marketable fruit yields in both crops in Nigeria. Furthermore, okra presents opportunities for diversifying income-generating activities and job creation through processing (Kumi et al., 2023). However, the development of okra value chains is limited by many constraints, such as access to finance (Olajide-Taiwo et al., 2014).

The importance of okra for low-income individuals, particularly smallholder farmers, is significant. The crop is usually cultivated by small-scale and economically challenged farmers (Murovhi et al., 2020; Woltering et al., 2011). The relevance and adaptability of okra make it a valuable element of agricultural development and emergency programs (Chadha & Olouch, 2007; Woldetsadik et al., 2022), particularly those focused on combating food insecurity and malnutrition in countries such as Ethiopia and Uganda (Woldetsadik et al., 2022).

Some studies indicate that okra may play a role in promoting gender empowerment. Indeed, various evaluations reveal that women are significantly involved in the growing, processing, and selling of okra and its derivatives in nations like Cameroon (Nkongho et al., 2022). Moreover, okra appears to be particularly important for enhancing the socio-economic and nutritional status of women in certain African regions and territories. Kushi et al. (2023a, 2023b, 2023c) argue that the consumption of locally produced okra can help improve household food security and dietary diversity of pregnant women in Ethiopia. Research addressing gender in relation to okra has been conducted in various African nations, such as Cameroon (Nkongho et al., 2022), and Burkina Faso and Ghana (Stenchly et al., 2017). These studies examine a range of subjects, including seed production (Nkongho et al., 2022), and marketing (Stenchly et al., 2017). Stenchly et al. (2017) found a significant connection between gender and the market orientation in okra farming in Burkina Faso and Ghana.

Enhancing value chains for okra has the potential to address multiple challenges and promote sustainable socio-economic development in Africa. Processing underutilised crops like okra can increase the income of smallholder farmers, strengthen food security, and aid in sustainable rural development. Chadha et al. (2007) posit that the promotion of indigenous vegetables, such as okra, can contribute to health, food security, and income generation in sub-Saharan Africa.

3.4. Study limitations

The systematic review performed has some limitations and drawbacks that should be considered. Firstly, choosing the Web of Science (WoS) database for the search process means that only high-quality academic literature was included. However, this decision also implies that grey literature (such as reports) and studies published in journals not indexed in WoS were excluded. In particular, research on African

indigenous crops such as okra published in local or regional journals that are not be indexed in WoS (e.g. via African Journals Online - AJOL) was not included in the present systematic review. Secondly, the search terms utilized might have influenced the results obtained, although several synonyms were employed to expand the initial screening scope. Thirdly, the methodological quality of the studies included in the synthesis was not assessed, which may indicate that some biased, peer-reviewed studies could have been included. Fourthly, this systematic review was an enormous undertaking, and the presented results are only up to 2 January 2025, so more than one year ago. Nonetheless, despite these limitations, the research is significant as it represents the first of its kind and offers a foundation for future studies and research projects regarding okra in Africa and beyond.

4. Conclusions

To the best of the authors' knowledge, this is the first comprehensive systematic review on okra in Africa that integrates bibliometric, geographical, and topical/thematic perspectives.

The bibliometric analysis indicates that Africa has a relatively marginal presence in academic literature related to okra. The annual number of publications on okra has demonstrated inconsistent and fluctuating interest. Research in this field primarily focuses on biological sciences, such as agriculture, entomology, and plant sciences, while representation from economics and social sciences is limited. The studies examined concerning okra align with 12 SDGs, with the most significant being Goal 2 (Zero Hunger), Goal 13 (Climate Action), Goal 15 (Life on Land), and Goal 3 (Good Health and Well-Being). There is a noticeable lack of consistency and specialization within this field, as many authors have only published a few articles. The leading countries for research affiliations are Nigeria, followed by Ghana and Cameroon.

The geographical analysis shows that Nigeria is the top country for research articles on okra, with Ghana, Cameroon, and Egypt also contributing significantly. However, several major okra-producing countries in Africa, such as Mali and Sudan, are behind in research related to this crop.

The content analysis suggests that the production phase of the food chain is predominantly the most discussed, followed by consumption and processing. Regarding production, several studies investigate pest control and fertilization, yet irrigation often gets overlooked. Only a small number of articles examine the potential of okra in addressing various environmental challenges in Africa, including climate change and land degradation. Academic research indicates that okra could contribute to food and nutrition security in Africa by improving food availability, increasing food accessibility, and enhancing dietary diversity and quality. However, most of the selected articles that relate okra to food security mainly concentrate on its nutritional benefits and food safety. A limited number of the selected studies address the health benefits of okra. The literature surrounding okra in Africa gives minimal attention to social and economic factors. Some studies suggest that okra can have positive impacts on local communities, particularly smallholder farmers, by supporting income generation, gender empowerment, and rural livelihoods. Nonetheless, these studies are few and narrow in focus.

Considering the confirmed potential of okra, it is crucial to advocate for its cultivation in Africa. Suggested strategies to improve the okra value chain in Africa include breeding or selecting high-yielding and stable varieties; adopting optimal production and agronomic techniques, utilizing appropriate fertilization and pest control practices, and identifying the best intercropping strategies; and organizing and coordinating farmers to enhance their market access. In this regard, research is crucial to overcome the current challenges and obstacles that impede okra promotion and development. Specifically, there is a need to deepen the understanding of the crop's genetic diversity to bolster breeding initiatives and refine production standards alongside effective agronomic practices (including fertilization, pest management, and irrigation) that should be communicated to and shared with farmers. Additionally, research is essential for developing suitable and economical processing and transformation techniques while maintaining the quality of okra and adhering to the highest safety standards. In particular, there is a need for more multidisciplinary and interdisciplinary research to bridge the gap between biological and agronomic performance of okra, market/consumption and its contribution to livelihoods. Improvements in quality and safety are expected to enhance the marketing and consumption of okra, thus contributing to the development of its value chain.

Acknowledgements

This work was carried out within the projects SUSTLIVES (SUSTaining and improving local crop patrimony in Burkina Faso and Niger for better LIVes and EcoSystems) and AgrEcoNUS+ (Enhancing value chains and markets of Neglected and Underutilized crop Species to contribute to Agroecological transition in Africa).

Author contributions

CRediT: **Hamid El Bilali**: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing; **Iro Dan Guimbo**: Conceptualization, Writing – original draft, Writing – review & editing; **Lawali Dambo**: Conceptualization, Funding acquisition, Project administration, Writing – original draft, Writing – review & editing; **Falalou Hamidou**: Conceptualization, Writing – original draft, Writing – review & editing; **Halima Oumarou Diadie**: Conceptualization, Writing – original draft, Writing – review & editing; **Awal Baboussouna**: Conceptualization, Writing – original draft, Writing – review & editing; **Andrea Veronelli**: Conceptualization, Writing – original draft, Writing – review & editing; **Filippo Acasto**: Conceptualization, Funding acquisition, Project administration, Writing – original draft, Writing – review & editing.

Disclosure statement

No potential conflict of interest was reported by the author(s). The funders had no role in the design of the study; the collection, analyses, or interpretation of data; the writing of the manuscript; or the decision to publish the results.

Funding

This work was supported by the DeSIRA initiative (Development Smart Innovation through Research in Agriculture) of the European Union under grants/contribution agreements.

About the authors

Dr. Hamid El Bilali is a senior researcher and scientific administrator at the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM Bari), Italy. Since December 2004, he has been engaged in research, training and cooperation activities relating to sustainable agri-food systems, food and nutrition security, food losses and waste, sustainable food consumption and production, neglected and underutilised species (NUS), and rural policy and governance. He is an author of more than 200 publications and a member of the editorial boards of numerous journals dealing with agriculture, food and rural development (e.g. Sustainability, Sustainable Horizons, BMC Agriculture, Discover Agriculture, CABI Reviews). He has been included over the last five years (2021-2025) in the list of the World's Top 2% Scientists elaborated by Stanford University.

Iro Dan Guimbo, an agronomist by training, holds a doctorate in Environmental Sciences. He has been a lecturer and researcher at the Faculty of Agronomy of Abdou Moumouni University (Niger) since 2012. He is a former National Director of Research and former Dean of the Faculty of Agronomic Sciences at the University of Tahoua. Professor Iro Dan Guimbo is the author and co-author of several scientific publications on the dynamics of forest resources in arid and semi-arid zones, plant species conservation, assisted natural regeneration, and ecosystem restoration. In recent years, he has focused on the characterisation, productivity assessment, and valorisation of neglected and underutilised crops in Niger.

Lawali Dambo holds a doctorate in Geosciences and Environment from the University of Lausanne (Switzerland). Specialising in cartography since 1992, he has been a lecturer and researcher in the Department of Geography at Abdou Moumouni University in Niamey (Niger) since 2008, where he has served as Dean of the Faculty of Arts and Humanities since 2024. He has participated in numerous research programs focused on rural development issues. Professor Dambo is co-editor of the books "Alpes-Sahel » (IGUL, 2005) and "Sahel : entre crises et espoirs" (L'Harmatan, 2014). He participated in the writing of the National Atlas of Niger (2002) and has published more than sixty scientific articles, as well as numerous expert reports on natural resource management, land use planning, the dynamics of small-scale irrigation, neglected and underutilised crops, land issues, cross-border cooperation and security issues in West Africa.

Falalou Hamidou is a Senior Scientist and full Professor specializing in Plant Ecophysiology, with a focus on managing Plant Genetic Resources. Based at ICRISAT Niger, he is an expert in studying crop responses to abiotic stresses, particularly drought, heat, and nutrient deficiency. His research aims to comprehend the mechanisms of adaptation

and identify agrophysiological traits that can be utilized in breeding programs to enhance crop yields. Additionally, Professor Falalou serves as the manager of the ICRISAT Africa genebank, where he adeptly oversees various ex situ conservation activities. These activities include germplasm acquisition, characterization, regeneration, distribution, and documentation. Proficient in adhering to international legislations governing germplasm access and benefit-sharing, he facilitates the distribution of seed samples requested by users. Furthermore, he provides training to NARS (National Agricultural Research Systems) partners on diverse aspects of genebank management. Hamidou Falalou holds a PhD in Plant Ecophysiology and previously worked as a lecturer at the University Abdou Moumouni before joining ICRISAT.

Dr. Halima Oumarou Diadie is a lecturer and researcher at the Faculty of Agronomy of Abdou Moumouni University (Niger). She specialises in human nutrition and food science. Her areas of expertise include nutrition education, food safety, infant and young child feeding, food and nutrition security, and sustainable food systems.

Awal Baboussouna holds a PhD in Geography from Abdou Moumouni University in Niamey (Niger), Faculty of Arts and Humanities, Department of Geography. His research focuses primarily on rural geography, food security, irrigation and agricultural systems, neglected and underutilised species (NUS), and mapping and territorial development in Niger. He has contributed to several research projects and scientific publications on farmer field schools in the Guidimouni basin, irrigated production systems in Maradi, flood zone mapping in Niamey, and the promotion of local crops and NUS for food security.

Andrea Veronelli is a rural development expert and human geographer with more than 15 years of professional experience across Sub-Saharan Africa and Asia. He currently works with the Italian Agency for Development Cooperation (AICS) in Niger and Chad, focusing on the identification, formulation, and management of programmes related to agroecology, rural resilience, economic development, and sustainable food systems. Throughout his career, he has collaborated with international organisations, NGOs, UN agencies, and the European Union in complex and fragile contexts with long-term missions in Niger/Chad, UK, Mongolia, Haiti/Dominican Republic, Burkina Faso, and Madagascar. His academic and professional interests focus on the relationships between territories, livelihoods, and adaptation strategies, particularly within rural communities facing environmental and socio-economic change.

Filippo Acasto is an international cooperation professional specialising in program management in the agricultural sector in West Africa. Currently a Program Manager at the Italian Agency for Development Cooperation (AICS) in Ghana, he works on sustainable food systems, agrobiodiversity, agroecology, and inclusive value chains, with a particular interest in neglected and underutilised species (NUS). He has experience managing EU-funded programs, institutional partnerships, policy dialogue, and regional coordination in several African countries, including Burkina Faso, Niger, Ghana, Senegal, and Guinea. His background is in international cooperation, with studies in political science, economics, international relations, and European studies conducted in Italy, Germany, Argentina, and Senegal.

ORCID

Hamid El Bilali http://orcid.org/0000-0002-0322-2034

Data availability statement

The data that support the findings of this study are available from the corresponding author, H.E.B., upon reasonable request.

