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Review

Impacts of the COVID-19 Pandemic on Agri-Food Systems in West Africa

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Abstract: A growing body of evidence suggests that the COVID-19 pandemic affected not only the functioning of food supply chains but also the performance and outcomes of agri-food systems. In this context, this paper analyses the scholarly literature dealing with the impacts of the pandemic on West African agriculture and food systems. A search carried out on the Web of Science in March 2023 returned 176 records and 87 eligible documents were included in the systematic review. The bibliometric analysis suggests a decreasing interest in the research field. Moreover, a large share of the eligible articles are authored by researchers based outside West Africa. There is a research gap, especially in Cabo Verde, Ivory Coast, Gambia, Guinea, Guinea-Bissau, Mauritania, Niger and Togo. Studies focus on the crop production subsector and consumption stage. The pandemic affected all four dimensions/pillars of food security (viz. availability, access, utilisation/use, and stability). However, most of the analysed documents focus on food access (economic accessibility and physical accessibility). Moreover, COVID-19 affected all the dimensions of agri-food systems (viz. environmental, economic, social, and political) but the analysed articles focus on the pandemic's socio-economic impacts, especially those relating to food security and health. The promotion of research on the impacts of the pandemic on agri-food systems in West Africa is paramount to designing the evidence-based policies needed to improve the preparedness of the region for current and future crises and shocks.

Keywords: bibliometrics; coronavirus; food security; nutrition; sustainable agriculture; sustainable food system; resilience; Sahel; sub-Saharan Africa

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1. Introduction

In March 2020, the World Health Organization (WHO) declared the coronavirus disease 2019 (COVID-19) a pandemic [1]. As of March 2023, COVID-19 affected all countries, with more than 759 million confirmed cases and causing more than 6 million deaths [2]. Beyond its health impacts, COVID-19 triggered an unparalleled global crisis with multidimensional impacts [3–5]. Indeed, the pandemic triggered a global economic and financial crisis, with increasing rates of unemployment and poverty [6]. Therefore, the pandemic is likely to jeopardise the implementation of the 2030 Agenda for Sustainable Development and the achievement of the Sustainable Development Goals (SDGs) [7]. Furthermore,

the pandemic triggered disruptive impacts on the global agri-food system [5,8–14]. The COVID-19 pandemic affected different components and elements of the agri-food system such as agricultural production and food supply, food distribution and food environments, food-related consumer behaviour, food consumption patterns and diets [15–21], with implications in terms of food and nutrition security [15,19]. Indeed, the strong virus containment measures (e.g., lockdowns, home confinements, and social distancing), enforced by governments and authorities across the globe, resulted in a food emergency [12,22]. The impacts were recorded not only in developing countries but also in developed ones. For instance, referring to the context of the United States, Fleischhacker et al. [19] posit that "*The coronavirus disease 2019 (COVID-19) outbreak has further laid bare these strains, including food insecurity, major diet-related comorbidities for poor outcomes from COVID-19 such as diabetes, hypertension, and obesity, and insufficient surveillance on and coordination of our food system*" (p. 721). Impacts regard all the dimensions/pillars of food security (viz. availability, access, utilisation/use, and stability) and have been particularly severe in low- and middle-income countries [23].

Indeed, growing evidence shows that not only the propagation of the virus and the deaths it caused but also its impacts varied from one country to another [24–29]. In this respect, West Africa, which is one of the poorest regions in the world that is still highly reliant on agriculture and where food insecurity was a challenge even before the pandemic, is a particularly interesting case study. The confirmed cases of COVID-19, as well as the deaths, have been rather low in West Africa (Table 1). This low rate of infection in West Africa, in particular, and sub-Saharan Africa, in general, was attributed, among others, to the young age of the population and plant-based diets [30], which boost the immune system. However, also the number of doses administered and vaccinated people have been low across the region.

Table 1. COVID-19 pandemic in West Africa.

Country	Confirmed Cases *	Deaths *	Vaccine Doses Administered *	Population (Thousands, 2021)
Benin	27,999	163	4,232,541	12,996.90
Burkina Faso	22,056	396	5,856,003	22,100.68
Cabo Verde/Cape Verde	63,244	413	859,940	587.92
Côte d'Ivoire/Ivory Coast	88,208	834	25,263,932	27,478.25
Gambia	12,598	372	1,444,492	2639.92
Ghana	171,172	1462	22,384,226	32,833.03
Guinea	38,267	467	10,624,849	13,531.91
Guinea-Bissau	8960	176	593,508	2060.72
Liberia	8090	294	4,460,668	5193.42
Mali	33,051	743	4,916,568	21,904.98
Mauritania	63,439	997	4,068,530	4614.97
Niger	9513	315	7,241,942	25,252.72
Nigeria	266,598	3155	111,985,403	213,401.32
Senegal	88,921	1971	2,929,547	16,876.72
Sierra Leone	7760	125	7,009,905	8420.64
Togo	39,382	290	3,398,445	8644.83
Source	WHO [2]		World Bank [31]	

* As of 7 March 2023.

The pandemic had far-reaching impacts on the economies and livelihoods in developing countries of Western Africa, e.g., Nigeria [32], Ghana [33], and Burkina Faso [34]. The pandemic also disrupted trade with Africa [35], with implications in terms of food security. Indeed, Vasseur et al. [36] suggest that restrictive measures in the West African countries affected all four pillars/dimensions of food security (viz. availability, access, utilisation/use, and stability) and point out that the "*region is highly vulnerable to such crises, which can combine their effects with those of other events such as climate change and civil unrest*".

Data referring to the pre-COVID-19 period (Table 2) show that agriculture had a high contribution to the gross domestic product (GDP) and employment in West African countries; the share of agriculture in GDP ranges from 4.6% in Cabo Verde to 58.2% in Sierra Leone versus 4.0% worldwide, whereas employment in agriculture ranges from 11% in

Cabo Verde to 73% in Niger vs. 27% globally. Meanwhile, food insecurity and malnutrition were big challenges in the region even before the pandemic. Indeed, the prevalence of undernourishment was high in the Western Africa region; it ranged from 5.1% in Mali to 37.5% in Liberia over the period 2017–2019. The situation was even more alarming when it came to the prevalence of moderate or severe food insecurity, which ranged from 37.7% in Côte d'Ivoire to 88.5% in Liberia over the same period. Regionwide, the prevalence of moderate or severe food insecurity increased from 50.8% in 2017–2019 to 57.0% in 2019–2021, which might have been due, among others, to the effects of the pandemic.

Table 2. Agriculture and food insecurity in West African countries.

Country	Agriculture, Forestry, and Fishing, Value Added (% of GDP)—2019	Employment in Agriculture (% of Total Employment)—2019	Prevalence of Undernourishment (% Population)		Prevalence of Moderate or Severe Food Insecurity (% Population)	
			2017–2019	2019–2021	2017–2019	2019–2021
Benin	26.9	38	7.4	7.4	n.a.	67.9
Burkina Faso	18.4	26	19.2	18.0	47.7	52.6
Cabo Verde	4.6	11	18.5	17.7	37.7	35.4
Côte d'Ivoire	20.7	40	19.9	4.4		42.8
Gambia	20.0	27	11.9	21.6	54.3	58.0
Ghana	17.3	30	6.5	4.1	51.1	36.6
Guinea	26.4	61	n.a.	n.a.	74.1	73.3
Guinea-Bissau	30.4	60	n.a.	31.7	n.a.	75.0
Liberia	36.4	43	37.5	38.3	88.5	80.6
Mali	37.3	62	5.1	9.8	n.a.	n.a.
Mauritania	21.7	31	11.9	10.1	44.8	45.3
Niger	36.9	73	n.a.	19.8		n.a.
Nigeria	21.9	35	12.6	12.7	44.1	58.5
Senegal	14.9	30	9.4	7.5	40.7	49.2
Sierra Leone	58.2	54	26.0	27.4	81.4	86.7
Togo	19.8	32	20.7	18.8		62.5
Source	World Bank [31]		FAO [14]	FAO et al. [14]	FAO [14]	FAO et al. [14]

n.a. No available data

Some previous reviews dealt with the COVID-19 pandemic in West Africa. However, most of them regarded only the efficacy of medicinal plants against the virus [37–39]. Other reviews touched upon food insecurity and malnutrition, but they did not cover the whole region and are not recent, e.g., VanVolkenburg et al. [40] published in February 2022, and Vasseur et al. [36] published in November 2021. Others do not have a specific focus on the COVID-19 pandemic, e.g., Adeyeye et al. [41], who published in July 2021, or do not focus on the food-related impacts of the pandemic, e.g., Losso et al. [30], who published in September 2021, and Chackalackal et al. [42], who published in October 2021. Therefore, there is so far no recent review that sheds in a comprehensive way light on the research relating the pandemic to food and agriculture in the whole of West Africa. To bridge this gap, this systematic review analyses the effects of the COVID-19 pandemic on agriculture and food systems in West African countries. In particular, it investigates the bibliometrics and geography of the research field and explores how it addresses key topics such as food security pillars and sustainability dimensions.