References

Aasa, A. O., Njobeh, P. B., & Fru, F. F. (2022). Incidence of Filamentous fungi in some food commodities from Ivory Coast. *Journal of Agriculture and Food Research*, *8*, 100304. https://doi.org/10.1016/j.jafr.2022.100304

Abang, A. F., Ramasamy, S., Hanna, R., Kekeunou, S., Fotso Kuate, A., Tenkouano, A., Fiaboe, K. K. M., & Bilong Bilong, C.-F. (2024). New okra genotypes for the management of aphids (Hemiptera: Aphididae) in the diverse ecological landscapes of Central Africa. *Journal of Economic Entomology*, *117*(5), 2123–2134. https://doi.org/10.1093/jee/toae165

Abang, A. F., Srinivasan, R., Hanna, R., Fotso, A. K., Kekeunou, S., Tenkouano, A., & Bilong, C.-F. B. (2021). Productivity and resistance of okra (*Abelmoschus spp.*) to the cotton aphid *Aphis gossypii* glover (Hemiptera: Aphididae) under tropical conditions. *International Journal of Tropical Insect Science*, *41*(1), 197–208. https://doi.org/10.1007/s42690-020-00193-w

Abang, A. F., Srinivasan, R., Kekeunou, S., Hanna, R., Chagomoka, T., Chang, J. C., & Bilong, C. F. B. (2014). Identification of Okra (*Abelmoschus* spp.) accessions resistant to Aphid (*Aphis gossypii* Glover) in Cameroon. *African Entomology*, *22*(2), 273–284. https://doi.org/10.4001/003.022.0201

Abang, A. F., Srinivasan, R., Kekeunou, S., Hanna, R., Kamga, R., & Bilong, C.-F. B. (2018). Influence of Okra (*Abelmoschus spp.*) accessions on colonization by *Aphis gossypii* (Hemiptera: Aphididae) and their effects on Aphid biological parameters. *Florida Entomologist*, *101*(4), 549. https://doi.org/10.1653/024.101.0415

Abd El-Fattah, B. E. S., Haridy, A. G., & Abbas, H. S. (2020). Response to planting date, stress tolerance and genetic diversity analysis among okra (*Abelmoschus esculentus* (L.) Moench.) varieties. *Genetic Resources and Crop Evolution*, *67*(4), 831–851. https://doi.org/10.1007/s10722-019-00821-6

Abdel-Motaal, F. F., Kamel, N. M., El-Sayed, M. A., & Abou-Ellail, M. (2022). Biocontrol of okra-rot-causing *Cochliobolus spicifer*-CSN-20 using secondary metabolites of endophytic fungi associated with *Solenostemma arghel*. *Annals of Agricultural Sciences*, *67*(1), 24–33. https://doi.org/10.1016/j.aoas.2022.04.001

Aboyeji, C. M., Dahunsi, S. O., Olaniyan, D. O., Dunsin, O., Adekiya, A. O., & Olayanju, A. (2021). Performance and quality attributes of okra (*Abelmoschus esculentus* (L.) Moench) fruits grown under soil applied Zn-fertilizer, green biomass and poultry manure. *Scientific Reports*, *11*(1), 8291. https://doi.org/10.1038/s41598-021-87663-4

Adebanjo, A., & Shopeju, E. (1993). Sources and Mycoflora associated with some sundried vegetables in storage. *International Biodeterioration & Biodegradation*, *31*(4), 255–263. https://doi.org/10.1016/0964-8305(93)90021-S

Adedoyin, A. M., Ayo-Vaughan, M. A., Ariyo, O. J., Otusanya, G. O., & Aremu, C. O. (2024). Heterosis, combining ability and genetic component in okra (*Abelmoschus esculentus* (L.) Moench) genotypes. *International Journal of Vegetable Science*, *30*(6), 656–672. https://doi.org/10.1080/19315260.2024.2422599

Adegbite, A. A., Adesiyan, S. O., Agbaje, G. O., & Omoloye, A. A. (2005). Host suitability of crops under yam intercrop to root-knot nematode (*Meloidogyne incognita* Race 2) in south-western Nigeria. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, *106*(2), 113–118.

Adejonwo, K. O., Ahmed, M. K., Lagoke, S. T. O., & Karikari, S. K. (1991). Chemical weed control in irrigated okra in the Nigerian Sudan savanna zone. *Tropical Pest Management*, *37*(1), 91–95. https://doi.org/10.1080/09670879109371544

Adejumo, A. O. D., Ilori, T. A., & Komolafe, C. A. (2020). Biodiesel production from Okra (*Abelmoschus Esculentus* (l) Moench) plant. *IOP Conference Series: Earth and Environmental Science*, *445*(1), 012051. https://doi.org/10.1088/1755-1315/445/1/012051

Adekunle, O. K. (2009). Population dynamics of Meloidogyne incognita and three other phytonematodes on okra cultivars planted in alleys of *Leucaena leucocephala* and *Gliricidia sepium*. *Australasian Plant Pathology*, *38*(3), 211–215. https://doi.org/10.1071/AP08067

Adelakun, O. E., Oyelade, O. J., Ade-Omowaye, B. I. O., Adeyemi, I. A., Van de Venter, M., & Koekemoer, T. C. (2009). Influence of pre-treatment on yield chemical and antioxidant properties of a Nigerian okra seed (*Abelmoschus esculentus* Moench) flour. *Food and Chemical Toxicology*, *47*(3), 657–661. https://doi.org/10.1016/j.fct.2008.12.023

Adelodun, B., Mohammed, A. A., Adeniran, K. A., Akanbi, S.-U. O., Abdulkadir, T. S., & Choi, K. S. (2021). Comparative assessment of technical efficiencies of irrigated crop production farms: A case study of the large-scale Kampe-Omi irrigation scheme, Nigeria. *African Journal of Science, Technology, Innovation and Development*, *13*(3), 293–302. https://doi.org/10.1080/20421338.2020.1755111

Adeniyi, O. R. (2001). An economic evaluation of intercropping with tomato and okra in a rain forest zone of Nigeria. *The Journal of Horticultural Science and Biotechnology*, *76*(3), 347–349. https://doi.org/10.1080/14620316.2001.11511375

Adewole, M. B., & Ilesanmi, A. O. (2011). Effects of soil amendments on the nutritional quality of okra (*Abelmoschus esculentus* [L.] Moench). *Journal of Soil Science and Plant Nutrition*, *11*(3), 45–55. https://doi.org/10.4067/S0718-95162011000300004

Adeyemi, O. R., Bashiruddin, A. A., Adigun, J. A., Adejuyigbe, C. O., & Osunleti, S. O. (2024). Fruit quality and marketability of Okra (*Abelmoschus esculentus* (L.) Moench) as influenced by biochar rates and weeding regime. *International Journal of Pest Management*, *70*(4), 1191–1199. https://doi.org/10.1080/09670874.2022.2094493

Adigbo, S. O., Okeleye, K. A., & Adigbo, V. B. (2007). Performance of upland rice fitted into lowland rice–vegetable/cowpea sequence in rainfed inland valley. *Agronomy Journal*, *99*(2), 377–383. https://doi.org/10.2134/agronj2005.0170

Aflakpui, G. K. S., Bolfrey-Arku, G. E. K., Anchirinah, V. M., Manu-Aduening, J. A., & Adu-Tutu, K. O. (2008). Incidence and severity of Striga spp. in the coastal savanna zone of Ghana results and implications of a formal survey. *Outlook on Agriculture*, *37*(3), 219–224. https://doi.org/10.5367/000000008785915548

Agahiu, A. E., Udensi, U. E., Tarawali, G., Okoye, B. C., Ogbuji, R. O., & Baiyeri, K. P. (2011). Assessment of weed management strategies and intercrop combinations on cassava yield in the middle belt of Nigeria. *African Journal of Agricultural Reseearch*, *6*(26), 5729–5735. https://doi.org/10.5897/AJAR11.428

Agarwal, M., Srinivasan, R., & Mishra, A. (2001). Study on flocculation efficiency of okra gum in sewage waste water. *Macromolecular Materials and Engineering*, *286*(9), 560–563. https://doi.org/10.1002/1439-2054(20010901)286:9<560::AID-MAME560>3.0.CO;2-B

Agbaglo, S. Y., Nyaku, S. T., Vigbedor, H. D., & Cornelius, E. W. (2020). Pathogenicity of *Meloidogyne incognita* and *Fusarium oxysporum* f. sp. *vasinfectum* on growth and yield of two okra varieties cultivated in Ghana. *International Journal of Agronomy*, *2020*, 1–12. https://doi.org/10.1155/2020/8824165

Agbenorhevi, J. K., Kpodo, F. M., Banful, B. K. B., Oduro, I. N., Abe-Inge, V., Datsomor, D. N., Atongo, J., & Obeng, B. (2020). Survey and evaluation of okra pectin extracted at different maturity stages. *Cogent Food & Agriculture*, *6*(1), 1760476. https://doi.org/10.1080/23311932.2020.1760476

Aguiar, J. L., McGiffen, M., Natwick, E., & Takele, E. (2011). *Okra production in California*. University of California, Agriculture and Natural Resources. https://doi.org/10.3733/ucanr.7210

Ahmad, N., Lesa, K. N., Ikawati, Z., & Fakhrudin, N. (2025). Health benefits of okra (*Abelmoschus esculentus*) against diabetes mellitus and cognitive dysfunction: A review. *Food Production, Processing and Nutrition*, *7*(1), 21. https://doi.org/10.1186/s43014-024-00284-y

Ahmad, Z. (2021). *Okra: Pakistan's national vegetable*. https://www.newsmakers.com.pk/en/blog/okra-pakistans-national-vegetable/134/.

Ahmed, D. A. E.-A., Galal, T. M., Al-Yasi, H. M., Hassan, L. M., & Slima, D. F. (2022). Accumulation and translocation of eight trace metals by the different tissues of *Abelmoschus esculentus* Moench. irrigated with untreated wastewater. *Environmental Science and Pollution Research International*, *29*(15), 21221–21231. https://doi.org/10.1007/s11356-021-17315-7

Aiyelaagbe, I. O. O., & Jolaoso, M. A. (1992). Growth and yield response of papaya to intercropping with vegetable crops in southwestern Nigeria. *Agroforestry Systems*, *19*(1), 1–14. https://doi.org/10.1007/BF00130090

Akande, M. O., Oluwatoyinbo, F. I., Kayode, C. O., & Olowokere, F. A. (2008). Response of maize (*Zea mays*) and okra (*Abelmoschus esculentus*) intercrop relayed with cowpea (*Vigna unguiculata*) to different levels of cow dung amended phosphate rock. *African Journal of Biotechnology*, *7*(17), 3039–3043.

Akinyele, B. O., & Osekita, O. S. (2006). Correlation and path coefficient analyses of seed yield attributes in okra (*Abelmoschus esculentus* (L.) Moench). *African Journal of Biotechnology*, *5*(14), 1330–1336.

Akoto, O., Gavor, S., Appah, M. K., & Apau, J. (2015). Estimation of human health risk associated with the consumption of pesticide-contaminated vegetables from Kumasi, Ghana. *Environmental Monitoring and Assessment*, *187*(5), 244. https://doi.org/10.1007/s10661-015-4471-0

Akpan-Idiok, A. U., Udo, I. A., & Braide, E. I. (2012). The use of human urine as an organic fertilizer in the production of okra (*Abelmoschus esculentus*) in South Eastern Nigeria. *Resources, Conservation and Recycling*, *62*, 14–20. https://doi.org/10.1016/j.resconrec.2012.02.003

Akpor, O. B., Maxwell, M.-M., Evbuomwan, I. O., Olaolu, T. D., Adeyonu, A. G., & Osemwegie, O. O. (2022). Growth promotion and protective potentials of leaf infusions of *Parkia biglobosa*, *Moringa oleifera* and *Vernonia amygdalina* on *Abelmoschus esculentus* seeds. *Scientific Reports*, *12*(1), 14106. https://doi.org/10.1038/s41598-022-18555-4

Aladesanwa, R. D. (2005). Screenhouse evaluation of atrazine for soil residual activity on growth, development and nutritional quality of okra (*Abelmoschus esculentus* Moench) in southwestern Nigeria. *Crop Protection*, *24*(10), 927–931. https://doi.org/10.1016/j.cropro.2005.01.022

Alegbejo, J. O., Ameh, D. A., Ogala, W. N., & Ibrahim, S. (2011). Glycaemic index and load of Acha (Fonio) in healthy and diabetic subjects. *Journal of Pure and Applied Microbiology*, *5*(1), 117–122.

Alegbejo, M., Ogunlana, M., & Banwo, O. (2008). Short communication. Survey for incidence of Okra mosaic virus in northern Nigeria and evidence for its transmission by beetles. *Spanish Journal of Agricultural Research*, *6*(3), 408–411. https://doi.org/10.5424/sjar/2008063-342

Aliku, O., Oshunsanya, S. O., & Aiyelari, E. A. (2022). Estimation of crop evapotranspiration of Okra using drainage Lysimeters under dry season conditions. *Scientific African*, *16*, e01189. https://doi.org/10.1016/j.sciaf.2022.e01189

Aloui, H., Jguirim, N., & Khwaldia, K. (2017). Effects of biopolymer-based active coatings on postharvest quality of okra pods in Tunisia. *Fruits*, *72*(6), 363–369. https://doi.org/10.17660/th2017/72.6.4

Amalu, U. C., & Okon, P. B. (2015). Nitrolimigation: A nutrient-in-water resource for sustainable crop production on 'acid sands' of Southern Nigeria. *Journal of Plant Nutrition*, *38*(7), 988–1005. https://doi.org/10.1080/01904167.2014.963117

Ameh, E. G., Omatola, O. D., & Akinde, S. B. (2019). Phytoremediation of toxic metal polluted soil: Screening for new indigenous accumulator and translocator plant species, northern Anambra Basin, Nigeria. *Environmental Earth Sciences*, *78*(12), 345. https://doi.org/10.1007/s12665-019-8343-8

Amiteye, S., Appiah, A. S., Boateng, F., Kutufam, J. T., & Amoatey, H. M. (2021). Physiological changes associated with okra mosaic virus infection in field grown okra plants. *Asian Journal of Agriculture and Biology*, *2021*(4), 1–10. https://doi.org/10.35495/ajab.2021.02.097

Anastasakis, K., Kalderis, D., & Diamadopoulos, E. (2009). Flocculation behavior of mallow and okra mucilage in treating wastewater. *Desalination*, *249*(2), 786–791. https://doi.org/10.1016/j.desal.2008.09.013

Anoliefo, E., Chah, J., & Abbah, O. (2020). Consumers' perception of dried onion and okra using load adaptive drying technology in Nsukka Urban, Nigeria. *Journal of Agricultural Extension*, *24*(3), 125–137. https://doi.org/10.4314/jae.v24i3.11

Anwar, F., Rashid, U., Ashraf, M., & Nadeem, M. (2010). Okra (*Hibiscus esculentus*) seed oil for biodiesel production. *Applied Energy*, *87*(3), 779–785. https://doi.org/10.1016/j.apenergy.2009.09.020

Anyaoha, C. O., Arogundade, O., Akinkunmi, O. Y., Okoyo, M. E., & Ikoro, J. I. (2023). Agro-morphological characterization of Okra (Abelmoschus species) for biotic stress and yield contributing traits under rainfed conditions in South Western Nigeria. *Plant Physiology Reports*, *28*(1), 92–106. https://doi.org/10.1007/s40502-023-00716-w

Appiah, A. S., Amiteye, S., Boateng, F., & Amoatey, H. M. (2020). Evaluation of okra (*Abelmoschus esculentus* L. Moench) cultivars for resistance to okra mosaic virus and okra yellow vein mosaic virus. *Australasian Plant Pathology*, *49*(5), 541–550. https://doi.org/10.1007/s13313-020-00727-3

Araújo, A., Galvão, A., Filho, C. S., Mendes, F., Oliveira, M., Barbosa, F., Filho, M. S., & Bastos, M. (2018). Okra mucilage and corn starch bio-based film to be applied in food. *Polymer Testing*, *71*, 352–361. https://doi.org/10.1016/j.polymertesting.2018.09.010

Asante, J., Opoku, V. A., Hygienus, G., Andersen, M. N., Asare, P. A., & Adu, M. O. (2024). Photosynthetic efficiency and water retention in okra (*Abelmoschus esculentus*) contribute to tolerance to single and combined effects of drought and heat stress. *Scientific Reports*, *14*(1), 28090. https://doi.org/10.1038/s41598-024-79178-5

Atawodi, S. E., Atawodi, J. C., Idakwo, G. A., Pfundstein, B., Haubner, R., Wurtele, G., Spiegelhalder, B., Bartsch, H., & Owen, R. W. (2009). Polyphenol composition and antioxidant potential of *Hibiscus esculentus* L. fruit cultivated in Nigeria. *Journal of Medicinal Food*, *12*(6), 1316–1320. https://doi.org/10.1089/jmf.2008.0211

Atiri, G. I., Njukeng, A. P., & Ekpo, E. J. A. (2000). Climate in relation to plant virus epidemiology and sustainable disease management in West Africa. *Journal of Sustainable Agriculture*, *16*(1), 17–30. https://doi.org/10.1300/J064v16n01_04

Avallone, S., Brault, S., Mouquet, C., & Treche, S. (2007). Home-processing of the dishes constituting the main sources of micronutrients in the diet of preschool children in rural Burkina Faso. *International Journal of Food Sciences and Nutrition*, *58*(2), 108–115. https://doi.org/10.1080/09637480601143320

Avallone, S., Tiemtore, T.-W. E., Mouquet-Rivier, C., & Trèche, S. (2008). Nutritional value of six multi-ingredient sauces from Burkina Faso. *Journal of Food Composition and Analysis*, *21*(7), 553–558. https://doi.org/10.1016/j.jfca.2008.04.012

Avicor, S. W., Eziah, V. Y., Owusu, E. O., & Wajidi, M. F. F. (2014). Insecticide susceptibility of *Bemisia tabaci* to Karate® and Cydim Super® and its associated carboxylesterase activity. *Sains Malaysiana*, *43*(1), 31–36.

Awodoyin, R. O., & Olubode, O. S. (2011). Assessment of critical period of weed interference in okra (*Abelmoschus esculentus* L. Moench) field in Ibadan, a rainforest-Savanna transition eco-zone of Nigeria. *Acta Horticulturae*, *911*, 99–111. https://doi.org/10.17660/ActaHortic.2011.911.11

Ayeni, M. D., Aremu, C., & Olufemi, A. A. (2023). Stochastic frontier analysis of technical efficiency and profitability of dry season OKRA production in Nigeria. *Sage Open*, *13*(2), 1–9. https://doi.org/10.1177/21582440231181589

Baah, P., Nyaku, S. T., Agamah, B., & Tongoona, P. B. (2024). Evaluation of preplant seed protectants for the management of root-knot nematode of okra in Ghana. *International Journal of Agronomy*, *2024*, 1–11. https://doi.org/10.1155/2024/4025844

Babatunde, S. E. (2008). Organic matter and okra growth and yield examination on sandy loam soil amended with cattle and pig manure in humid Southwest Nigeria. *Journal of Food Agriculture & Environment*, *6*(2), 197–200.

Bakasso, Y., Zaman-Allah, M., Mariac, C., Billot, C., Vigouroux, Y., Zongo, J. D., & Saadou, M. (2014). Genetic diversity and population structure in a collection of roselle (*Hibiscus sabdariffa* L.) from Niger. *Plant Genetic Resources*, *12*(2), 207–214. https://doi.org/10.1017/S1479262113000531

Bakry, M. M. S., & Fathipour, Y. (2023). Population ecology of the cotton mealybug, *Phenacoccus solenopsis* (Hemiptera: Pseudococcidae) on okra plants in. *Journal of Agricultural Science and Technology*, *25*(6), 1387–1402.

Basha, H. A., Mostafa, E. M., & Eldeeb, A. M. (2021). Mite pests and their predators on seven vegetable crops (Arachnida: Acari). *Saudi Journal of Biological Sciences*, *28*(6), 3414–3417. https://doi.org/10.1016/j.sjbs.2021.03.004

Bayili, R. G., Abdoul-Latif, F., Kone, O. H., Diao, M., Bassole, I. H. N., & Dicko, M. H. (2011). Phenolic compounds and antioxidant activities in some fruits and vegetables from Burkina Faso. *African Journal of Biotechnology*, *10*(62), 13543–13547.

Bayissa, W., Ekesi, S., Mohamed, S. A., Kaaya, G. P., Wagacha, J. M., Hanna, R., & Maniania, N. K. (2017). Selection of fungal isolates for virulence against three aphid pest species of crucifers and okra. *Journal of Pest Science*, *90*(1), 355–368. https://doi.org/10.1007/s10340-016-0781-4

BBC Good Food. (2025). *Okra.* https://www.bbcgoodfood.com/glossary/okra-glossary.

Bighaghire, R., Okidi, L., Muggaga, C., & Ongeng, D. (2021). Traditional vegetable preservation technologies practiced in Acholi subregion of Uganda improves mineral bioavailability but impacts negatively on the contribution of vegetables to household needs for micronutrients. *Food Science & Nutrition*, *9*(2), 589–604. https://doi.org/10.1002/fsn3.1931

Birka, R. J., Jude Kawzu, K., & Nnaji, C. C. (2024). Climate change adaptation through rainwater harvesting to enhance food security in Diamaré, Cameroon. *Journal of Water, Sanitation and Hygiene for Development*, *14*(12), 1244–1259. https://doi.org/10.2166/washdev.2024.120

Blench, R. (2006). *Archaeology, language, and the African past*. Rowman Altamira.

Boeckmann, C. (2025). *How to grow okra: Planting, growing & harvesting tips.* https://www.almanac.com/plant/okra#.

Borokini, F. B., Oladipo, G. O., Komolafe, O. Y., & Ajongbolo, K. F. (2022a). Phytochemical, nutritional and antioxidant properties of *Abelmoschus esculentus* Moench L leaf: A pointer to its fertility potentials. *Measurement: Food*, *6*, 100034. https://doi.org/10.1016/j.meafoo.2022.100034

Borokini, F. B., Oladipo, G. O., Komolafe, O. Y., Ajongbolo, K. F., & Oladipo, M. C. (2022b). *Abelmoschus esculentus* Moench L. leaf inhibited lipid peroxidation and deproteination, and caused dose-dependent spermatogenesis and impaired hormonal synchronism in Wistar rats. *Applied Food Research*, *2*(2), 100179. https://doi.org/10.1016/j.afres.2022.100179

Brazilian Confederation of Agriculture and Livestock (CNA). (2022). Okra: A Brazilian cuisine's favorite | Brazilian Farmers. https://brazilianfarmers.com/news/made-in-brazil/okra-a-brazilian-cuisines-favorite/.

Burban, C., Fishpool, L. D. C., Fauquet, C., Fargette, D., & Thouvenel, J. -C. (1992). Host-associated biotypes within West African populations of the whitefly *Bemisia tabaci* (Genn.), (Hom., Aleyrodidae). *Journal of Applied Entomology*, *113*(1–5), 416–423. https://doi.org/10.1111/j.1439-0418.1992.tb00682.x

Chadha, M. L., & Olouch, M. (2007). Healthy diet gardening kit – for better health and income. *Acta Horticulturae*, *752*, 581–584. https://doi.org/10.17660/ActaHortic.2007.752.109

Chadha, M. L., Oluoch, M. O., & Silue, D. (2007). Promoting indigenous vegetables for health, food security, and income generation in Africa. *Acta Horticulturae*,*762*, 253–262. https://doi.org/10.17660/ActaHortic.2007.762.24

Clair-Caliot, G., Marks, S. J., Hug, S. J., Bretzler, A., N'guessan, N. D., Tihe, S. F. K., & Lalanne, F. (2021). Uptake of arsenic by irrigated vegetables and cooked food products in Burkina Faso. *Frontiers in Water*, *3*, 1–17. https://doi.org/10.3389/frwa.2021.667308

Dabiré-Binso, C. L., Ba, M. N., Somé, K., & Sanon, A. (2009). Preliminary studies on incidence of insect pest on okra, *Abelmoschus esculentus* (L.) Moench in central Burkina Faso. *African Journal of Agricultural Research*, *4*(12), 1488–1492.

Danso, O. E., Abenney-Mickson, S., Sabi, E. B., Plauborg, F., Abekoe, M., Kugblenu, Y. O., Jensen, C. R., & Andersen, M. N. (2015). Effect of different fertilization and irrigation methods on nitrogen uptake, intercepted radiation and yield of okra (*Abelmoschus esculentum* L.) grown in the Keta Sand Spit of Southeast Ghana. *Agricultural Water Management*, *147*, 34–42. https://doi.org/10.1016/j.agwat.2014.07.029

Dare, M. O., Soremekun, J. A., Inana, F. O., Adenuga, O. S., & Ajiboye, G. A. (2014). Microbial biomass carbon and nitrogen under different maize cropping systems. In Hartemink, A. E. & McSweeney, K. (Eds.), *Soil carbon* (pp. 305–311). Springer International Publishing. https://doi.org/10.1007/978-3-319-04084-4_32

Dauda, T. O., Asiribo, O. E., Akinbode, S. O., Saka, J. O., & Salahu, B. F. (2009). An assessment of the roles of irrigation farming in the millennium development goals. *African Journal of Agricultural Research*, *4*(5), 445–450.

Dawoud, D. A., & Sauerborn, J. (2015). Efficiency of some crops in inducing suicidal germination of the parasitic weed, *Striga hernonthica* Del Benth. *Egyptian Journal of Biological Pest Control*, *25*(3), 735–738.

de Bon, H., Rey, J.-Y., Grechi, I., Diarra, K., Bordat, D., & Ndiaye, O. (2015). Exotic and African biodiversities in fruit and vegetable agroecosystems in Senegal. *Acta Horticulturae*, *1099*, 653–659. https://doi.org/10.17660/ActaHortic.2015.1099.80

De Rosa, I. M., Kenny, J. M., Puglia, D., Santulli, C., & Sarasini, F. (2010). Morphological, thermal and mechanical characterization of okra (*Abelmoschus esculentus*) fibres as potential reinforcement in polymer composites. *Composites Science and Technology*, *70*(1), 116–122. https://doi.org/10.1016/j.compscitech.2009.09.013

Diario Libre. (2012). *El intrépido molondrón.* https://www.diariolibre.com/revista/el-intrpido-molondrn-EPDL347993.

Dimande, P., Arrobas, M., & Rodrigues, M. Â. (2023). Effect of Bat Guano and biochar on okra yield and some soil properties. *Horticulturae*, *9*(7), 728. https://doi.org/10.3390/horticulturae9070728

Dry, S. (2020). *A short history of gumbo.* https://www.southernfoodways.org/interview/a-short-history-of-gumbo/.

Dwomoh, E. A., & Boakye, D. B. (2003). Field evaluation of chlorpyrifos, lambda-cyhalothrin, and *Bacillus thuringiensis* (Berliner) for the control of *Xanthodes graellsii* (Feisth) (Lepidoptera: Nactuidae), on okra in Ghana. *Tropical Agriculture*, *80*(4), 211–214.