2. Methods

The present article draws upon a systematic review that follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [43,44]. A search was performed on 2 March 2023, considering all the databases of the Web of Science (WoS), viz. Web of Science Core Collection, Current Contents Connect, SCiELO Citation Index and MEDLINE. The search was carried out using the following string: *("COVID-19" OR COVID19 OR Coronavirus OR "SARS-CoV-2") AND ("agricultur*" OR agro OR food) AND ("West* Africa" OR Sahel OR Benin OR Burkina OR "Cape Verde" OR "Cabo Verde" OR Gambia OR Ghana OR Guinea OR "Guinea-Bissau" OR "Ivory Coast" OR "*Côte d'Ivoire*" OR Liberia OR Mali OR Mauritania OR Niger OR Nigeria OR Senegal OR "Sierra Leone" OR Togo)*. It returned 176 potentially eligible documents. The selection of eligible documents was informed by the methodology adopted by El Bilali [45] and El Bilali et al. [46]. The selection steps and process are described in Table 3. In particular, three eligibility crite-

ria were considered: geographical coverage (viz., the document addresses at least one West African country); thematic focus (viz., the document addresses *both* COVID-19 and agriculture/food); and document type (viz., only research articles/papers, book chapters or conference papers were included; editorials, letters to editors, commentaries and/or notes, as well as reviews, were discarded). Only documents meeting all three criteria were assessed as eligible and included in the systematic review.

Table 3. Eligible articles selection steps and process.

Selection Step	Number of Documents Selected	Number of Documents Excluded and Reasons for Exclusion
Search on WoS	176	No duplicate
Screening of records based on titles	176	7 documents were discarded because they deal with countries outside West Africa, e.g., Kenya, Malawi, Namibia, Papua New Guinea, Sao Tome and Principe, Tanzania, and Uganda
Screening of records based on abstracts	169	74 documents excluded: • 10 documents not dealing with West Africa/West African countries • 14 documents not dealing with COVID-19 • 34 documents not addressing agri-food systems • 4 documents without abstracts • 12 editorial materials
Scrutiny of full texts	95	8 documents excluded: • 1 document not dealing with West Africa • 7 reviews
Confirmation of eligibility and inclusion in the systematic review	87	

Following the screening of the document titles, seven documents were considered ineligible as they do not refer to West Africa; documents covering larger geographical areas (e.g., Sahel, and Sub-Saharan Africa), as well as those where the geographical focus was not indicated in the title, were kept for further analysis in the following steps. Further, 74 documents were excluded following the analysis of abstracts as they do not meet at least one of the inclusion criteria. For instance, some documents refer to *Aspergillus niger*, a fungus, or *Hyoscyamus niger* L., a plant, which have nothing to do with 'Niger' the country. Furthermore, 'Guinea' refers sometimes to Guinea pigs, used in vaccine tests, Equatorial Guinea or Papua New Guinea rather than the two Western African countries (viz., Guinea and Guinea-Bissau). Similarly, Senegal refers sometimes to plants such as *Acacia senegal*. Other documents deal with the Ebola virus and provide only in the end some general recommendations regarding COVID-19. Documents that analyse the health effects of COVID-19 without any reference to food were excluded as well. Likewise, studies describing in vitro tests of the efficacy of some plant-based treatments on the virus were discarded, while those describing the relationships between food intake and the immune system were included. Moreover, eight ineligible documents were discarded following the scrutiny of the full texts, and these included seven reviews [30,36,37,39–42].

Accordingly, 87 documents that resulted were eligible and were included in the systematic review (Table 4), consisting of only articles, without book chapters or proceeding papers.

Table 4. List of the selected articles.

Year	Number of Documents	References
2023 *	4	Agyei-Holmes et al. [47]; Balana et al. [48]; Bamidele et al. [49]; Jha et al. [50]
2022	28	Aberese-Ako et al. [51]; Aggarwal et al. [52]; Amoako et al. [53]; Asante et al. [54]; Bamiwuye et al. [55]; Bukari et al. [56]; Dasgupta and Robinson [57]; Folayan et al. [58]; Folorunso et al. [59]; Gligorić et al. [60]; Iheme et al. [61]; Kuuwill et al. [62]; Lamontagne et al. [63]; Martey et al. [64]; Middendorf et al. [65]; Mueller et al. [66]; Odebunmi et al. [67]; Omeje et al. [68]; Omidiji et al. [69]; Omotayo et al. [70]; Onyenweaku et al. [71]; Onyenweaku et al. [72]; Ouoba and Sawadogo [73]; Ragasa et al. [74]; Rudin-Rush et al. [75]; Tchuenchieu Kamgain et al. [76]; Traoré et al. [77]; Wrabel et al. [78]
2021	48	Abay et al. [79]; Adebayo and Oluwamayowa [80]; Adenubi et al. [81]; Adewopo et al. [82]; Adjognon et al. [83]; Agbawodikeizu et al. [84]; Agyei et al. [85]; Amare et al. [86]; Andrieu et al. [87]; Asante-Poku and van Huellen [88]; Ayande and Chilufya [89]; Baada et al. [90]; Bamidele and Amole [91]; Chiemela et al. [92]; Coulibaly [93]; Dasgupta and Robinson [94]; Davis et al. [95]; de Boef et al. [96]; Dear et al. [97]; Dugué et al. [98]; Eboreime et al. [99]; Egger et al. [100]; Ekoh et al. [101]; Folayan et al. [102]; Gummerson et al. [103]; Hemler et al. [104]; Houessou et al. [105]; Ilesanmi et al. [106]; Inegbedion [107]; Jha et al. [108]; Josephson et al. [109]; Kasim et al. [110]; Liverpool-Tasie et al. [111]; Madzorera et al. [112]; Mertens and Peñalvo [113]; Middendorf et al. [114]; Nchanji and Lutomia [115]; Nkrumah et al. [116]; Obayelu et al. [117]; Ogunji et al. [118]; Okonkwo et al. [119]; Saah et al. [120]; Ukaro Ofuoku et al. [121]; Vall et al. [122]; Van Hoyweghen et al. [123]; Wang et al. [124]; Yaw Codjoe et al. [125]; Yegbemey et al. [126]
2020	7	Afriyie et al. [127]; Arouna et al. [128]; Buonsenso et al. [129]; Igwe et al. [130]; Kinda et al. [34]; Okyere et al. [131]; Zidouemba et al. [132]

* As of 2 March 2023.

The analysis of the selected documents was related to both the bibliometrics and topics addressed. Actually, the analysis focused on bibliographical metrics, research geography, agriculture subsectors, food chain stages, food security pillars, and sustainability dimensions (Table 5).

Table 5. Analyses undergone by the eligible documents.

Item	Description	Used Method References
Bibliographical metrics	Sources/journals, research areas, authors, affiliation institutions/organisations, and countries	El Bilali [45] and El Bilali et al. [46]
Research geography	West African countries where studies were performed	El Bilali [45] and El Bilali et al. [46]
Agriculture subsectors	Crop production (and main crops addressed), animal production/pastoralism, and fisheries/aquaculture	El Bilali [45] and El Bilali et al. [46]
Food chain stages	Production, processing, distribution/retail/marketing, consumption, and waste management	El Bilali [45] and El Bilali et al. [46]
Food security	Food security dimensions/pillars: availability, access, utilisation/use, and stability	El Bilali [133] and El Bilali [45]
Sustainability	Sustainability dimensions: environment, economy, society, and policy and governance	El Bilali et al. [13]

The limitations of this systematic review are similar to those pointed out by the authors whose methods were applied, viz. El Bilali [45], El Bilali et al. [46], El Bilali [133] and El Bilali et al. [13]. They relate to the choice of the search terms/keywords as well as the use of the Web of Science database for the search, which implies that the article includes

only publications indexed in WoS. This, in turn, means that the paper includes neither articles published in journals that are not indexed in WoS nor the so-called grey literature (e.g., reports).

3. Results and Discussion

3.1. Bibliometrics and Research Geography

The analysis of the selected documents suggests that there was a time lag between the outbreak of the disease and the publication of the results of the first studies on the impacts of the pandemic on agri-food systems in West Africa; the first article indexed in WoS [34] dates back to August 2020. The *annual output* of articles is quite high but the peak of the number of publications in 2021 (48 articles) might suggest that interest in the research field is decreasing across the region.