Echezona, B. C., & Offordile, J. I. (2011). Responses of flea beetles (*Podagrica spp.*) and okra plants (*Abelmoschus esculentus* L. Moench) to differently coloured polyethylene shades. *International Journal of Pest Management*, *57*(2), 161–168. https://doi.org/10.1080/09670874.2010.547282

Egedigwe, U., Udengwu, O., Ekeleme-Egedigwe, C., Maduakor, C., Urama, C., Odo, C., & Ojua, E. (2024). Integrated stress responses in okra plants (cv. Meya'): Unravelling the mechanisms underlying drought and nematode co-occurrence. *BMC Plant Biology*, *24*(1), 986. https://doi.org/10.1186/s12870-024-05686-1

Ekoja, E. E., & Pitan, O. O. R. (2022). Refining trapping protocols for field management of Podagrica spp. *Crop Protection*, *162*, 106096. https://doi.org/10.1016/j.cropro.2022.106096

El Bilali, H. (2024). State and contours of research on roselle (*Hibiscus sabdariffa* L.) in Africa. *Open Agriculture*, *9*(1), 1–27. https://doi.org/10.1515/opag-2022-0336

El Bilali, H., Dan Guimbo, I., Nanema, R. K., Falalou, H., Kiebre, Z., Rokka, V.-M., Tietiambou, S. R. F., Nanema, J., Dambo, L., Grazioli, F., Naino Jika, A. K., Gonnella, M., & Acasto, F. (2024a). Research on Moringa (*Moringa oleifera* Lam.) in Africa. *Plants*, *13*(12), 1613. https://doi.org/10.3390/plants13121613

El Bilali, H., Kiebre, Z., Nanema, R. K., Dan Guimbo, I., Rokka, V.-M., Gonnella, M., Tietiambou, S. R. F., Dambo, L., Nanema, J., Grazioli, F., & Acasto, F. (2024b). Mapping research on Bambara groundnut (*Vigna subterranea* (L.) Verdc.) in Africa: Bibliometric, geographical, and topical perspectives. *Agriculture*, *14*(9), 1541. https://doi.org/10.3390/agriculture14091541

Essumang, D. K., Asare, E. A., & Dodoo, D. K. (2013). Pesticides residues in okra (non-target crop) grown close to a watermelon farm in Ghana. *Environmental Monitoring and Assessment*, *185*(9), 7617–7625. https://doi.org/10.1007/s10661-013-3123-5

Fakudze, N., Sarbadhikary, P., George, B., & Abrahamse, H. (2023). Ethnomedicinal uses, phytochemistry, and anticancer potentials of African medicinal fruits: A comprehensive review. *Pharmaceuticals*, *16*(8), 1117. https://doi.org/10.3390/ph16081117

Fan, Y., Wu, L., Zhang, Y., Hu, Q., Mei, J., Prabahar, K., Hernández-Wolters, B., Kord-Varkaneh, H., Lei, C., & Zheng, S. (2025). The impact of okra (*Abelmoschus esculentus*) supplementation on diabetes and obesity biomarkers in type 2 diabetes patients: A systematic review and meta-analysis of randomized controlled trials. *Phytotherapy Research*, *39*(10), 4693–4703. https://doi.org/10.1002/ptr.70071

FAO. (2026). *FAOSTAT: Crops and livestock products* – Okra. https://www.fao.org/faostat/en/#data/QCL.

Fapohunda, H. (1992). Irrigation frequency and amount for okra and tomato using a point-source sprinkler system. *Scientia Horticulturae*, *49*(1–2), 25–31. https://doi.org/10.1016/0304-4238(92)90140-8

Farsia Djidjonri, P., Nchiwan, N. E., & Koehler, H. (2021). Comparative experimental effects of intercropping and cypermethrin on insect pest infestation and yield of maize, cowpea and okra in two Cameroonian agro-ecological zones. *AgriEngineering*, *3*(2), 383–393. https://doi.org/10.3390/agriengineering3020025

Frimpong, K. A., Phares, C. A., Boateng, I., Abban-Baidoo, E., & Apuri, L. (2021). One-time application of biochar influenced crop yield across three cropping cycles on tropical sandy loam soil in Ghana. *Heliyon*, *7*(2), e06267. https://doi.org/10.1016/j.heliyon.2021.e06267

Gaur, S. S., Raveendran, A., Athulya, A., Narayanan, S. A., Shams, R., Dash, K. K., Shaikh, A. M., & Béla, K. (2025). Exploring the nutritional, pharmacological, and industrial potential of okra and its byproducts: A comprehensive review. *Discover Food*, *5*(1), 251. https://doi.org/10.1007/s44187-025-00492-6

Gemede, H. F., Haki, G. D., Beyene, F., Rakshit, S. K., & Woldegiorgis, A. Z. (2018). Indigenous Ethiopian okra (*Abelmoschus esculentus)* mucilage: A novel ingredient with functional and antioxidant properties. *Food Science & Nutrition*, *6*(3), 563–571. https://doi.org/10.1002/fsn3.596

Gemede, H. F., Haki, G. D., Beyene, F., Woldegiorgis, A. Z., & Rakshit, S. K. (2016). Proximate, mineral, and antinutrient compositions of indigenous Okra (*Abelmoschus esculentus*) pod accessions: Implications for mineral bioavailability. *Food Science & Nutrition*, *4*(2), 223–233. https://doi.org/10.1002/fsn3.282

Gerrano, A. S., Van Rensburg, W. J., Bairu, M., Amoo, S., & Venter, S. (2020). Selection of okra (*Abelmoschus esculentus*) collections based on seed minerals and total phenolic content. *Acta Horticulturae*, *1282*, 433–440. https://doi.org/10.17660/ActaHortic.2020.1282.65

Grubben, G. J. H., & Denton, O. A. (2004). Plant *resources of tropical* Africa 2. Vegetables. PROTA Foundation, Blackhuys Publishers & CTA.

Guedeungbe, Z., Bayang, J. P., & Koubala, B. B. (2024). Evaluation of glycemic response of ten local meals commonly consumed from Chad. *Journal of Agriculture and Food Research*, *17*, 101251. https://doi.org/10.1016/j.jafr.2024.101251

Gungoosingh-Bunwaree, A., Contaldo, N., Paltrinieri, S., Benimadhu, S. P., & Bertaccini, A. (2011). Detection of phytoplasma infection in okra in Mauritius. *Bulletin of Insectology*, *64*, S103–S104.

Gutierrez, P. C. (1992). *Cajun foodways*. University Press of Mississippi.

Hachi, M., Ouafae, B., Hachi, T., Mohamed, E. B., Imane, B., Atmane, R., & Zidane, L. (2016). Contribution to the ethnobotanical study of antidiabetic medicinal plants of the Central Middle Atlas region (Morocco). *Lazaroa*, *37*(0), 135–144. https://doi.org/10.5209/LAZAROA.51854

Hamon, S., & Hamon, P. (1991). Future prospects of the genetic integrity of two species of okra (*Abelmoschus esculentus* and *A. caillei*) cultivated in West Africa. *Euphytica*, *58*(2), 101–111. https://doi.org/10.1007/BF00022810

Hell, K., Gnonlonfin, B. G. J., Kodjogbe, G., Lamboni, Y., & Abdourhamane, I. K. (2009). Mycoflora and occurrence of aflatoxin in dried vegetables in Benin, Mali and Togo, West Africa. *International Journal of Food Microbiology*, *135*(2), 99–104. https://doi.org/10.1016/j.ijfoodmicro.2009.07.039

Ibitoye, D. O., & Kolawole, A. O. (2022). Farmers' appraisal on okra [*Abelmoschus esculentus* (L.)] production and phenotypic characterization: A synergistic approach for improvement. *Frontiers in Plant Science*, *13*, 787577. https://doi.org/10.3389/fpls.2022.787577

Ikeorgu, J. (1991). Effects of maize and cassava on the performance of intercropped egusi melon (*Citrullus-lanatus* (L) Thunb) and okra (*Abelmoschus-esculentus* (L) Moench) in Nigeria. *Scientia Horticulturae*, *48*(3–4), 261–268. https://doi.org/10.1016/0304-4238(91)90134-K

Ikeorgu, J. E. G., & Ezumah, H. C. (1991). Some analytical aspects of cassava/maize/okra/egusi-melon complex mixture: I. Soil temperature in relation to leaf-area variation. *Field Crops Research*, *27*(1–2), 51–60. https://doi.org/10.1016/0378-4290(91)90021-M

Imoloame, E. O., Yusuf, O. J., Abdulrauf, L. B., & Aliyu, T. H. (2024). Effect of integrated pest management practices on the occurrence of pesticide residue in okra cultivated by farmers in Kwara state. *Environmental Monitoring and Assessment*, *196*(11), 1048. https://doi.org/10.1007/s10661-024-13163-3

Internet Public Library. (2009). *Colonial food in Philadelphia*. https://www.ipl.org/essay/Colonial-Food-In-Philadelphia-FCQJKU678SB.

Irma, K.-N. G., Thierry, E.-B. J., Isaka, K.-N., Vanelle, W. S., Efietngab, A.-N., Emilie, T.-T., Judith, T., & Lucia, N. (2023). Parasitological assessment of some fruits and vegetables commonly sold in retail outlets in the Mfoundi Division of Cameroon. *Parasite Epidemiology and Control*, *22*, e00313. https://doi.org/10.1016/j.parepi.2023.e00313

Ishola, A. D., Ogunlaja, O. O., Arojojoye, O. A., Nwaechefu, O. O., & Ogunlaja, A. (2023). Cadmium, chromium, nickel and lead content of fish and vegetables from selected dams in Osun State, Nigeria. *Journal of Food Composition and Analysis*, *124*, 105687. https://doi.org/10.1016/j.jfca.2023.105687

Jacobsen, K., Maes, L., Norgrove, L., Mouassom, H., Hauser, S., & De Waele, D. (2009). Host status of twelve commonly cultivated crops in the Cameroon Highlands for the nematode *Pratylenchus goodeyi*. *International Journal of Pest Management*, *55*(4), 293–298. https://doi.org/10.1080/09670870902890140

Jafari, A., Mardani, H., Karimi, M. A., Sahami Gilan, M., Hemmat, H., Shoja, F., Enayati Soofi, N., & Eslamian, G. (2026). Therapeutic potential of okra (*Abelmoschus esculentus*) in dysglycaemia and metabolic dysfunction: A systematic review and meta-analysis across the diabetes spectrum. *Experimental Physiology*, 1–41. https://doi.org/10.1113/EP093293

Jafari, A., Mardani, H., Parsi Nezhad, B., Alaghi, A., & Sahebkar, A. (2025). Beneficial effects of okra (*Abelmoschus esculentus* L.) consumption on anthropometric measures, blood pressure, glycaemic control, lipid profile and liver function tests in randomised controlled trials: A GRADE-assessed systematic review and dose–response meta-analysis. *The British Journal of Nutrition*, *133*(5), 637–664. https://doi.org/10.1017/S0007114525000303

Kacholi, D. S., & Sahu, M. (2018). Levels and health risk assessment of heavy metals in soil, water, and vegetables of Dar es Salaam, Tanzania. *Journal of Chemistry*, *2018*, 1–9. https://doi.org/10.1155/2018/1402674

Kehinde, M. O., Olumide, O. F., Ramat, M. F., & Oluwakemi, O. B. (2015). Adequacy of mineral contents of raw and plain sticky sauce of common and bush Okra. *Italian Journal of Food Science*, *27*(4), 513–520.

Kenaw, W., Mohammed, W., & Woldetsadik, K. (2023). Morpho-agronomic variability of okra [*Abelmoschus esculentus* (L.) Moench] genotypes in Dire Dawa, eastern Ethiopia. *PLOS One*, *18*(7), e0288534. https://doi.org/10.1371/journal.pone.0288534

Khan, R., Ikram, A., Arshad, M. T., Naveed, F., Hossain, M. S., Maqsood, S., Al-Aoh, H. A., & Gnedeka, K. T. (2025). Okra mucilage as a multifunctional fat replacer in Mozzarella cheese: A nutritious and sustainable solution for the food industry. *Food Science & Nutrition*, *13*(9), e70858. https://doi.org/10.1002/fsn3.70858

Khan, R., Ikram, A., Arshad, M. T., Naveed, F., & Justin, O. B. (2026). Sustainable synthesis of iron oxide nanomaterials using *Abelmoschus esculentus* mucilage: Current status and future perspectives. *Cogent Food & Agriculture*, *12*(1), 1–32. https://doi.org/10.1080/23311932.2026.2618285

Kobta, W. R., Bokossa, H. J. K., Yabi, I., Kissira, A., & Johnson, R. C. (2023). Évaluation de la contamination des feuilles comestibles de la zone cotonnière de Kérou et de Péhunco (Bénin) par les éléments traces métalliques, les pyréthrinoïdes et le glyphosate. *Environnement, Risques et Santé*, *22*(2), 131–139. https://doi.org/10.1684/ers.2023.1717

Kodzwa, J. J., Madamombe, G., Masvaya, E. N., & Nyamangara, J. (2023). Optimization of African indigenous vegetables production in sub Saharan Africa: A review. *CABI Agriculture and Bioscience*, *4*(1), 44. https://doi.org/10.1186/s43170-023-00184-0

Komolafe, R. J., Ariyo, O. J., & Alake, C. O. (2021). Diversity in phenotypic traits and mineral elements of okra (*Abelmoschus esculentus* L. Moench) genotypes. *International Journal of Agronomy*, *2021*, 1–13. https://doi.org/10.1155/2021/5528703

Kon, T., Rojas, M. R., Abdourhamane, I. K., & Gilbertson, R. L. (2009). Roles and interactions of begomoviruses and satellite DNAs associated with okra leaf curl disease in Mali, West Africa. *The Journal of General Virology*, *90*(Pt 4), 1001–1013. https://doi.org/10.1099/vir.0.008102-0

Konaté, G., Barro, N., Fargette, D., Swanson, M., & Harrison, B. (1995). Occurrence of whitefly-transmitted geminiviruses in crops in Burkina Faso, and their serological detection and differentiation. *Annals of Applied Biology*, *126*(1), 121–129. https://doi.org/10.1111/j.1744-7348.1995.tb05008.x

Kumar, A., Singh, J., Singh, A., & Pratap, D. (2025). Study of genetic variability and emerging strains of Okra enation leaf curl virus: Increasing risks to okra production in India. *Physiology and Molecular Biology of Plants*, *31*(5), 767–783. https://doi.org/10.1007/s12298-025-01578-2

Kumar, S., Dagnoko, S., Haougui, A., Ratnadass, A., Pasternak, D., & Kouame, C. (2010). Okra (*Abelmoschus* spp.) in West and Central Africa: Potential and progress on its improvement. *African Journal of Agricultural Research*, *5*(25), 3590–3598.

Kumi, P. G. K., Elolu, S., Odongo, W., Okello, C., & Kalule, S. W. (2023). Where is the market? Assessing the role of dryer performance and marketability of solar-dried products in acceptance of solar dryers amongst smallholder farmers. *Heliyon*, *9*(8), 1–10. https://doi.org/10.1016/j.heliyon.2023.e18668

Kung, S.-J., Steenhoff, A. P., & Gray, C. (2014). Food allergy in Africa: Myth or reality? *Clinical Reviews in Allergy & Immunology*, *46*(3), 241–249. https://doi.org/10.1007/s12016-012-8341-z

Kushi, E. N., Belachew, T., & Tamiru, D. (2023a). Antenatal care follow-up was significantly associated with a higher probability of high dietary diversity score among pregnant women in okra-producing areas of western Ethiopia: Proportional odds model. *Food & Nutrition Research*, *67,* 1–11. https://doi.org/10.29219/fnr.v67.9608

Kushi, E. N., Belachew, T., & Tamiru, D. (2023b). The impacts of okra consumption on the nutritional status of pregnant women, west Ethiopia. *Food Science & Nutrition*, *11*(9), 5554–5564. https://doi.org/10.1002/fsn3.3512

Kushi, E. N., Belachew, T., & Tamiru, D. (2023c). Understanding the traditional values and use of okra among pregnant women in western Ethiopia: A qualitative study. *BMJ Open*, *13*(4), e071612. https://doi.org/10.1136/bmjopen-2023-071612

Kwok, C. T.-K., Ng, Y.-F., Chan, H.-T. L., & Chan, S.-W. (2025). An overview of the current scientific evidence on the biological properties of *Abelmoschus esculentus* (L.) Moench (okra). *Foods*, *14*(2), 177. https://doi.org/10.3390/foods14020177

Leke, W. N., Kvarnheden, A., Avelar, S., & Brown, J. K. (2020). Molecular characterization of two previously undescribed begomovirus-associated alphasatellite molecules infecting malvaceous species in Cameroon. *Archives of Virology*, *165*(3), 775–779. https://doi.org/10.1007/s00705-020-04523-8

Leke, W. N., Sattar, M. N., Ngane, E. B., Ngeve, J. M., Kvarnheden, A., & Brown, J. K. (2013). Molecular characterization of begomoviruses and DNA satellites associated with okra leaf curl disease in Cameroon. *Virus Research*, *174*(1-2), 116–125. https://doi.org/10.1016/j.virusres.2013.03.010

Lutoti, S., Kaggwa, B., Kamba, P. F., Mukonzo, J., Sesaazi, C. D., & Katuura, E. (2023). Ethnobotanical survey of medicinal plants used in breast cancer treatment by traditional health practitioners in Central Uganda. *Journal of Multidisciplinary Healthcare*, *16*, 635–651. https://doi.org/10.2147/JMDH.S387256

Madras Courier. (2022). *From Eritrea to India: A brief history of Bhendi.* https://madrascourier.com/insight/from-eritrea-to-india-short-history-of-bhendi.

Mafulul, S. G., Potgieter, J. H., Longdet, I. Y., Okoye, Z. S. C., & Potgieter-Vermaak, S. S. (2022). Health risks for a rural community in Bokkos, plateau state, Nigeria, exposed to potentially toxic elements from an abandoned tin mine. *Archives of Environmental Contamination and Toxicology*, *83*(1), 47–66. https://doi.org/10.1007/s00244-022-00936-5

Magdy, M., Appiah, A. S., Rizk, S. M., Elhifnawi, H. T., Karikari, B., Ahiakpa, J. K., & El-Dougdoug, N. K. (2021). Genome sequence of an *okra leaf curl virus* from Egypt. *Microbiology Resource Announcements*, *10*(29), e0053321. https://doi.org/10.1128/MRA.00533-21

Mahmoudi, M., Khelil, M., Hechmi, S., Latrech, B., Ghrib, R., Boujlben, A., & Yacoubi, S. (2022). Effect of surface and subsurface drip irrigation with treated wastewater on soil and water productivity of okra (*Abemoschus esculentus*) crop in semi-arid region of Tunisia. *Agriculture*, *12*(12), 2048. https://doi.org/10.3390/agriculture12122048

Makinde, A. A., Bello, N. J., Olasantan, F. O., Eruola, A. O., & Ufoegbune, G. C. (2012). Agroclimatic potential for cultivation of two sorghum cultivars in mixtures with okra and maize in a forest-savanna transition zone of Nigeria. *Rivista Italiana Di Agrometeorologia* [Italian Journal of Agrometeorology], *17*(3), 35–48.

Makinde, E. A., Odeyemi, O. M., Abiodun, O. L., & Ayeni, O. S. (2022). Plant spatial arrangement on growth, weed control, and yield of okra. *International Journal of Vegetable Science*, *28*(1), 3–14. https://doi.org/10.1080/19315260.2020.1816592

Malhat, F., Saber, A., Saber, E.-S., Shokr, S. A. S., & Abdel-Megeed, M. (2024). Nationwide surveillance and cumulative risk assessment of pesticide residues in Egyptian vegetables: Results from 2018 to 2021. *Separations*, *11*(11), 318. https://doi.org/10.3390/separations11110318

Mangena, P., Gerrano, A. S., Truter, M., Molatudi, L., Gumede, M. T., Khoza, L., Masemola, M., Nyathi, M., & Moalafi, A. (2026). Advancing okra (*Abelmoschus esculentus* L. Moench) breeding to unlock inherent multi-stress resistance for efficiency and sustainability in agriculture. *Frontiers in Plant Science*, *17*, 1728617. https://doi.org/10.3389/fpls.2026.1728617

Marrez, D., Salem, S., Abdel-Rahman, G., Fouzy, A., & Abd-El Fatah, S. (2021). Screening for pesticide residues in soil and crop samples in Egypt. *Egyptian Journal of Chemistry*, *64*(5), 2–3. https://doi.org/10.21608/ejchem.2021.64117.3374

Martin, F. W. (1982). Okra, potential multiple-purpose crop for the temperate zones and tropics. *Economic Botany*, *36*(3), 340–345. https://doi.org/10.1007/BF02858558

Massrie, K. D. (2025). Constraints and opportunities on okra (*Abelmoschus esculentus*) production in Ethiopia: A review. *Frontiers in Sustainable Food Systems*, *9*,1–9. https://doi.org/10.3389/fsufs.2025.1546995

Mativavarira, M., Simango, K., Dube, P., Gasura, E., Savadye, D. T., & Mujaju, C. (2024). Opportunities for African indigenous vegetables (AIVs): Regulations in the vegetable seed sector in sub Saharan Africa. *CABI Agriculture and Bioscience*, *5*, 1–16. https://doi.org/10.1186/s43170-024-00295-2

Mays, D. A., Buchanan, W., Bradford, B. N., & Giordano, P. M. (1990). Fuel production potential of several agricultural crops. In J. Janick & J. Simon (Eds.), *Advances in new crops* (pp. 260–263). Timber Press.

Mbah, C. N., Mbah, E. C., Orji, J. E., Igberi, C., Abam, P., & Awere, S. U. (2024). Using *Gliricidia sepium* prunings as green manure in a degraded ultisol; effects on soil physical properties and yield of okra (*Abelmuschus esculentus*) in Abakaliki, southeast Nigeria. *Biological Agriculture & Horticulture*, *40*(4), 257–266. https://doi.org/10.1080/01448765.2024.2393590

Mbatchou, V. C., Yunusah, O. D., & Iddrisu, U. F. (2024). Effects of pesticide residues on the growth and yield of vegetables at Navrongo of Ghana. *CABI Agriculture and Bioscience*, *5*(1), 1–12. https://doi.org/10.1186/s43170-024-00252-z

Meck, M. L., Mudimbu, D., & Davies, T. C. (2020). Accumulation of potentially harmful elements in edible parts of vegetables grown on two different geological substrates in Zimbabwe. *Journal of Geochemical Exploration*, *208*, 106392. https://doi.org/10.1016/j.gexplo.2019.106392

Merriam-Webster. (2025a). *Gumbo.* https://www.merriam-webster.com/dictionary/gumbo.

Merriam-Webster. (2025b). *Okra.* https://www.merriam-webster.com/dictionary/okra.

Mertz, O., Lykke, A., & Reenberg, A. (2001). Importance and seasonality of vegetable consumption and marketing in Burkina Faso. *Economic Botany*, *55*(2), 276–289. https://doi.org/10.1007/BF02864565

Mkhabela, S. S., Shimelis, H., Gerrano, A. S., & Mashilo, J. (2022). Phenotypic and genotypic divergence in okra [*Abelmoschus esculentus* (L.) Moench] and implications for drought tolerance breeding: A review. *South African Journal of Botany*, *145*, 56–64. https://doi.org/10.1016/j.sajb.2020.12.029

Mkiga, A. M., Mohamed, S. A., Du Plessis, H., Khamis, F. M., & Ekesi, S. (2019). Field and laboratory performance of false codling moth, *Thaumatotibia leucotreta* (Lepidoptera: Troticidae) on orange and selected vegetables. *Insects*, *10*(3), 63. https://doi.org/10.3390/insects10030063

Mohammed, H. Y., Teferra, T. F., & Sime, G. (2024). Indigenous knowledge and nutritional and morphological characterization of okra (*Abelmoschus esculentus* (L.) Moecnh) varieties in Western Ethiopia. *Food Science & Nutrition*, *12*(4), 2537–2550. https://doi.org/10.1002/fsn3.3936

Mohammed, I. G., Osipitan, A. A., Pitan, O. R., & Atayese, M. (2013). Evaluation of 15 varieties of okra (*Abelmoschus esculentus* (L.) Moench to field infestation by flea beetles (*Podagrica* spp.). *African Entomology*, *21*(1), 70–78. https://doi.org/10.4001/003.021.0120

Mohammed, J., Mohammed, W., & Shiferaw, E. (2022a). Performance and genetic variability of okra (*Abelmoschus esculentus* (L.) Moench) genotypes in Ethiopia for agromorphology and biochemical traits. *Advances in Agriculture*, *2022*, 1–8. https://doi.org/10.1155/2022/5521151

Mohammed, J., Mohammed, W., & Shiferaw, E. (2022b). Phenotypic diversity assessment of okra (*Abelmoschus Esculentus* (L.) Moench) genotypes in Ethiopia using multivariate analysis. *Scientifica*, *2022*, 3306793–3306799. https://doi.org/10.1155/2022/3306793

Mokgalabone, T. T., Mpai, S., Nyakudya, T. T., & Ndhlala, A. R. (2025). Amino acids, UPLC-MS phenolic metabolites and multivariate approach for elucidating the effect of two growing conditions on growth and yield attributes in okra pods and leaves. *Food Chemistry*, *467*, 142220. https://doi.org/10.1016/j.foodchem.2024.142220

Mokgalaboni, K., Phoswa, W. N., Hanser, S., & Lebelo, S. L. (2026). Investigating the impact of *Abelmoschus esculentus* on glycemia and insulin resistance in type 2 diabetes and prediabetes. *Plants*, *15*(5), 817. https://doi.org/10.3390/plants15050817

Motis, T. N., Longfellow, J. M., Jani, A. D., Lingbeek, B. J., D'Aiuto, C. J., & Bergen, J. C. J. (2017). Productivity of *Moringa oleifera* augmented with intercropped tropical legumes. *Acta Horticulturae*, *1158*, 85–96. https://doi.org/10.17660/ActaHortic.2017.1158.11

Moyin-Jesu, E. I., & Ojeniyi, S. O. (2007). Effect of sole and amended plant residues on soil nutrient contents and yield of okra (*Abelmoschus esculentum* L). *Discovery and Innovation*, *18*(4), 318–326. https://doi.org/10.4314/dai.v18i4.15760

Muimba-Kankolongo, A. (2018). Vegetable production. In Muimba-Kankolongo, A. (Ed), *Food crop production by smallholder farmers in Southern Africa* (pp. 205–274). Elsevier. https://doi.org/10.1016/B978-0-12-814383-4.00011-6

Müller, A., Eltigani, A., & George, E. (2019). The abundance of arbuscular mycorrhizal fungal species in symbiosis with okra plants is affected by induced drought conditions in a calcareous substrate. *Rhizosphere*, *10*, 100150. https://doi.org/10.1016/j.rhisph.2019.100150

Muoneke, C. O., & Mbah, E. U. (2007). Productivity of cassava/okra intercropping systems as influenced by okra planting density. *African Journal of Agricultural Research*, *2*(5), 223–231.

Muoneke, C., & Udeogalanya, A. (1991). Response of okra (*Hibiscus-esculentus*) to plant-density and pattern of plant arrangement in Nigeria. *Indian Journal of Agricultural Sciences*, *61*(10), 726–730.

Murovhi, J., Phophi, M. M., & Mafongoya, P. (2020). Efficacy of plant materials in controlling Aphids on okra (*Abelmoschus esculentus* L. Moench) in Limpopo Province of South Africa. *Agronomy*, *10*(12), 1968. https://doi.org/10.3390/agronomy10121968

National Research Council. (2006). *Lost crops of Africa – volume II: Vegetables*. National Academies Press.

Nchang, E. C., Nkontcheu, D. B. K., Taboue, G. C. T., Bonwen, F. R., & Fokam, E. B. (2023). Pesticides drive patterns of insect visitors and pollination-related attributes of four crops in Buea, Southwest Cameroon. *International Journal of Tropical Insect Science*, *44*(1), 117–128. https://doi.org/10.1007/s42690-023-01138-9

Ndunguru, J., & Rajabu, A. C. (2004). Effect of okra mosaic virus disease on the above-ground morphological yield components of okra in Tanzania. *Scientia Horticulturae*, *99*(3–4), 225–235. https://doi.org/10.1016/S0304-4238(03)00108-0

Nguessan, K., Fargette, D., Fauquet, C., & Thouvenel, J. (1992). Aspects of the epidemiology of okra leaf curl virus in Cote-D'Ivoire. *Tropical Pest Management*, *38*(2), 122–126.