Regarding the *sources* (Table 6), the analysis shows that the maximum number of articles was published in *PLoS ONE* (5 articles), *Agricultural Systems* (4 articles), *American Journal of Tropical Medicine and Hygiene*, *Food Policy*, *Global Food Security: Agriculture Policy, Economics and Environment*, *International Journal of Environmental Research and Public Health*, and *Sustainability* (3 articles each). Nevertheless, the findings of the research on the impacts of the pandemic on agri-food systems in West Africa were published in 63 further sources and journals, which shows that there is no prominent publication outlet. The majority of the selected articles fall under the *research areas* of *agriculture* (21 articles, 24.1%), *science technology* (15 articles, 17.2%), *occupational health* (13 articles, 14.9%), *business economics* and *food science technology* (10 articles, 11.5%, each), and *environmental sciences—ecology* (9 articles, 10.3%). However, the selected 87 articles can be categorised under 34 research areas (e.g., development studies, infectious diseases, nutrition dietetics, sociology, tropical medicine, geography, plant sciences, psychology, anthropology, and behavioural sciences), which implies that the research field is multidisciplinary.

Table 6. Metrics of research on the impacts of the pandemic on agri-food systems in West Africa: top ten sources/journals, research areas, authors, affiliation countries/regions and affiliation institutions.

Journals (a *)	Research Areas (b *)	Authors (c *)	Affiliation Countries/Regions (d *)	Affiliation Institutions (e *)
PLoS ONE (5)	Agriculture (21)	Jha P.K. (4)	Nigeria (30)	CGIAR (10)
Agricultural Systems (4)	Science technology (15)	Middendorf B.J. (4)	USA (28)	University of Ibadan (7)
American Journal of Tropical Medicine and Hygiene (3)	Occupational health (13)	Prasad P.V.V. (4)	Ghana (16)	University of Nigeria (7)
Food Policy (3)	Business Economics (10)	Assefa N. (3)	Burkina Faso (11)	University of Cape Coast (5)
Global Food Security: Agriculture Policy, Economics and Environment (3)	Food science technology (10)	Berhane Y. (3)	England (9)	University of Ghana (5)
International Journal of Environmental Research and Public Health (3)	Environmental sciences—Ecology (9)	Chukwu A. (3)	South Africa (8)	University of London (5)
Sustainability (3)	Development studies (6)	Fawzi W.W. (3)	Kenya (7)	*Centre de coopération internationale en recherche agronomique pour le développement*—CIRAD (4)
African Development Review—Revue Africaine de Développement (2)	Infectious diseases (6)	Faye A. (3)	Canada (6)	Harvard University (4)
Applied Economic Perspectives and Policy (2)	Nutrition dietetics (6)	Folayan M.O. (3)	Netherlands (6)	Kansas State University (4)
Cahiers Agricultures, Heliyon, Scientific African, Scientific Papers Series, Scientific Reports (2)	Sociology (3)	Hemler E.C., Korte M.L., Lankoande B., Middendorf G., Oduola A., Sie A., Wang D.Q., Workneh F. (3)	Ethiopia, France, Senegal (5)	Obafemi Awolowo University, *Universite de Montpellier* (4)

* Numbers in brackets indicate the number of articles.

The bibliometric analysis indicates that the most prominent, productive *authors* in the research field are Prakash Kumar Jha, Jan B. Middendorf and Vara P. V. Prasad (four articles

each). However, the fact that the 87 eligible articles were authored by 482 scholars, which implies that the majority of the concerned scholars authored only one paper, shows, on the one side, that there is an extended collaboration in the research field and, on the other side, that this is rather expected given that the research strand is rather young.

The analysis of *countries* and *affiliations* shows that the list of the most active countries is dominated by Nigeria (30 articles, 34.5%) and the USA (28 articles, 32.2%) followed by Ghana (16 articles, 18.4%) and Burkina Faso (11 articles, 12.6%). The list of the top ten affiliation countries includes only four West African countries (viz., Nigeria, Ghana, Burkina Faso, Senegal), while the remaining countries are from outside the region (viz., USA, England, South Africa, Kenya, Canada, Netherlands, Ethiopia, and France). The 87 eligible articles were authored by scholars and researchers from 51 countries. Apart from Nigeria, Ghana, and Burkina Faso, affiliation countries from West Africa also included Senegal (four articles), and Benin and Cote d'Ivoire (two articles each).

Nevertheless, a large share of the eligible articles is authored by researchers based outside West Africa, either in Africa (e.g., Cameroon, Egypt, Ethiopia, Kenya, South Africa, and Tanzania), Asia (e.g., China), Europe (e.g., Belgium, England, France, Germany, Hungary, Italy, Netherlands, Sweden, and Switzerland), North America (e.g., Canada and the USA), or Oceania (e.g., Australia). In fact, it comes as no surprise that the most important funding agencies are based outside West Africa, especially in the USA (e.g., United States Agency for International Development—USAID, United States Department of Health, Harvard T. H. Chan School of Public Health, and National Institutes of Health—NIH) or international foundations (e.g., Bill and Melinda Gates Foundation) and organisations (Consultative Group on International Agricultural Research—CGIAR).

Concerning *affiliation institutions*, the 87 selected articles were authored by researchers from 266 universities and research centres, which suggests a strong collaboration. The most prominent institutions in the research field are CGIAR (10 articles, 11.5%), the University of Ibadan and the University of Nigeria (7 articles, 8.0%, each), and the University of Cape Coast (Ghana), the University of Ghana and the University of London (5 articles, 5.7%, each). Apart from the above-cited ones, prominent West African institutions are located in Nigeria (e.g., Obafemi Awolowo University, Alex Ekwueme Federal University, Ebonyi State University, Federal University of Technology Owerri, Nigerian Institute of Medical Research, and Nnamdi Azikiwe University), Ghana (e.g., Kwame Nkrumah University of Science and Technology), Burkina Faso (e.g., University of Ouagadougou, Nouna Health Research Centre) and Senegal (e.g., Senegalese Agricultural Research Institute—ISRA).

The analysis of the *geography of the research field* shows that there are considerable differences among West African countries (Table 7). In fact, the lion's share of studies on the impacts of the pandemic on agri-food systems were carried out in Nigeria; 50 articles (so 57.5% of the selected documents) deal with Nigeria either alone (31 articles) or with other countries (19 articles). This result is somehow expected since Nigeria is the largest and most populous country in the region. Research in this field was also performed in Ghana (15 articles), Burkina Faso (6 articles), Senegal (3 articles), and Benin, Liberia, Mali, and Sierra Leone (1 article each). Meanwhile, no article deals specifically with the impacts of the pandemic in many West African countries, viz. Cape Verde, Ivory Coast, Gambia, Guinea, Guinea-Bissau, Mauritania, Niger, and Togo. This suggests a huge gap in this research field in the concerned countries. However, some of these West African countries are mentioned in studies dealing with the impacts of the COVID-19 on prices of sorghum, maize and rice in Africa, viz. Benin, Burkina Faso, Cabo Verde, Ghana, Guinea, Ivory Coast, Liberia, Mauritania, Mali, Nigeria, Niger, Senegal, Sierra Leone, and Togo [85], the living standards during the pandemic, viz. Burkina Faso, Ghana, and Sierra Leone [100], the burden of malnutrition during the pandemic viz. Burkina Faso, Liberia, Mali, and Niger [113], or policy options to mitigate the pandemic's impacts on rice value chains, viz. Benin, Burkina Faso, Ivory Coast, Ghana, Guinea-Bissau, Guinea, Liberia, Mali, Mauritania, Nigeria, Niger, Sierra Leone, Senegal, Gambia, and Togo [128].

Table 7. Geography of research on the impacts of the COVID-19 pandemic on agriculture and food systems in Western Africa.