Njoku, S. C., Muoneke, C. O., Okpara, D. A., & Agbo, F. M. O. (2007). Effect of intercropping varieties of sweet potato and okra in an ultisol of southeastern Nigeria. *African Journal of Biotechnology*, *6*(14), 1650–1654.

Nkakini, S. O., & Akor, A. J. (2013). Effects of tillage on soil moisture content, okra (*Abelmosehus esculentus*) emergence and yields. *AMA-Agricultural Mechanization in Asia Africa and Latin America*, *44*(2), 15–21.

Nkongho, R. N., Efouba-Mbong, J. T., Ndam, L. M., Ketchem, G. A., Etchu-Takang, E. G., & Agbor, D. T. (2022). Seed production system and adaptability of okra (*Abelmoschus esculentus* L.) cultivars in Buea, Cameroon. *PLOS One*, *17*(12), e0278771. https://doi.org/10.1371/journal.pone.0278771

Nolte, K. (2014). *Okra seed.* https://web.archive.org/web/20141031143119/http://cals.arizona.edu/fps/sites/cals.arizona.edu.fps/files/cotw/Okra_Seed.pdf.

Nwangburuka, C. C., Denton, O. A., Kehinde, O. B., Ojo, D. K., & Popoola, A. R. (2012). Genetic variability and heritability in cultivated okra [*Abelmoschus esculentus* (L.) Moench]. *Spanish Journal of Agricultural Research*, *10*(1), 123–129. https://doi.org/10.5424/sjar/2012101-021-11

Nwangburuka, C. C., Kehinde, O. B., Ojo, D. K., Denton, O. A., & Popoola, A. R. (2011). Morphological classification of genetic diversity in cultivated okra, *Abelmoschus esculentus* (L) Moench using principal component analysis (PCA) and single linkage cluster analysis (SLCA). *African Journal of Biotechnology*, *10*(54), 11165–11172.

Nzikou, J. M., Mvoula-Tsieri, M., Matouba, E., Ouamba, J. M., Kapseu, C., Parmentier, M., & Desobry, S. (2006). A study on gumbo seed grown in Congo Brazzaville for its food and industrial applications. *African Journal of Biotechnology*, *5*(24), 2469–2475.

Obasi, P. N., Chibuike, A., & Immaculate, N. (2023). Contamination levels and health risk assessment of heavy metals in food crops in Ishiagu area, lower Benue trough South-eastern Nigeria. *International Journal of Environmental Science and Technology*, *20*(11), 12069–12088. https://doi.org/10.1007/s13762-022-04748-x

Obebe, O. O., Aluko, O. O., Falohun, O. O., Akinlabi, K. B., & ThankGod, O. E. (2020). Parasitic contamination and public health risk of commonly consumed vegetables in Ibadan-Nigeria. *The Pan African Medical Journal*, *36*, 126. https://doi.org/10.11604/pamj.2020.36.126.19364

Odeleye, F. O., Odeleye, O. M. O., Olaleye, A. O., & Yakubu, F. B. (2007). Effect of sowing depth on emergence, growth and yield of okra (*Abelmoschus esculentus* (L.) Moench). *Journal of Food Agriculture & Environment*, *5*(1), 205–209.

Ofuya, T. I., Okunlola, A. I., & Mbata, G. N. (2023). A review of insect pest management in vegetable crop production in Nigeria. *Insects*, *14*(2), 111. https://doi.org/10.3390/insects14020111

Okeji, M. C., Agwu, K. K., & Idigo, F. U. (2012). Natural radioactivity in cultivated land in the vicinity of a phosphate fertilizer plant in Nigeria. *Radiation Physics and Chemistry*, *81*(12), 1823–1826. https://doi.org/10.1016/j.radphyschem.2012.07.015

Okon, P. B., Ogeh, J. S., & Amalu, U. C. (2005). Effect of rice husk ash and phosphorus on some properties of acid sands and yield of okra. *Communications in Soil Science and Plant Analysis*, *36*(7–8), 833–845. https://doi.org/10.1081/CSS-200049460

Okonji, C. J., Ajayi, E. O., Adewale, B. D., Oikeh, S. O., Akash, M. W., & Ogundeji, A. J. (2020). Performance of upland rice as influenced by varying row ratios in rice/okra intercrop. *Journal of Crop Improvement*, *34*(5), 687–696. https://doi.org/10.1080/15427528.2020.1762272

Olabode, O. S., Gunyemi, S., & Adesina, G. O. (2007). Response of okra (*Abelmoschus esculentus* (L). Moench) to weed control by mulching. *Journal of Food Agriculture & Environment*, *5*(3–4), 324–326.

Oladele, B. B., Ugbede, F. O., Arogunjo, A. M., Ajayi, O. S., & Pereira, A. (2023). Gamma spectroscopy study of soil-plant transfer factor characteristics of 40K, 232Th and 226Ra in some crops cultivated in southwestern region of Nigeria. *Heliyon*, *9*(9), e19377. https://doi.org/10.1016/j.heliyon.2023.e19377

Oladokun, M. A. O. (1990). Tree crop based agroforestry in Nigeria: A checklist of crops intercropped with cocoa. *Agroforestry Systems*, *11*(3), 227–241. https://doi.org/10.1007/BF00045901

Olajide-Taiwo, L. O., Bamimore, K., Olajide-Taiwo, F. B., Cofie, O., & Babajide, K. S. (2014). Prospects, challenges and institutional linkages of vegetable value chain in Ibadan City of Nigeria. *Acta Horticulturae*, *1021*, 299–305. https://doi.org/10.17660/ActaHortic.2014.1021.27

Olasantan, F. (1998). Effects of preceding maize (*Zea mays*) and cowpea (*Vigna unguiculata*) in sole cropping and intercropping on growth, yield and nitrogen requirement of okra (*Abelmoschus esculentus*). *The Journal of Agricultural Science*, *131*(3), 293–298. https://doi.org/10.1017/S0021859698005711

Olasantan, F. (1999). Nitrogen fertilization of okra (*Abelmoschus esculentus*) in an intercropping system with cassava (*Manihot esculenta*) and maize (*Zea mays*) in south-western Nigeria. *The Journal of Agricultural Science*, *133*(3), 325–334. https://doi.org/10.1017/S0021859699007054

Olasantan, F. (2001a). Optimum plant populations for okra (*Abelmoschus esculentus*) in a mixture with cassava (*Manihot esculenta*) and its relevance to rainy season-based cropping systems in south-western Nigeria. *The Journal of Agricultural Science*, *136*(2), 207–214. https://doi.org/10.1017/S0021859601008656]

Olasantan, F. O. (1991). Response of tomato and okra to nitrogen fertilizer in sole cropping and intercropping with cowpea. *Journal of Horticultural Science*, *66*(2), 191–199. https://doi.org/10.1080/00221589.1991.11516144

Olasantan, F. O. (2001b). Tropical vegetables and spices: Potential value and contributions to sustainable agriculture in Nigeria. *Outlook on Agriculture*, *30*(1), 55–67. https://doi.org/10.5367/000000001101293463

Olasantan, F. O. (2005). Cassava cultivation management for sustainable vegetable production in intercropping with okra. *Journal of Sustainable Agriculture*, *27*(2), 53–68. https://doi.org/10.1300/J064v27n02_05

Olasantan, F. O. (2007). Vegetable production in tropical Africa: Status and strategies for sustainable management. *Journal of Sustainable Agriculture*, *30*(3), 41–70. https://doi.org/10.1300/J064v30n03_05

Olasantan, F. O., & Bello, N. J. (2004). Optimum sowing dates for okra (*Abelmoschus esculentus*) in monoculture and mixture with cassava (*Manihot esculenta*) during the rainy season in the south-west of Nigeria. *The Journal of Agricultural Science*, *142*(1), 49–58. https://doi.org/10.1017/S0021859604004010

Olasantan, F. O., & Salau, A. W. (2008). Effect of pruning on growth, leaf yield and pod yields of okra (*Abelmoschus esculentus* (L.) Moench). *The Journal of Agricultural Science*, *146*(1), 93–102. https://doi.org/10.1017/S0021859607007290

Olowokere, F. A., Adebambo, L. O., Adejuyigbe, C. O., & Olasantan, F. O. (2021). Okra (*Abelsmoschus esculentus* L. Moench) performance with the application of composts made from different source materials. *Biological Agriculture & Horticulture*, *37*(3), 197–212. https://doi.org/10.1080/01448765.2021.1942207

Olubode, O. O. (2012). Influence of seasonal variations on components of pawpaw/okra mixtures in a pawpaw-based cropping system. *Biological Agriculture & Horticulture*, *28*(4), 251–266. https://doi.org/10.1080/01448765.2012.740283

Olubode, O. O., Aiyelaagbe, I. O. O., & Bodunde, J. G. (2012a). Effect of stage of introduction on performance of okra as an intercrop in pawpaw orchards. *Biological Agriculture & Horticulture*, *28*(1), 61–70. https://doi.org/10.1080/01448765.2012.672176

Olubode, O. O., Aiyelaagbe, I. O. O., & Bodunde, J. G. (2012b). Responses of 'Sunrise-solo' pawpaw, okra and cucumber components of pawpaw based cropping system to time of intercropping. *Scientia Horticulturae*, *139*, 71–78. https://doi.org/10.1016/j.scienta.2012.03.003

Omondi, A. B., Obeng-Ofori, D., Kyerematen, R. A., & Danquah, E. Y. (2005). Host preference and suitability of some selected crops for two biotypes of *Bemisia tabaci* in Ghana. *Entomologia Experimentalis et Applicata*, *115*(3), 393–400. https://doi.org/10.1111/j.1570-7458.2005.00296.x

Omonkhua, A. A., Okonofua, F. E., Ntoimo, L. F. C., Aruomaren, A. I., Adebayo, A. M., & Nwuba, R. (2020). Community perceptions on causes of high dizygotic twinning rate in Igbo-Ora, South-west Nigeria: A qualitative study. *PLOS One*, *15*(12), e0243169. https://doi.org/10.1371/journal.pone.0243169

Ondo, J. A., Menye Biyogo, R., Eba, F., Prudent, P., Fotio, D., Ollui-Mboulou, M., & Omva-Zue, J. (2013). Accumulation of soil-borne aluminium, iron, manganese and zinc in plants cultivated in the region of Moanda (Gabon) and nutritional characteristics of the edible parts harvested. *Journal of the Science of Food and Agriculture*, *93*(10), 2549–2555. https://doi.org/10.1002/jsfa.6074

Onyeneke, R. U., Agyarko, F. F., Onyeneke, C. J., Osuji, E. E., Ibeneme, P. A., & Esfahani, I. J. (2023). How does climate change affect tomato and okra production? Evidence from Nigeria. *Plants*, *12*(19), 3477. https://doi.org/10.3390/plants12193477

Oshunsanya, S. O. (2013). Crop yields as influenced by land preparation methods established within Vetiver grass alleys for sustainable agriculture in Southwest Nigeria. *Agroecology and Sustainable Food Systems*, *37*(5), 578–591. https://doi.org/10.1080/21683565.2012.762439]

Osman, H. E. M., Abdel-Hamed, E. M. W., Al-Juhani, W. S. M., Al-Maroai, Y. A. O., & El-Morsy, M. H. E.-M. (2021). Bioaccumulation and human health risk assessment of heavy metals in food crops irrigated with freshwater and treated wastewater: A case study in Southern Cairo, Egypt. *Environmental Science and Pollution Research International*, *28*(36), 50217–50229. https://doi.org/10.1007/s11356-021-14249-y

Ouattara, A., Tiendrébéogo, F., Lefeuvre, P., Hoareau, M., Claverie, S., Allibert, A., Chiroleu, F., Traoré, E. V., Barro, N., Traoré, O., & Lett, J. -M. (2020). Diversity, distribution and prevalence of vegetable-infecting geminiviruses in Burkina Faso. *Plant Pathology*, *69*(2), 379–392. https://doi.org/10.1111/ppa.13120

Ounis, S., Turóczi, G., & Kiss, J. (2024). Arthropod pests, nematodes, and microbial pathogens of okra (*Abelmoschus esculentus*) and their management—a review. *Agronomy*, *14*(12), 2841. https://doi.org/10.3390/agronomy14122841

Owusu, F. W. A., Boakye-Gyasi, M. E., Agbenorhevi, J. K., Bayor, M. T., & Ofori-Kwakye, K. (2021a). Potential and comparative tablet disintegrant properties of pectin obtained from five okra genotypes in Ghana. *Scientifica*, *2021*, 2902335–2902311. https://doi.org/10.1155/2021/2902335

Owusu, F. W. A., Boakye-Gyasi, M. E., Entsie, P., Bayor, M. T., & Ofori-Kwakye, K. (2021b). Utilization of pectin from okra as binding agent in immediate release tablets. *BioMed Research International*, *2021*(1), 6002286. https://doi.org/10.1155/2021/6002286

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, *372*(372), n71. https://doi.org/10.1136/bmj.n71

Palada, M. C., Crossman, S. M., & O'Donnell, J. J. (2008). Integrating high value horticultural crops into agroforestry systems in the tropics with focus on alley cropping. In O. Onokpise, D. Rockwood, D. Worthen, & T. Willis (Eds.), *Symposium on celebrating minority professionals in forestry and natural resources conservation* (pp. 93–101). USDA.