Country or Region (Articles Number)	Documents
Benin (1)	Houessou et al. [105]
Burkina Faso (6)	Dugué et al. [98]; Kinda et al. [34]; Middendorf et al. [65]; Ouoba and Sawadogo [73]; Traoré et al. [77]; Zidouemba et al. [132]
Ghana (15)	Aberese-Ako et al. [51]; Afriyie et al. [127]; Agyei-Holmes et al. [47]; Amoako et al. [53]; Asante et al. [54]; Asante-Poku and van Huellen [88]; Baada et al. [90]; Bukari et al. [56]; Kuuwill et al. [62]; Martey et al. [64]; Nkrumah et al. [116]; Okyere et al. [131]; Ragasa et al. [74]; Saah et al. [120]; Yaw Codjoe et al. [125]
Liberia (1)	Davis et al. [95]
Mali (1)	Adjognon et al. [83]
Nigeria (31)	Abay et al. [79]; Adebayo and Oluwamayowa [80]; Adenubi et al. [81]; Adewopo et al. [82]; Agbawodikeizu et al. [84]; Amare et al. [86]; Balana et al. [48]; Bamidele and Amole [91]; Bamidele et al. [49]; Bamiwuye et al. [55]; Chiemela et al. [92]; Ekoh et al. [101]; Folayan et al. [102]; Folayan et al. [58]; Folorunso et al. [59]; Igwe et al. [130]; Iheme et al. [61]; Ilesanmi et al. [106]; Inegbedion [107]; Lamontagne et al. [63]; Liverpool-Tasie et al. [111]; Obayelu et al. [117]; Odebunmi et al. [67]; Ogunji et al. [118]; Okonkwo et al. [119]; Omeje et al. [68]; Omidiji et al. [69]; Omotayo et al. [70]; Onyenweaku et al. [71]; Ukaro Ofuoku et al. [121]; Yegbemey et al. [126]
Senegal (3)	Jha et al. [50]; Middendorf et al. [114]; Van Hoyweghen et al. [123]
Sierra Leone (1)	Buonsenso et al. [129]
West Africa * (3)	Arouna et al. [128]—Burkina Faso, Benin, Cote d'Ivoire, Ghana, Guinea-Bissau, Guinea, Liberia, Mali, Mauritania, Niger, Nigeria, Sierra Leone, Senegal, Gambia, and Togo; Coulibaly [93]—Benin, Burkina Faso, Guinea-Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo; Jha et al. [108]—Senegal and Burkina Faso
Sub-Saharan Africa ** (16)	Aggarwal et al. [52]—Liberia and Malawi; Ayande and Chilufya [89]—Ghana and Zambia; Dasgupta and Robinson [94]—Chad, Djibouti, Ethiopia, Kenya, Mali, Malawi, Nigeria, South Africa and Uganda; Dear et al. [97]—Kenya, Nigeria, Tanzania, Uganda; Eboreime et al. [99]—Botswana, Kenya, Malawi, Nigeria, Tanzania, Zambia and Zimbabwe; Gummerson et al. [103]—Kenya and Burkina Faso, Democratic Republic of Congo (RDC) and Nigeria; Hemler et al. [104]—Burkina Faso, Ethiopia, and Nigeria; Josephson et al. [109]— Malawi, Ethiopia, Nigeria and Uganda; Madzorera et al. [112]—Burkina Faso, Ethiopia and Nigeria; Mueller et al. [66]—Bangladesh, Kenya and Nigeria; Nchanji and Lutomia [115]—Burkina Faso, Burundi, Cameroon, Eswatini, Kenya, Lesotho, Madagascar, Tanzania, Uganda, Zambia, and Zimbabwe; Onyenweaku et al. [72]—South Africa, Cameroon, Nigeria, Ghana, Ethiopia, and Kenya; Rudin-Rush et al. [75]—Burkina Faso, Ethiopia, Malawi, and Nigeria; Tchuenchieu Kamgain et al. [76]—Cameroon, Ethiopia, Ghana, Kenya, Nigeria, and South Africa; Vall et al. [122]—Burkina Faso, Kenya, Madagascar, and Senegal; Wang et al. [124]—Burkina Faso, Ethiopia, and Nigeria
Global *** (9)	Agyei et al. [85]—Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Chad, DRC, Ethiopia, Ghana, Guinea, Ivory Coast, Liberia, Malawi, Mali, Mauritania, Morocco, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, and Zimbabwe; Andrieu et al. [87]—Burkina Faso, Colombia, and France; Dasgupta and Robinson [57]—Armenia, Cambodia, Chad, Djibouti, Ethiopia, Kenya, Malawi, Mali, Nigeria, South Africa, and Uganda; de Boef et al. [96]—Ethiopia, Myanmar, Nigeria, and Uganda; Gligorić et al. [60]—Australia, Brazil, Canada, Denmark, Egypt, France, Germany, Italy, Indonesia, India, Japan, Kenya, Mexico, Nigeria, Sweden, Spain, United Kingdom, and the United States; Kasim et al. [110]—Guyana and Nigeria; Wrabel et al. [78]—Bangladesh, DRC, Ethiopia, India, Jordan, Kenya, Malawi, Myanmar, Nepal, Nigeria, Pakistan, Philippines, Somalia, South Sudan, Tanzania, Uganda and Yemen; Egger et al. [100]—Bangladesh, Burkina Faso, Colombia, Ghana, Kenya, Nepal, Philippines, Rwanda and Sierra Leone; Mertens and Peñalvo [113], e.g., Angola, Burkina Faso, Chad, Liberia, Mali, Niger, Sudan, and Tanzania, Yemen, and Guyana

* Includes articles addressing at least two Western African countries. ** Includes articles dealing with at least another sub-African country outside West Africa. *** Includes articles covering at least a country outside sub-Saharan Africa.

Moreover, there is no single study that analyses the impacts of the pandemic on agri-food systems in the whole West Africa region but there are some multi-country studies. For instance, Coulibaly [93] assesses the impacts of government policy responses to the COVID-19 pandemic in the West African Economic and Monetary Union (viz. Benin, Burkina Faso, Guinea-Bissau, Ivory Coast, Mali, Niger, Senegal, and Togo) and their spillover effects on the consumer price index. Jha et al. [108] evaluate the impact of the pandemic on the sown area and yields of the major cereals (viz. rice, sorghum maize, and millet) in Burkina Faso and Senegal.

Some studies focus on sub-Saharan Africa, including countries from West Africa. For instance, Onyenweaku et al. [72] analyse the special foods and drinks that were consumed to boost the immune system and prevent COVID-19 during the lockdown in numerous countries in sub-Saharan Africa (viz. Cameroon, Nigeria, Ghana, Ethiopia, Kenya, and South Africa). Rudin-Rush et al. [75] document trends in food insecurity during 2020, the first year of the COVID-19 pandemic, in four sub-Saharan African countries, namely Burkina Faso, Ethiopia, Malawi, and Nigeria.

Other studies are rather global, dealing with countries from different continents; for instance, Wrabel et al. [78] document the operational experiences and lessons learned by nutrition practitioners dealing with the screening of acute malnutrition and its treatment during the COVID-19 pandemic in 17 developing countries from Africa (viz., Democratic Republic of Congo, Ethiopia, Nigeria, Kenya, Malawi, Somalia, South Sudan, Tanzania, and Uganda) and Asia (viz. Bangladesh, India, Jordan, Myanmar, Nepal, Pakistan, Philippines, and Yemen). Meanwhile, Gligorić et al. [60] analyse population-wide shifts in dietary interests in 18 developed and developing countries from Africa (viz., Egypt, Kenya, and Nigeria), Americas (viz., Brazil, Canada, Mexico, and the United States), Asia (viz., India, Indonesia, and Japan), Europe (viz., Denmark, France, Germany, Italy, Spain, Sweden, and the United Kingdom), and Oceania (viz., Australia).

3.2. Agriculture Subsectors and Food Chain Stages

As for the *agriculture subsectors*, most of the selected articles do not refer to any specific subsector. This is particularly the case of studies that deal with trends in consumption as well as changes in food consumption patterns and diets during the pandemic. Articles dealing with a specific subsector generally address crop production whereas animal production/livestock and fisheries/aquaculture are generally overlooked (Table 8). As for crop production, the crops analysed include rice [68,128], vegetables [65,123,126], cereals [85,108], beans/pulses [115], and aromatic and medicinal plants [67]. For instance, Martey et al. [64] analyse how the perceptions of the shocks related to the COVID-19 pandemic affected the acceptance and adoption of sustainable agricultural practices (e.g., zero tillage, mixed cropping, and mulching) among Ghanaian farmers. In the case of animal production, studies regard poultry [49,91] and dairy cattle [122]. For instance, Vall et al. [122] analyse the immediate effects of COVID-19 on the dairy sector in Burkina Faso, Kenya, Madagascar, and Senegal. Only a few articles deal with fisheries and aquaculture [74,131]. For instance, Ragasa et al. [74] shed light on the development and resilience of pond aquaculture in Ghana during the pandemic.

Table 8. Agriculture subsectors.