Palada, M. C., Kang, B. T., & Claassen, S. L. (1992). Effect of alley cropping with *Leucaena leucocephala* and fertilizer application on yield of vegetable crops. *Agroforestry Systems*, *19*(2), 139–147. https://doi.org/10.1007/BF00138504

Pasquini, M. W., Weinberger, K., Assogba-Komlan, F., Kouamé, C., Akplogan, F., Djidji, H., Achigan-Dako, E. G., & Young, E. M. (2014). Characterising urban and peri-urban production systems for african indigenous vegetables in four cities in Benin and Cote d'Ivoire. *Acta Horticulturae*, *1021*(1021), 137–151. https://doi.org/10.17660/ActaHortic.2014.1021.12

Phoswa, W. N., & Mokgalaboni, K. (2023). Comprehensive overview of the effects of amaranthus and *Abelmoschus esculentus* on markers of oxidative stress in diabetes mellitus. *Life*, *13*(9), 1830. https://doi.org/10.3390/life13091830

Pitan, O. O. R., & Olatunde, G. O. (2006). Effects of intercropping tomato (*Lycopersicon esculentum*) at different times with cowpea (*Vigna unguiculata*) or okra (*Abelmoschus esculentus*) on crop damage by major insect pests. *The Journal of Agricultural Science*, *144*(4), 361–368. https://doi.org/10.1017/S0021859606006277

Rai, N., Thakur, A., Shelke, M., Unavane, S., Hase, S., Syed, S. H., Raiger, S., Singh, M., Vishwakarma, N., & Vishwakarma, A. (2025). A review on medicinal effects of *Abelmoschus esculentus* on type 2 diabetes. *Asian Journal of Pharmaceutics*, *19*(4), 1794–1798.

Ratnadass, A., Avelino, J., Fernandes, P., Letourmy, P., Babin, R., Deberdt, P., Deguine, J.-P., Grechi, I., Naudin, K., Rhino, B., DeClerck, F., Kadi Kadi, H. A., Mahob, R., Rabary, B., Rafarasoa, L. S., Lescourret, F., & Van Den Berg, J. (2021). Synergies and tradeoffs in natural regulation of crop pests and diseases under plant species diversification. *Crop Protection*, *146*, 105658. https://doi.org/10.1016/j.cropro.2021.105658

Ratnadass, A., Deberdt, P., Fernandes, P., Grechi, I., Rhino, B., Ryckewaert, P., & Malézieux, E. (2011a). An Ecologically Intensive Approach for the design of sustainable horticultural systems in the tropics. *Acta Horticulturae*, *921*(921), 35–40. https://doi.org/10.17660/ActaHortic.2011.921.3

Ratnadass, A., Ryckewaert, P., Claude, Z., Nikiema, A., Pasternak, D., Woltering, L., Thunes, K., & Zakari-Moussa, O. (2011b). New ecological options for the management of horticultural crop pests in Sudano-Sahelian agroecosystems of West Africa. *Acta Horticulturae*, *917*, 85–91. https://doi.org/10.17660/ActaHortic.2011.917.10

Ratnadass, A., Zakari-Moussa, O., Kadi-Kadi, H. A., Kumar, S., Grechi, I., Ryckewaert, P., Salha, H., Akourki, M., Maâzou, A. A., Siaka, S. A., & Salami, I. (2014). Potential of pigeon pea as a trap crop for control of fruit worm infestation and damage to okra. *Agricultural and Forest Entomology*, *16*(4), 426–433. https://doi.org/10.1111/afe.12072

Rutsaert, P., Achigan-Dako, E. G., Ayenan, M. A. T., Chamberlin, J., Daudi, H., Houdegbe, A. C., Kresovich, S., Mbugua Gitonga, A., Nas, T. M., Ojiewo, C. O., Sibiya, J., Gandhi, H., Banda, V. R., Niang, M., Betran, J., Chisikaurayi, B., Egesi, C., Gangashetty, P., Ibitoye, D., … Pixley, K. V. (2026). Steps to transform African opportunity crops into reality crops. *Nature Communications*, *17*(1), 2872. https://doi.org/10.1038/s41467-026-70990-3

Salako, V. K., Fandohan, B., Kassa, B., Assogbadjo, A. E., Idohou, A. F. R., Gbedomon, R. C., Chakeredza, S., Dulloo, M. E., & Glele Kakaï, R. (2014). Home gardens: An assessment of their biodiversity and potential contribution to conservation of threatened species and crop wild relatives in Benin. *Genetic Resources and Crop Evolution*, *61*(2), 313–330. https://doi.org/10.1007/s10722-013-0035-8

Salau, A. W., Olasantan, F. O., Bodunde, J. G., & Makinde, E. A. (2015). Soil temperature and moisture content changes with growth and yield of cassava/vegetable intercrops. *Archives of Agronomy and Soil Science*, *61*(4), 447–460. https://doi.org/10.1080/03650340.2014.939958

Salem, S. A., A., El-Salam, A. M. E., & El-Kholy, M. Y. (2008). Field trapping of the American Bollworm, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) with the sex pheromone. *Egyptian Journal of Biological Pest Control*, *18*(1), 161–165.

Sami, R., Li, Y., Qi, B., Wang, S., Zhang, Q., Han, F., Ma, Y., Jing, J., & Jiang, L. (2014). HPLC. Analysis of water-soluble vitamins (B2, B3, B6, B12, and C) and fat-soluble vitamins (E, K, D, A, and β-Carotene) of okra (*Abelmoschus esculentus*). *Journal of Chemistry*, *2014*, 1–6. https://doi.org/10.1155/2014/831357

Sechser, B., Reber, B., & Bourgeois, F. (2002). Pymetrozine: Selectivity spectrum to beneficial arthropods and fitness for integrated pest management. *Anzeiger Für Schädlingskunde*, *75*(3), 72–77. https://doi.org/10.1034/j.1399-5448.2002.02021.x

Sereno, A. B., Dayane Pinto, C., Antunes Andrade, F., Aparecida Bertolazo da Silva, M., Carvalho Garcia, A., Carneiro Hecke Krüger, C., & José de Messias Reason, I. (2022). Effects of okra (*Abelmoschus esculentus* (L.) Moench) on glycemic markers in animal models of diabetes: A systematic review. *Journal of Ethnopharmacology*, *298*, 115544. https://doi.org/10.1016/j.jep.2022.115544

Sheferie, M. B., Ali, W. M., Wakjira, K. W., & Atinku Bekele, E. (2023). Fruit yield and yield-related traits of okra [*Abelmoschus esculentus* (L.) Moench] genotypes as influenced by different seed priming techniques in Dire Dawa, Ethiopia. *Heliyon*, *9*(7), e17830. https://doi.org/10.1016/j.heliyon.2023.e17830

Shehata, A., El-Gendy, M., Mohamed, M., & Atala, S. (2022). The influence of mucilages extracted from some vegetable plants residues as an edible coating on maintaining the quality of sweet pepper fruits. *Egyptian Journal of Chemistry*, *66*(6), 393–403. https://doi.org/10.21608/ejchem.2022.156497.6794

Singh, A., Weisser, W. W., Hanna, R., Houmgny, R., & Zytynska, S. E. (2017). Reduce pests, enhance production: Benefits of intercropping at high densities for okra farmers in Cameroon. *Pest Management Science*, *73*(10), 2017–2027. https://doi.org/10.1002/ps.4636

Singh, A., Zytynska, S. E., Hanna, R., & Weisser, W. W. (2016). Ant attendance of the cotton aphid is beneficial for okra plants: Deciphering multitrophic interactions. *Agricultural and Forest Entomology*, *18*(3), 270–279. https://doi.org/10.1111/afe.12159

Snyder, R. L., & de Melo-Abreu, J. P. (2005). *Frost protection: Fundamentals, practice and economics*. FAO. https://www.fao.org/4/y7223e/y7223e00.pdf.

Southern Integrated Pest Management Center. (2005). *Okra pest management strategic plan (PMSP)*. https://ipmdata.ipmcenters.org/source_report.cfm?view=yes&sourceid=1040.

Sseruwagi, P., Legg, J. P., Maruthi, M. N., Colvin, J., Rey, M. E. C., & Brown, J. K. (2005). Genetic diversity of *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae) populations and presence of the B biotype and a non-B biotype that can induce silverleaf symptoms in squash, in Uganda. *Annals of Applied Biology*, *147*(3), 253–265. https://doi.org/10.1111/j.1744-7348.2005.00026.x

Sseruwagi, P., Maruthi, M. N., Colvin, J., Rey, M. E. C., Brown, J. K., & Legg, J. P. (2006). Colonization of non-cassava plant species by cassava whiteflies (*Bemisia tabaci*) in Uganda. *Entomologia Experimentalis et Applicata*, *119*(2), 145–153. https://doi.org/10.1111/j.1570-7458.2006.00402.x

Stenchly, K., Lippmann, S., Waongo, A., Nyarko, G., & Buerkert, A. (2017). Weed species structural and functional composition of okra fields and field periphery under different management intensities along the rural-urban gradient of two West African cities. *Agriculture, Ecosystems & Environment*, *237*, 213–223. https://doi.org/10.1016/j.agee.2016.12.028]

Swamy, K. R. M. (2023). Origin, distribution, taxonomy, botanical description, cytogenetics, genetic diversity and breeding of okra (*Abelmoschus esculentus* (L.) Moench.). *International Journal of Development Research*, *13*(03), 62026–62046.

Taffner, J., Laggner, O., Wolfgang, A., Coyne, D., & Berg, G. (2020). Exploring the microbiota of East African indigenous leafy greens for plant growth, health, and resilience. *Frontiers in Microbiology*, *11*, 585690. https://doi.org/10.3389/fmicb.2020.585690

Taylor Sen, C. (2004). *Food culture in India*. Greenwood Press.

Temam, N., Mohammed, W., & Aklilu, S. (2021). Variability assessment of okra (*Abelmoschus esculentus* (L.) Moench) genotypes based on their qualitative traits. *International Journal of Agronomy*, *2021*, 1–6. https://doi.org/10.1155/2021/6678561

Texas AgriLife Extension Service. (2005). *Okra, or 'Gumbo,' from Africa.* https://web.archive.org/web/20050304125817/https://plantanswers.tamu.edu/publications/vegetabletravelers/okra.html.

Tiendrébéogo, F., Lefeuvre, P., Hoareau, M., Villemot, J., Konaté, G., Traoré, A. S., Barro, N., Traoré, V. S., Reynaud, B., Traoré, O., & Lett, J.-M. (2010a). Molecular diversity of Cotton leaf curl Gezira virus isolates and their satellite DNAs associated with okra leaf curl disease in Burkina Faso. *Virology Journal*, *7*(1), 48. https://doi.org/10.1186/1743-422X-7-48

Tiendrébéogo, F., Traoré, V. S. E., Lett, J.-M., Barro, N., Konaté, G., Traoré, A. S., & Traoré, O. (2010b). Impact of okra leaf curl disease on morphology and yield of okra. *Crop Protection*, *29*(7), 712–716. https://doi.org/10.1016/j.cropro.2010.02.007]

Tsopzong, A. B. T., Njapndounke, B., Hermann Arantes, K. F., Nanga Ndjang, M. M., Kenfack, J. O., Klang, M. J., & Téléfo, P. B. (2024). Screening of West Cameroonian edible plant-based mucilage for the production of improved protein-polysaccharide conjugates. *Journal of Agriculture and Food Research*, *15*, 100981. https://doi.org/10.1016/j.jafr.2024.100981

Uaboi-Egbenni, P. O., Okolie, P. O., Adejuyitan, O. E., Sobande, A. O., & Akinyemi, O. (2009). Effect of industrial effluents on the growth and anatomical structures of *Abelmoschus esculentus* (okra). *African Journal of Biotechnology*, *8*(14), 3251–3260.

Ugwu, S. N., & Enweremadu, C. C. (2019). Biodegradability and kinetic studies on biomethane production from okra (*Abelmoschus esculentus*) waste. *South African Journal of Science*, *115*(7/8), 1–5. https://doi.org/10.17159/sajs.2019/5595

Umoren, A. S., Mijinyawa, Y., Sridhar, M. K. C., & Udosen, C. I. (2024). The influence of biochar on heavy metals phytoaccumulation by okra and fluted pumpkin plants in soil contaminated with petroleum hydrocarbons. *Environmental Quality Management*, *34*(1), 1–13. https://doi.org/10.1002/tqem.22286

Uwah, D. F., Ukoha, G. O., & Iyango, J. (2012). Okra performance and soil and water conservation as influenced by poultry manure and organic mulch amendments. *Journal of Food Agriculture & Environment*, *10*(1), 748–754.

Vogt, J. (2009). *Gumbo: The mysterious history.* https://www.theatlantic.com/health/archive/2009/12/gumbo-the-mysterious-history/32659/

Voice of America. (2018). *Many food names in English come from Africa.* https://learningenglish.voanews.com/a/4241283.html.

Waceke, J. W., & Waudo, S. W. (1993). Effect of soil amendments on pathogenicity of *Meloidogyne incognita* on okra. *International Journal of Pest Management*, *39*(4), 385–389. https://doi.org/10.1080/09670879309371827

Wammanda, D. T., Kadams, A. M., & Jonah, P. M. (2010). Combining ability analysis and heterosis in a diallel cross of okra (*Abelmoschus esculentus* L. Moench). *African Journal of Agricultural Research*, *5*(16), 2108–2115.

Wang, Z., Chai, Y., Dai, Y., Lin, X., Zhang, K., Shi, Y., & Zou, J. (2025). Recent progress in the polysaccharides from okra (*Abelmoschus esculentus* L.): Preparation methods, structural characterization, pharmacological properties, and applications. *International Journal of Biological Macromolecules*, *320*(Pt 1), 145649. https://doi.org/10.1016/j.ijbiomac.2025.145649

Whats4eats. (2025). *Quimbombó Guisado recipe.* https://www.whats4eats.com/vegetables/quimbombo-guisado-recipe.

Willis, V. (2014). *Okra: A savor the south cookbook*. University of North Carolina Press.