Agriculture Subsector	Examples of Articles
Crop production	Agyei et al. [85]; Andrieu et al. [87]; Arouna et al. [128]; de Boef et al. [96]; Houessou et al. [105]; Jha et al. [108]; Martey et al. [64]; Middendorf et al. [114]; Middendorf et al. [65]; Nchanji and Lutomia [115]; Odebunmi et al. [67]; Omeje et al. [68]; Van Hoyweghen et al. [123]; Yegbemey et al. [126]
Animal production	Bamidele et al. [91]; Bamidele et al. [49]; Middendorf et al. [114]; Vall et al. [122]
Fisheries/aquaculture	Okyere et al. [131]; Ragasa et al. [74]

Concerning the *food chain stages*, the analysis suggests that the pandemic affected the whole food chain from input procurement to food waste management through production, processing, transport and distribution, and consumption. Nevertheless, most of the selected documents deal with the downstream stages of the food chain (e.g., consumption), while the upstream stages (e.g., production) and, especially, intermediate stages (e.g., processing and packing) are often overlooked (Table 9). Indeed, most of the scientific literature addresses the impacts of the pandemic on food consumption patterns, diets and food security (especially access to food) in West Africa.

Table 9. Food chain stages.

Food Chain Stage *	Articles
Production	Agyei-Holmes et al. [47]; Andrieu et al. [87]; Arouna et al. [128]; Bamidele et al. [49]; Chiemela et al. [92]; de Boef et al. [96]; Dugué et al. [98]; Houessou et al. [105]; Ilesanmi et al. [106]; Jha et al. [108]; Jha et al. [50]; Kinda et al. [34]; Kuuwill et al. [62]; Martey et al. [64]; Middendorf et al. [114]; Middendorf et al. [65]; Nchanji and Lutomia [115]; Obayelu et al. [117]; Okyere et al. [131]; Omeje et al. [68]; Ragasa et al. [74]; Ukaro Ofuoku et al. [121]; Vall et al. [122]; Van Hoyweghen et al. [123]; Yegbemey et al. [126]
Processing	Vall et al. [122]; Yegbemey et al. [126]
Marketing and distribution/retail	Adewopo et al. [82]; Aggarwal et al. [52]; Agyei et al. [85]; Asante-Poku and van Huellen [88]; Coulibaly [93]; Iheme et al. [61]; Ilesanmi et al. [106]; Middendorf et al. [65]; Ogunji et al. [118]; Vall et al. [122]; Van Hoyweghen et al. [123]; Yaw Codjoe et al. [125]
Consumption (including food waste)	Abay et al. [79]; Aberese-Ako et al. [51]; Adebayo and Oluwamayowa [80]; Adenubi et al. [81]; Adewopo et al. [82]; Adjognon et al. [83]; Afriyie et al. [127]; Agbawodikeizu et al. [84]; Aggarwal et al. [52]; Agyei et al. [85]; Amare et al. [86]; Amoako et al. [53]; Arouna et al. [128]; Asante et al. [54]; Ayande and Chilufya [89]; Baada et al. [90]; Balana et al. [48]; Bamiwuye et al. [55]; Bukari et al. [56]; Buonsenso et al. [129]; Coulibaly [93]; Dasgupta and Robinson [94]; Dasgupta and Robinson [57]; Davis et al. [95]; Dear et al. [97]; Eboreime et al. [99]; Egger et al. [100]; Ekoh et al. [101]; Folayan et al. [102]; Folayan et al. [58]; Folorunso et al. [59]; Gligorić et al. [60]; Gummerson et al. [103]; Hemler et al. [104]; Houessou et al. [105]; Igwe et al. [130]; Iheme et al. [61]; Inegbedion [107]; Josephson et al. [109]; Kasim et al. [110]; Kinda et al. [34]; Lamontagne et al. [63]; Liverpool-Tasie et al. [111]; Madzorera et al. [112]; Mertens and Peñalvo [113]; Mueller et al. [66]; Nkrumah et al. [116]; Obayelu et al. [117]; Odebunmi et al. [67]; Ogunji et al. [118]; Okonkwo et al. [119]; Omidiji et al. [69]; Omotayo et al. [70]; Onyenweaku et al. [71]; Onyenweaku et al. [72]; Ouoba and Sawadogo [73]; Rudin-Rush et al. [75]; Saah et al. [120]; Tchuenchieu Kamgain et al. [76]; Traoré et al. [77]; Vall et al. [122]; Wang et al. [124]; Wrabel et al. [78]; Yaw Codjoe et al. [125]; Zidouemba et al. [132]

* Several articles address different stages of the food chain.

The pandemic made more difficult access to inputs, which affected negatively yield and production. Referring to smallholder farmers in Senegal, Jha et al. [50] stated that "*77.7% of respondents experienced a reduction in access to inputs, 70.3% experienced a reduction in ability to plant crops during the planting season, 57.1% experienced a reduction in ability to rent farm machinery, and 69.2% reported a reduction in yields*".

Only a few papers deal with processing and often in a marginal way. Vall et al. [122] suggest that milk processing costs increased during the pandemic in Burkina Faso, Kenya, Madagascar, and Senegal. Yegbemey et al. [126] report that vegetable farmers in North-Western Nigeria increased their own home processing during the pandemic, to cope with marketing difficulties.

The pandemic also affected access to markets and distribution of agri-food products. Referring to vegetable producers in Burkina Faso, Middendorf et al. [65] conclude that "*The survey results clearly show impacts of COVID-19 on vegetable systems, including a reduction in access to inputs, a reduction in yields, a loss of income, reduced access to local and urban markets, reduced access to transportation, and an increase in post-harvest loss*".

Many studies suggest that the pandemic affected negatively food consumption patterns and diets, especially during the period of lockdown [48,53]. However, other studies posit that attention to health and healthy diets, especially those presumed to boost the immune system, increased during the pandemic [59,60,67,72]. Further studies deal with food (in)security during the pandemic [66,94,112]. Others address the effects of the pandemic on waste; Kasim et al. [110] show that the generation of waste increased and its composition changed in Guyana and Nigeria.

Some articles take a more holistic, systemic approach, thus addressing different stages of the food chain. For instance, Vall et al. [122] assess the impacts of the COVID-19 outbreak as well as the containment measures on the production, collection, processing, marketing, and consumption of milk in four African countries (viz., Burkina Faso, Kenya, Madagascar, and Senegal).

3.3. Impacts on Food Security and Nutrition

The analysis of the scholarly literature suggests that the pandemic impacted all four dimensions/pillars of food security (viz., availability, access, utilisation/use and stability). However, the magnitude of the impacts changed from one dimension to another (Table 10). Indeed, most of the analysed documents focus on food access. Moreover, the results are in line with the review by Van Volkenburg et al. [40] who point out that "*Documents reporting on food security seldom included all four pillars (i.e., availability, access, utility, stability) in their analysis despite the reciprocal connection between them all*". The only exception is Obayelu et al. [117], who analyse the immediate and potential long-term effects of COVID-19 on agriculture production (cf., food availability), food access and dietary intake (cf., food utilisation) in Nigeria. The impacts of the pandemic on food security dimensions involve different channels and pathways.

As for *food availability*, the pandemic affected both domestic food production and global food chains. The pandemic caused a decrease in domestic food production due, among other reasons, to a decrease in yield and productivity, with a consequent decrease in food supply and availability. This decrease is due to the difficult access to inputs [50,64,65,92,98,115], such as fertilisers, pesticides, and, even, seeds. Furthermore, the disruption of global food supply chains caused an increase in the prices of inputs [64,96]. Such a disruption also affected the trade and import of some products and their availability on the domestic market [57,82,88,111,123]. The decrease in the domestic food supply is also caused by losses of agri-food products [65,106] that are, inter alia, caused by labour shortages [50,65,106] and, therefore, missed harvests.

As for *food access*, the analysis suggests that the pandemic affected both economic accessibility and affordability, and physical accessibility. Physical access to food was affected by the containment measures that were introduced in West African countries. However, the impacts varied not only among countries, depending on the severity and stringency of the containment measures, but also from one socio-economic group to another. In particular, the poor [77,94] and women [63,77,94] seem to be more affected. Referring to the context of Burkina Faso, Traoré et al. [77] found that "*during COVID-19, female-headed households, poor households and farm households remain the most vulnerable in terms of access to basic foods, health services and food insecurity*". Likewise, focusing on nine sub-Saharan African countries (viz., Chad, Djibouti, Ethiopia, Kenya, Mali, Malawi, Nigeria, South Africa, and Uganda), Dasgupta and Robinson [94] point out that "*Econometric analysis reveals that female-headed households, the poor, and the less-formally educated, appear to suffer more in terms of food insecurity during this global pandemic*". Economic access was negatively affected by the pandemic due to the increase in food prices [61,82,85]. Agyei et al. [85] found that the outbreak of COVID-19 caused an increase in the prices of cereals (e.g., maize, sorghum, and rice) in sub-Saharan Africa. Furthermore, the purchasing power of many households decreased during the pandemic due to job losses [54] as well as negative impacts on livelihoods [80,114].

Table 10. Impacts of the pandemic on food security in West Africa.

Food Security Dimension *	Topics Addressed	Documents
Food availability	Domestic food production and productivity	Agyei et al. [85]; Agyei-Holmes et al. [47]; Andrieu et al. [87]; Arouna et al. [128]; Bamidele and Amole [91]; Bamidele et al. [49]; Chiemela et al. [92]; de Boef et al. [96]; Dugué et al. [98]; Houessou et al. [105]; Inegbedion [107]; Jha et al. [108]; Jha et al. [50]; Kuuwill et al. [62]; Martey et al. [64]; Middendorf et al. [114]; Nchanji and Lutomia [115]; Obayelu et al. [117]; Omeje et al. [68]; Omotayo et al. [70]; Ragasa et al. [74]; Ukaro Ofuoku et al. [121]; Vall et al. [122]; Van Hoyweghen et al. [123]; Yegbemey et al. [126]; Zidouemba et al. [132]
	Food chains and markets	Adewopo et al. [82]; Aggarwal et al. [52]; Arouna et al. [128]; Asante-Poku and van Huellen [88]; Ayande and Chilufya [89]; Dasgupta and Robinson [57]; de Boef et al. [96]; Dugué et al. [98]; Liverpool-Tasie et al. [111]; Martey et al. [64]; Okonkwo et al. [119]; Okyere et al. [131]; Vall et al. [122]; Van Hoyweghen et al. [123]
	Agri-food products losses	Middendorf et al. [65]; Ilesanmi et al. [106]
Food access	Economic access and affordability	Aberese-Ako et al. [51]; Adebayo and Oluwamayowa [80]; Adewopo et al. [82]; Afriyie et al. [127]; Agbawodikeizu et al. [84]; Aggarwal et al. [52]; Agyei et al. [85]; Amare et al. [86]; Amoako et al. [53]; Asante et al. [54]; Asante-Poku and van Huellen [88]; Ayande and Chilufya [89]; Balana et al. [48]; Bamidele and Amole [91]; Bamiwuye et al. [55]; Bukari et al. [56]; Buonsenso et al. [129]; Coulibaly [93]; Dasgupta and Robinson [94]; Dasgupta and Robinson [57]; Davis et al. [95]; Egger et al. [100]; Folayan et al. [102]; Folayan et al. [58]; Gummerson et al. [103]; Igwe et al. [130]; Iheme et al. [61]; Josephson et al. [109]; Kinda et al. [34]; Kuuwill et al. [62]; Lamontagne et al. [63]; Madzorera et al. [112]; Middendorf et al. [114]; Middendorf et al. [65]; Mueller et al. [66]; Nkrumah et al. [116]; Obayelu et al. [117]; Ogunji et al. [118]; Okonkwo et al. [119]; Omidiji et al. [69]; Omotayo et al. [70]; Onyenweaku et al. [71]; Ouoba and Sawadogo [73]; Rudin-Rush et al. [75]; Vall et al. [122]; Yegbemey et al. [126]; Zidouemba et al. [132]
	Physical access	Abay et al. [79]; Aberese-Ako et al. [51]; Adebayo and Oluwamayowa [80]; Adenubi et al. [81]; Adewopo et al. [82]; Adjognon et al. [83]; Afriyie et al. [127]; Agbawodikeizu et al. [84]; Aggarwal et al. [52]; Agyei et al. [85]; Amare et al. [86]; Asante et al. [54]; Asante-Poku and van Huellen [88]; Ayande and Chilufya [89]; Baada et al. [90]; Balana et al. [48]; Bamidele and Amole [91]; Bukari et al. [56]; Buonsenso et al. [129]; Chiemela et al. [92]; Dasgupta and Robinson [94]; Dasgupta and Robinson [57]; Davis et al. [95]; Dear et al. [97]; Dugué et al. [98]; Egger et al. [100]; Ekoh et al. [101]; Folayan et al. [102]; Folayan et al. [58]; Gummerson et al. [103]; Hemler et al. [104]; Houessou et al. [105]; Igwe et al. [130]; Ilesanmi et al. [106]; Inegbedion [107]; Josephson et al. [109]; Kinda et al. [34]; Lamontagne et al. [63]; Madzorera et al. [112]; Middendorf et al. [114]; Mueller et al. [66]; Nchanji and Lutomia [115]; Obayelu et al. [117]; Okonkwo et al. [119]; Okyere et al. [131]; Omidiji et al. [69]; Omotayo et al. [70]; Onyenweaku et al. [71]; Ouoba and Sawadogo [73]; Rudin-Rush et al. [75]; Saah et al. [120]; Traoré et al. [77]; Ukaro Ofuoku et al. [121]; Vall et al. [122]; Van Hoyweghen et al. [123]; Wang et al. [124]; Wrabel et al. [78]; Yaw Codjoe et al. [125]; Zidouemba et al. [132]
Food utilisation	Diet quality and dietary diversity	Abay et al. [79]; Afriyie et al. [127]; Amoako et al. [53]; Balana et al. [48]; Davis et al. [95]; Folorunso et al. [59]; Gligorić et al. [60]; Madzorera et al. [112]; Obayelu et al. [117]; Odebunmi et al. [67]; Onyenweaku et al. [71]; Onyenweaku et al. [72]; Saah et al. [120]
	Food safety	Adenubi et al. [81]; Eboreime et al. [99]; Kasim et al. [110]; Mertens and Peñalvo [113]; Odebunmi et al. [67]; Onyenweaku et al. [72]; Saah et al. [120]; Tchuenchieu Kamgain et al. [76]; Yaw Codjoe et al. [125]
Stability	Food-related scenarios and projections	Agyei et al. [85]; Coulibaly [93]; Jha et al. [108]; Kinda et al. [34]; Obayelu et al. [117]; Zidouemba et al. [132]

* Several articles address different food security dimensions.

Concerning *food utilisation*, the focus of the studies is mainly on diet quality and dietary diversity, and food safety. The pandemic affected diet quality with a reduction in the consumption of many health-enhancing products [60,112] as well as an increase in the use of unhealthy foods [60] and alcohol [53]. This, as well as the reduction in physical activity/exercise especially during the lockdown [53], caused an increase in the prevalence of non-communicable diseases. However, there was, at the same time, an increase in attention to and interest in health [59,60,72]. For that, some scholars suggest that the pandemic improved nutritional knowledge [59,120]. Saah et al. [120] found that "*Health knowledge has improved due to COVID-19 in terms of access to health information and increased understanding of health issues. There were reductions in risky health-related lifestyles (alcohol intake, sharing of personal items, and consumption of junk foods) while improvements were observed in healthy lifestyles such as regular physical exercise and increased consumption of fruits*

and vegetables". Meanwhile, the population started to pay more attention to the safety of agri-food products [76,125]. Tchuenchieu Kamgain et al. [76] stated that "*The awareness of the pandemic led to a reduction in street foods consumption, a rise in the preference for cooked foods, and a greater awareness of hygiene during food preparation and washing of fruits and vegetables before eating*" in Cameroon, Ethiopia, Ghana, Kenya, Nigeria, and South Africa.

As for the *stability* dimension, some studies provide scenarios and projections regarding the evolution of food production and access over time. For instance, Jha et al. [108] use a calibrated model for crop simulation to estimate the potential impacts of COVID-19 on major cereal crops (viz., rice, maize, millet and sorghum) in Senegal and Burkina Faso. Zidouemba et al. [132] use alternative scenarios (optimistic and pessimistic) in a computable general equilibrium model to analyse the impacts of COVID-19 on the food security status of households in Burkina Faso.

3.4. Impacts on Food System Sustainability

The evidence collected from the analysed papers suggests that COVID-19 affected all the dimensions of agri-food systems (Table 11). Referring to the Senegalese context, Middendorf et al. [114] posit that "*Anticipated impacts of COVID-19 on agriculture will be felt on both the biophysical aspects such as production and access to inputs and socioeconomic aspects such as access to labor, markets, or rapid shifts in demand*". However, it comes as no surprise that most of the documents that were found to be eligible and were analysed focus on the socio-economic impacts of the pandemic, especially those relating to food security and health.