Woldetsadik, D., Llorent-Martínez, E. J., Gebrezgabher, S., Njenga, M., Mendum, R., Castillo-López, R., Fernández-de Córdova, M. L., Hailu, H., Evans, C. T., Madani, N., Mafika, T. P., & Fleming, D. E. B. (2022). Okra (*Abelmoschus esculentus*) in a refugee context in East Africa: Kitchen gardening helps with mineral provision. *SN Applied Sciences*, *4*(1), 32. https://doi.org/10.1007/s42452-021-04898-6

Woltering, L., Ibrahim, A., Pasternak, D., & Ndjeunga, J. (2011). The economics of low pressure drip irrigation and hand watering for vegetable production in the Sahel. *Agricultural Water Management*, *99*(1), 67–73. https://doi.org/10.1016/j.agwat.2011.07.017

Xu, Y., Cao, H., & He, J. (2025). Research advances in okra polysaccharides: Green extraction technology, structural features, bioactivity, processing properties and application in foods. *Food Research International*, *202*, 115686. https://doi.org/10.1016/j.foodres.2025.115686

Zaki, F. N. (1996). Field application of *Steinernema feltiae* in the form of baits against the greesy cutworm *Agrotis ipsilon* in an okra field in Egypt. *Anzeiger für Schädlingskunde Pflanzenschutz Umweltschutz*, *69*(4), 79–80. https://doi.org/10.1007/BF01908434

Zhai, W. B., Zhang, M. Z., Gao, H., Meng, J., Shi, J. Y., Zhang, W. W., & Qi, F. J. (2019). Occurrence of verticillium wilt caused by *Verticillium dahliae* on okra (*Abelmoschus esculentus*) in North China. *Plant Disease*, *103*(6), 1413. https://doi.org/10.1094/PDIS-07-18-1279-PDN

Zhang, L., Li, X., Bi, B., & Sun, Y. (2025). Progress in the isolation, purification, structural characteristics and biological functions of polysaccharides from okra (*Abelmoschus esculentus* (L.) Moench): A review. *International Journal of Biological Macromolecules*, *312*, 144184. https://doi.org/10.1016/j.ijbiomac.2025.144184

Appendix A

Table A1. Production, area harvested, and yield of okra worldwide and in Africa, 2024.

	Area	Area harvested (ha)	Yield (kg/ha)	Production (t)
Top 20 world countries (Production)	India	557001	13115.6	7305410
	Nigeria	2094633	862.8	1807284
	Dominican Republic	9767	85633.1	836360.5
	Mali	55506	11818	655971.2
	Guinea	47514	11991.2	569749
	Pakistan	27310	11215.5	306294
	Sudan	27234	11156.3	303831.1
	Niger	108673	1844.6	200458.3
	Côte d'Ivoire	63878	2837.8	181276
	Egypt	6872	14639.7	100610.1
	Bangladesh	12654	7829.9	99079
	Benin	23000	3908	89883.31
	Sierra Leone	26265	3209.1	84287.4
	Cameroon	32016	2352.3	75308.81
	Sri Lanka	7907	9184.6	72623
	Malaysia	3854	18213.3	70202.62
	Ghana	3069	21875.4	67128.03
	Iraq	5753	8163.9	46969
	United Republic of Tanzania	9690	4531.4	43910.11
	Mexico	3770	9368.1	35320.11
Other African countries	Burkina Faso	3119	7649	23859.29
	Senegal	597	38452.8	22969
	Kenya	1447	15277.1	22106
	Zimbabwe	3534	5004.5	17686.37
	Malawi	1442	1993.7	2874.55
	Congo	521	3007.9	1565.73
	Djibouti	4	7191.9	30.34
	Gabon	17	1197.9	20.36

Source: FAO (2026).

Table A2. Earlier reviews dealing partially with okra in Africa.

Review	Publication date	Review type	Geographical coverage	Thematic focus
Mativavarira et al. (2024)	October 2024	Narrative review	Eastern Africa (Kenya and Tanzania) and Southern Africa (Malawi, Zambia, and Zimbabwe)	Regulations in the vegetable seed sector and implications for African indigenous vegetables (AIVs)
Kodzwa et al. (2023)	October 2023	Narrative review	Sub-Saharan Africa, with a focus on Zimbabwe	Production of AIVs
Phoswa and Mokgalaboni (2023)	September 2023	Narrative review	Global	Effects of amaranth and okra on markers of oxidative stress in diabetes mellitus
Fakudze et al. (2023)	August 2023	Systematic review	Global	African medicinal fruits
Ofuya et al. (2023)	February 2023	Narrative review	Nigeria	Insect pest management in vegetable crop production
Sereno et al. (2022)	November 2022	Systematic review	Global	Effects of okra on glycemic markers
Mkhabela et al. (2022)	March 2022	Narrative review	Global	Phenotypic and genotypic divergence in okra
Ratnadass et al. (2021)	August 2021	Narrative review	Global	Natural regulation of pests and diseases under crop diversification
Kung et al. (2014)	June 2014	Systematic review	Africa	Food allergies
Ratnadass et al. (2011a)	2011	Narrative review	Global/tropics	Design of sustainable horticultural systems
Kumar et al. (2010)	2010	Narrative review	West and Central Africa	Potential and improvement of okra
Palada et al. (2008)	2008	Narrative review	Global/tropics	Horticultural crops in agroforestry systems and alley cropping
Olasantan (2007)	2007	Narrative review	Tropical Africa	Vegetable production
Olasantan (2001b)	March 2001	Narrative review	Nigeria	Tropical vegetables and spices
Atiri et al. (2000)	2000	Narrative review	West Africa	Effects of climate on plant virus epidemiology

Table A3. Studies on okra in Africa included in the systematic review.

Year	Number of documents	References
2025*	1	Mokgalabone et al. (2025)
2024	14	Abang et al. (2024); Adedoyin et al. (2024); Adeyemi et al. (2024); Baah et al. (2024); Birka et al. (2024); Egedigwe et al. (2024); Guedeungbe et al. (2024); Imoloame et al. (2024); Malhat et al. (2024); Mbah et al. (2024); Mbatchou et al. (2024); Mohammed et al. (2024); Tsopzong et al. (2024); Umoren et al. (2024)
2023	18	Anyaoha et al. (2023); Ayeni et al. (2023); Bakry and Fathipour (2023); Dimande et al. (2023); Irma et al. (2023); Ishola et al. (2023); Kenaw et al. (2023); Kobta et al. (2023); Kumi et al. (2023); Kushi et al. (2023a); Kushi et al. (2023b); Kushi et al. (2023c); Lutoti et al. (2023); Nchang et al. (2023); Obasi et al. (2023); Oladele et al. (2023); Onyeneke et al. (2023); Sheferie et al. (2023)
2022	17	Aasa et al. (2022); Abdel-Motaal et al. (2022); Ahmed et al. (2022); Akpor et al. (2022); Aliku et al. (2022); Borokini, Oladipo, Komolafe, and Ajongbolo (2022); Borokini, Oladipo, Komolafe, Ajongbolo, and Oladipo (2022) Ekoja and Pitan (2022); Ibitoye and Kolawole (2022); Mafulul et al. (2022); Mahmoudi et al. (2022); Makinde et al. (2022); Mohammed et al. (2022a); Mohammed et al. (2022b); Nkongho et al. (2022); Shehata et al. (2022); Woldetsadik et al. (2022)
2021	17	Abang et al. (2021); Aboyeji et al. (2021); Adelodun et al. (2021); Amiteye et al. (2021); Basha et al. (2021); Bighaghire et al. (2021); Clair-Caliot et al. (2021); Farsia Djidjonri et al. (2021); Frimpong et al. (2021); Komolafe et al. (2021); Magdy et al. (2021); Marrez et al. (2021); Olowokere et al. (2021); Osman et al. (2021); Owusu, Boakye-Gyasi, Agbenorhevi, et al. (2021); Owusu, Boakye-Gyasi, Entsie, et al. (2021); Temam et al. (2021)
2020	15	Abd El-Fattah et al. (2020); Adejumo et al. (2020); Agbaglo et al. (2020); Agbenorhevi et al. (2020); Anoliefo et al. (2020); Appiah et al. (2020); Gerrano et al. (2020); Leke et al. (2020); Meck et al. (2020); Murovhi et al. (2020); Obebe et al. (2020); Okonji et al. (2020); Omonkhua et al. (2020); Ouattara et al. (2020); Taffner et al. (2020)
2019	4	Ameh et al. (2019); Mkiga et al. (2019); Müller et al. (2019); Ugwu and Enweremadu (2019)
2018	3	Abang et al. (2018); Gemede et al. (2018); Kacholi and Sahu (2018)
2017	5	Aloui et al. (2017); Bayissa et al. (2017); Motis et al. (2017); Singh et al. (2017); Stenchly et al. (2017)
2016	3	Gemede et al. (2016); Hachi et al. (2016); Singh et al. (2016)
2015	7	Akoto et al. (2015); Amalu and Okon (2015); Danso et al. (2015); Dawoud and Sauerborn (2015); de Bon et al. (2015); Kehinde et al. (2015); Salau et al. (2015)
2014	9	Abang et al. (2014); Avicor et al. (2014); Bakasso et al. (2014); Dare et al. (2014); Olajide-Taiwo et al. (2014); Pasquini et al. (2014); Ratnadass et al. (2014); Salako et al. (2014); Sami et al., 2014)
2013	6	Essumang et al. (2013); Leke et al. (2013); Mohammed et al. (2013); Nkakini and Akor (2013); Ondo et al. (2013); Oshunsanya (2013)
2012	8	Akpan-Idiok et al. (2012); Makinde et al. (2012); Nwangburuka et al. (2012); Okeji et al. (2012); Olubode (2012); Olubode et al. (2012a); Olubode et al. (2012b); Uwah et al. (2012)
2011	10	Adewole and Ilesanmi (2011); Agahiu et al. (2011); Alegbejo et al. (2011); Awodoyin and Olubode (2011); Bayili et al. (2011); Echezona and Offordile (2011); Gungoosingh-Bunwaree et al. (2011); Nwangburuka et al. (2011); Ratnadass et al. (2011b); Woltering et al. (2011)
2010	3	Tiendrébéogo, Lefeuvre, et al. (2010); Tiendrébéogo, Traoré et al. (2010); Wammanda et al. (2010)
2009	9	Adekunle (2009); Adelakun et al. (2009); Atawodi et al. (2009); Dabiré-Binso et al. (2009); Dauda et al. (2009); Hell et al. (2009); Jacobsen et al. (2009); Kon et al. (2009); Uaboi-Egbenni et al. (2009)
2008	7	Aflakpui et al. (2008); Akande et al. (2008); Alegbejo et al. (2008); Avallone et al. (2008); Babatunde (2008); Olasantan and Salau (2008); Salem et al. (2008)
2007	8	Adigbo et al. (2007); Avallone et al. (2007); Chadha and Olouch (2007); Chadha et al. (2007); Muoneke and Mbah (2007); Njoku et al. (2007); Odeleye et al. (2007); Olabode et al. (2007)
2006	5	Akinyele and Osekita (2006); Moyin-Jesu and Ojeniyi (2007); Nzikou et al. (2006); Pitan and Olatunde (2006); Sseruwagi et al. (2006)
2005	6	Adegbite et al. (2005); Aladesanwa (2005); Okon et al. (2005); Olasantan (2005); Omondi et al. (2005); Sseruwagi et al. (2005)
2004	2	Ndunguru and Rajabu (2004); Olasantan and Bello (2004)
2003	1	Dwomoh and Boakye (2003)
2002	1	Sechser et al. (2002)
2001	3	Adeniyi (2001); Mertz et al. (2001); Olasantan (2001)
1999	1	Olasantan (1999)
1998	1	Olasantan (1998)
1996	1	Zaki (1996)
1995	1	Konaté et al. (1995)
1993	2	Adebanjo and Shopeju (1993); Waceke and Waudo (1993)
1992	5	Aiyelaagbe and Jolaoso (1992); Burban et al. (1992); Fapohunda (1992); Nguessan et al. (1992); Palada et al. (1992)
1991	5	Adejonwo et al. (1991); Ikeorgu (1991); Ikeorgu and Ezumah (1991); Muoneke and Udeogalanya (1991); Olasantan, 1991)
1990	1	Oladokun, 1990)

*As of 02 January 2025.

Table A4. Research on okra in Africa – evolution of research areas.

1990–1999 (17 Publications)	2000–2009 (42 Publications)	2010–2019 (59 Publications)	2020–2025 (76 Publications)
Agriculture (76.47%)	Agriculture (47.62%	Agriculture (47.46%)	Agriculture (31.58%)
Entomology (17.65%)	Food science technology (19.05%)	Entomology (18.64%)	Science technology Other topics (15.79%)
Forestry (17.65%)	Biotechnology Applied microbiology (14.29%)	Environmental sciences Ecology (11.86%)	Food science technology (14.47%)
Biotechnology Applied microbiology (5.88%)	Entomology (11.90%)	Plant sciences (11.86%)	Plant sciences (10.53%)
Environmental sciences Ecology (5.88%)	Nutrition dietetics (7.14%)	Food science technology (10.17%)	Environmental sciences Ecology (7.89%)
Zoology (5.88%)	Plant sciences (7.14%)	Chemistry (6.78%)	Chemistry (6.56%)
	Chemistry (4.76%)	Biotechnology Applied microbiology (5.08%)	Entomology (5.26%)
	Area studies (2.38%)	Science technology Other topics (5.08%)	Life sciences Biomedicine Other topics (3.95%)
	Microbiology (2.38%)	Water resources (5.08%)	Microbiology (2.63%)
	Pharmacology Pharmacy (2.38%)	Microbiology (3.39%)	Nutrition dietetics (2.63%)

N.B. Only the top ten research areas in each decade are reported in the table.