The analysis shows that the environmental dimension is often overlooked. For instance, no studies connect the pandemic directly to biodiversity and natural resource management. However, there are a few exceptions. For instance, Andrieu et al. [87] assess the possible effects of the responses of both farmers and policymakers of mitigating and alleviating the adverse effects of the pandemic on the agricultural sector in Burkina Faso, Colombia, and France on the emissions of greenhouse gases (GHG). Kasim et al. [110] investigate how the pandemic affected household waste generation and waste composition in Guyana and Nigeria. Martey et al. [64] analyse the effects of COVID-19 shocks on the adoption of sustainable agricultural practices (e.g., zero tillage, mixed cropping, and mulching) in Ghana.

Regarding the economic dimension, the pandemic affected socio-economic activities, including the primary sector, which determined the loss of jobs. Moreover, it affected the marketing of agri-food products and caused in many countries of West Africa an increase in food prices. Agyei et al. [85] found that restrictions on movements and lockdowns in the wake of COVID-19 increased food prices in sub-Saharan Africa and argue that "*exchange rate, inflation and crude oil prices exerted a detrimental effect on food prices*". Likewise, referring to Enugu State (Nigeria), Chiemela et al. [92] found that "*COVID-19 has led to disruptions in rural agribusiness in Enugu state, Nigeria, by reducing the profitability of agribusinesses through channels such as high cost of seeds, credit sales, produce not harvested due to the pandemic, and unavailability of seeds*".

As for the social dimension, studies focus on the effects of the pandemic on health and food (in)security. As shown in the previous section, the pandemic affected all the dimensions of food security in West Africa. Moreover, the analysis shows that the pandemic increased vulnerability and poverty. The impacts are often differentiated not only between urban and rural areas but also by socio-economic groups and genders. The pandemic also had some cascading effects; for example, its effects on food security catalysed conflicts among rural households, especially poor ones. This was the case in Nigeria where Adebayo and Oluwamayowa [80] suggest that "*Extreme volatility in their inability to access food as a result of food shortages and the inability to benefit from government palliatives has been found to trigger incidents of conflict and malnutrition on households*".

Table 11. Sustainability of West African agri-food systems in the context of the pandemic.

Sustainability Dimension *	Documents	Topics Addressed
Environment	Andrieu et al. [87]; Kasim et al. [110]; Martey et al. [64]	Climate change Waste
Economy	Aberese-Ako et al. [51]; Adewopo et al. [82]; Afriyie et al. [127]; Agbawodikeizu et al. [84]; Aggarwal et al. [52]; Agyei et al. [85]; Asante et al. [54]; Asante-Poku and van Huellen [88]; Baada et al. [90]; Bamidele and Amole [91]; Bamidele et al. [49]; Bamiwuye et al. [55]; Bukari et al. [56]; Buonsenso et al. [129]; Chiemela et al. [92]; Coulibaly [93]; Dasgupta and Robinson [57]; Davis et al. [95]; de Boef et al. [96]; Dugué et al. [98]; Egger et al. [100]; Ekoh et al. [101]; Folayan et al. [102]; Gummerson et al. [103]; Houessou et al. [105]; Iheme et al. [61]; Jha et al. [108]; Josephson et al. [109]; Kinda et al. [34]; Lamontagne et al. [63]; Madzorera et al. [112]; Martey et al. [64]; Middendorf et al. [114]; Middendorf et al. [65]; Mueller et al. [66]; Nkrumah et al. [116]; Obayelu et al. [117]; Ogunji et al. [118]; Omeje et al. [68]; Omidiji et al. [69]; Omotayo et al. [70]; Ouoba and Sawadogo [73]; Ragasa et al. [74]; Vall et al. [122]	Competitiveness Employment Income Jobs Market/marketing Poverty Prices of inputs and agri-food products Profitability
Society and culture	Abay et al. [79]; Aberese-Ako et al. [51]; Adebayo and Oluwamayowa [80]; Adenubi et al. [81]; Adewopo et al. [82]; Adjognon et al. [83]; Afriyie et al. [127]; Agbawodikeizu et al. [84]; Aggarwal et al. [52]; Agyei-Holmes et al. [47]; Amoako et al. [53]; Arouna et al. [128]; Asante et al. [54]; Asante-Poku and van Huellen [88]; Ayande and Chilufya [89]; Baada et al. [90]; Balana et al. [48]; Bamidele and Amole [91]; Bamidele et al. [49]; Bamiwuye et al. [55]; Bukari et al. [56]; Buonsenso et al. [129]; Dasgupta and Robinson [94]; Dasgupta and Robinson [57]; Davis et al. [95]; Dear et al. [97]; Dugué et al. [98]; Eboreime et al. [99]; Egger et al. [100]; Ekoh et al. [101]; Folayan et al. [102]; Folayan et al. [58]; Folorunso et al. [59]; Gligorić et al. [60]; Gummerson et al. [103]; Hemler et al. [104]; Houessou et al. [105]; Igwe et al. [130]; Iheme et al. [61]; Ilesanmi et al. [106]; Inegbedion [107]; Jha et al. [108]; Jha et al. [50]; Josephson et al. [109]; Kasim et al. [110]; Kuuwill et al. [62]; Lamontagne et al. [63]; Liverpool-Tasie et al. [111]; Madzorera et al. [112]; Mertens and Peñalvo [113]; Middendorf et al. [114]; Middendorf et al. [65]; Mueller et al. [66]; Nchanji and Lutomia [115]; Nkrumah et al. [116]; Obayelu et al. [117]; Odebunmi et al. [67]; Okonkwo et al. [119]; Okyere et al. [131]; Omeje et al. [68]; Omidiji et al. [69]; Omotayo et al. [70]; Onyenweaku et al. [71]; Onyenweaku et al. [72]; Ouoba and Sawadogo [73]; Ragasa et al. [74]; Rudin-Rush et al. [75]; Saah et al. [120]; Tchuenchieu Kamgain et al. [76]; Traoré et al. [77]; Ukaro Ofuoku et al. [121]; Vall et al. [122]; Van Hoyweghen et al. [123]; Wang et al. [124]; Wrabel et al. [78]; Yaw Codjoe et al. [125]; Yegbemey et al. [126]; Zidouemba et al. [132]	Conflict Culture (e.g., indigenous or traditional knowledge) Equity Food (in)security Food safety Gender Health Labor quality Lifestyle Livelihoods Resilience Vulnerability
Policy and governance	Andrieu et al. [87]; Arouna et al. [128]; Baada et al. [90]; Coulibaly [93]; Dasgupta and Robinson [94]; Liverpool-Tasie et al. [111]; Nkrumah et al. [116]; Omotayo et al. [70]	Coping and mitigation strategies Policy measures

* Several articles address different sustainability dimensions.

While many articles end up with some policy recommendations, there are only a few articles dealing with policy and governance. Studies dealing with the policy dimension focus on the effects of the virus containment measures introduced by governments and/or measures taken to mitigate the impacts of the COVID-19 pandemic on the economy and population's livelihoods, with a particular emphasis on food (in)security. For instance, Coulibaly [93] analyses the impacts of the policy responses to COVID-19 in the West African Economic and Monetary Union and underlines "*the importance of regional cooperation and coordination for fighting the adverse socioeconomic impacts of the COVID-19 pandemic*". Meanwhile, referring to safety nets and coping strategies in nine sub-Saharan African countries (viz., Chad, Djibouti, Ethiopia, Kenya, Mali, Malawi, Nigeria, South Africa, and

Uganda), Dasgupta and Robinson [94] point out that "*These nine countries employ both food and cash safety nets, with the evidence suggesting that, at least when these data were collected, cash safety nets have been slightly more effective at reducing food insecurity*".

Some studies address at the same time different dimensions of sustainability. For instance, Aberese-Ako et al. [51] analyse the socio-economic and health impacts of the pandemic on rural and urban slum dwellers in Ghana. Meanwhile, Baada et al. [90], referring to the Upper West Region in Ghana, highlight "*how interlocking vulnerabilities regarding historical, environmental, geopolitical, socio-economic, health, and gendered inequalities affect the disposition of agrarian communities to cope with and recover from the COVID-19 pandemic*".

Scholars made several recommendations to make the agri-food systems in West Africa more sustainable and resilient to the COVID-19 pandemic and, eventually, to future crises, pandemics, and shocks. These fall within the domains of practice, policy and research (Table 12). Different scholars also stress that lessons learned and conclusions drawn from the COVID-19 pandemic should be used to improve preparedness for future crises and shocks [86,118]. In particular, some scholars call for strengthening social protection policies [86]. They also call for paying more attention to food security issues in continency plans and strategies. Vasseur et al. [36] argue that "*Food security must be seriously considered by governments when implementing restrictive measures during a pandemic. Consideration of health factors alone at the expense of food security can greatly exacerbate health problems and even increase cases of disease*". Similarly, Mertens and Peñalvo [113] suggest that "*COVID-19 response plans in malnourished countries, vulnerable to fatal COVID-19, should incorporate food security, nutrition, and social protection as a priority component in order to reduce COVID-19 fatality*". Moreover, future policies should be evidence-based to be effective and for that research is paramount. For instance, Dasgupta and Robinson [57] highlight the "*importance of improving household resilience to future systemic crises, and using evidence-based best practice in the design of relevant policy instruments*". Some scholars consider the COVID-19 pandemic as an opportunity to bring about the transition towards more sustainable and resilient agri-food systems. For instance, Dugué et al. [98] argue that "*This crisis is an opportunity to consider areas for intervention to make Burkina Faso's agriculture less dependent on external markets and imported factors of production. This implies the substitution of imported food products by local products and an agro-ecological transition to reduce the importation of synthetic inputs*". Proposals in that direction also include the promotion of short food supply chains [115].

Table 12. Some recommendations relating to agriculture and food in the context of the COVID-19 pandemic.

Domains	Examples of Recommendations	Sources
Policy	Effective policy responses to and interventions in COVID-19 or similar shocks should consider the socioeconomic conditions of households and take cognisance of the disparities between urban and rural areas	Bamiwuye et al. [55] Traoré et al. [77]
	Targeting safety nets and other social protection/support interventions temporally, spatially, and across social groups to improve their effectiveness amid shocks	Balana et al. [48]
	Policy intervention in rural areas should focus on fostering sustainable livelihoods to eradicate food insecurity and enable rural households to recover quickly and be able to sustain themselves against future shocks and crises	Omotayo et al. [70]
	Vulnerable populations and low-income households should be targeted for the government's packages and programs against COVID-19	Aberese-Ako et al. [51]
	Institutionalisation of social protection systems and provision of loans and grants to overcome financial difficulties during the COVID-19 pandemic	Madzorera et al. [112] Ilesanmi et al. [106]
	Governments should set up ad hoc units to develop physical and digital plans for implementation during lockdowns or other emergencies	Ogunji et al. [118]
	Emergency agencies should have offices in rural areas to be closer to farmers and rural populations in times of crises	Omeje et al. [68]

Table 12. *Cont.*

Domains	Examples of Recommendations	Sources
Policy Practice	Prioritising investments in local economies and job creation and building households' assets and wealth base (e.g., land tenure security) to enhance resilience to shocks	Balana et al. [48]
	Governments should invest in market-oriented strategies such as postharvest handling, processing, storage, and marketing to ensure sufficient food supply during crises	Yegbemey et al. [126]
	Investing in infrastructure and providing adequate support to agri-food industries to improve efficiencies in the food supply chain and food availability and accessibility during pandemics	Agyei et al. [85]
	Building sustainable and resilient local food systems through strengthening public–private partnerships and investing in short food supply chains and input supply systems	Nchanji and Lutomia [115]
	Designing and implementing alternative social protection policies and programs to substitute nutritional services (e.g., school feeding programs) affected by the pandemic	Abay et al. [79]
	Communities should be helped to keep the coping strategies and measures adopted during the COVID-19 pandemic even afterwards	Aberese-Ako et al. [51]
Policy Practice	Public extension services should be strengthened to help farmers adapt better to crises and shocks	Yegbemey et al. [126]
Policy	Providing social protection measures and programs that address basic human needs (e.g., food, shelter, and clothing) and specifically target food insecurity	Davis et al. [95]
Practice	Promoting campaigns and programmes to improve the awareness of dietary measures for the prevention of COVID-19	Madzorera et al. [112] Onyenweaku et al. [72]
	Promoting waste sorting at the household level and training the personnel dealing with waste management with particular attention to the adherence to COVID-19 protocol to prevent the spread of the virus	Kasim et al. [110]
	Addressing the inappropriate knowledge of COVID-19 and its impacts on nutrition and education among the young and adolescents	Wang et al. [124]
Research	Evaluating the health and nutritional benefits and antiviral and immunomodulatory properties of medicinal plants and special foods to select foods to prioritise in the fight against COVID-19	Odebunmi et al. [67] Onyenweaku et al. [72]
	Performing in-depth comparative studies to understand the pandemic's differentiated impact on various groups within societies, differences in the efficacy of safety nets, and why some countries have coped better with the pandemic than others have	Dasgupta and Robinson [57]
	Using a farming systems approach to assess the COVID-19 impacts to ensure an in-depth examination of agronomic, social (e.g., livelihoods and well-being), and environmental/biophysical issues at community and household levels	Middendorf et al. [114]

4. Conclusions

To the best of our knowledge, this is the first review that analyses systematically and comprehensively the scholarly literature dealing with the multifaceted impacts of the COVID-19 pandemic on agri-food systems in the whole of West Africa.

The bibliometric analysis shows that the annual output of articles is quite high but the peak of publications number in 2021 might suggest that interest in the research field is decreasing. The selected articles relate to more than thirty research areas, which suggests that the research field is multidisciplinary. The analysis of the countries of authors' affiliations shows that the most active countries are Nigeria and USA followed by Ghana and Burkina Faso. However, a large share of the eligible articles is authored by researchers and scholars based outside West Africa. Likewise, the most important funding agencies are based outside the region, especially in the USA. Meanwhile, the lion's share of studies were carried out in Nigeria whereas no article deals with any West African countries, viz. Cape Verde, Ivory Coast, Gambia, Guinea-Bissau, Guinea, Mauritania, Niger, and Togo. This suggests a huge gap in the concerned countries.

Most of the selected articles do not refer to any specific agriculture subsector. This is particularly the case with studies that deal with changes in food consumption patterns and diets. Articles dealing with a specific subsector generally address crop production whereas animal production and fisheries are generally overlooked. The pandemic affected the whole food chain from input procurement to food waste management through production, pro-

cessing, transport and distribution, and consumption. Nevertheless, most of the analysed documents deal with the downstream stages of the food chain (e.g., consumption), while the upstream stages (e.g., production) and, especially, intermediate stages (e.g., processing and packing) are often overlooked.

The pandemic impacted all four dimensions/pillars of food security (viz., availability, access, utilisation and stability). However, the magnitude of the impacts changed from one dimension to another. Indeed, most of the analysed documents focus on food access. The impacts of the pandemic on food security dimensions involve different channels and pathways. As for food access, the analysis suggests that the pandemic affected both economic accessibility and affordability, and physical accessibility. Physical access to food was affected by the containment measures that were introduced in West African countries. However, the impacts varied not only among countries, depending on the stringency of the containment measures, but also from one socio-economic group to another. Economic access was negatively affected by the pandemic due to the increase in food prices. Furthermore, the purchasing power of many households decreased during the pandemic due to job losses as well as negative impacts on livelihoods.

The evidence collected from the analysed papers suggests that COVID-19 affected all the dimensions of agri-food systems. However, it comes as no surprise that most of the selected documents focus on the socio-economic impacts of the pandemic, especially those relating to food security and health. Regarding the economic dimension, the pandemic affected socio-economic activities, including the primary sector, which saw a loss of jobs. Moreover, it affected the marketing of agri-food products and caused in many countries of West Africa an increase in food prices. As for the social dimension, studies focus on the pandemic impacts on health and food (in)security. Moreover, the analysis shows that the pandemic increased vulnerability and poverty. The impacts are often differentiated not only between urban and rural areas but also by socio-economic groups and genders. Only a few articles deal with policy, especially the effects of the virus containment measures and/or the measures taken to mitigate and alleviate the impacts of the pandemic on the economy and population's livelihoods, with a particular emphasis on food (in)security.

The COVID-19 pandemic has shown the multiple vulnerabilities and dysfunctions of the agri-food system in West Africa. For that, urgent actions—in practice, policy, and research—are needed to make the regional agri-food system more sustainable and resilient. In this respect, the lessons learned and conclusions drawn from the COVID-19 pandemic should be used to improve the preparedness for future crises, pandemics and shocks, with particular attention to safety nets and protection systems. Indeed, the pandemic can be seized as an opportunity to pinpoint areas of intervention and leverage points to improve food sovereignty and self-sufficiency while reducing dependence on imports and vulnerability to disruptions in global food supply chains. Moreover, it is necessary to pay more attention to the issue of food and nutrition security, especially for the poor and vulnerable groups of the population, in future contingency plans and strategies. It is also necessary to boost short food supply chains and agroecological production models in all agriculture subsectors (viz., crop production, animal production, and pastoralism, and fisheries and aquaculture). Moreover, future policies should be evidence-based to be effective and for that research is paramount to ensure the effectiveness, efficiency, and sustainability of policies.

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