

Consolidating the one health content of agricultural guidance documents in West Africa: a scoping review

Jessica Mitchell, Muiz O. Akinyemi & Bassey Ebenso

To cite this article: Jessica Mitchell, Muiz O. Akinyemi & Bassey Ebenso (2025) Consolidating the one health content of agricultural guidance documents in West Africa: a scoping review, Cogent Food & Agriculture, 11:1, 2552287, DOI: [10.1080/23311932.2025.2552287](https://doi.org/10.1080/23311932.2025.2552287)

To link to this article: <https://doi.org/10.1080/23311932.2025.2552287>



© 2025 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



[View supplementary material](#)



Published online: 29 Aug 2025.



[Submit your article to this journal](#)



Article views: 221



[View related articles](#)



[View Crossmark data](#)

Consolidating the one health content of agricultural guidance documents in West Africa: a scoping review

Jessica Mitchell^{a,b} , Muiz O. Akinyemi^{b,c}  and Bassey Ebenso^b 

^aGlobal Agriculture and Food Systems, Royal (Dick) School of Veterinary Studies, College of Medicine and Veterinary Medicine, University of Edinburgh, Midlothian, UK; ^bNuffield Centre for International Health and Development, Leeds Institute of Health Sciences, University of Leeds, Leeds, UK; ^cUnit for Environmental Science and Management, North-West University, Potchefstroom, South Africa

ABSTRACT

West Africa faces numerous challenges to food security, including rising human populations, climate change, (re)emerging infectious diseases, Antimicrobial Resistance (AMR), and biodiversity loss. As such, the URBANE consortium is collaborating across West Africa to re-imagine food production systems that are climate-smart, nature-based, and resilient to contextually specific One Health stressors of the region. However, the documentation supporting such progress is broad. It is currently unclear how well agriculture investment plans are linked to government-produced documents such as National One Health Strategic Plans and National Action Plans on AMR. This study employed a systematic methodology to assess the availability and content of relevant agricultural guidance documents. This analysis 1) identifies 24 key agricultural and One Health document for Benin, Burkina Faso, Ghana, Nigeria, Senegal and Morocco. 2) An inductive approach was used to identify the common terminology used within and between One Health and agricultural document. 3) Demonstrate how One Health terminology differs between documents aimed at food production and those with wider One Health narratives. 4) Explore how such differences could silo One Health action within certain sectors, and 5) identify examples of One Health synergies across documents that could pave the way for One Health-centred agricultural reform.

ARTICLE HISTORY

Received 7 February 2025
Revised 4 August 2025
Accepted 18 August 2025

KEYWORDS

Agriculture; farming; one health; agroecology; antimicrobial resistance; West Africa

SUBJECTS

Agriculture & Environmental Sciences; Agricultural Development; Agriculture & Related Industries

Introduction

Global human populations have expanded rapidly over the past 50 years, with the planet now home to almost eight billion people. West Africa is one of the fastest-growing sub-regions, with annual district growth rates of 2.75% and up to 9% in major cities (CILSS, 2016; United Nations DoEaSA & Population Division, 2021). Among other challenges, one repercussion of increased human population is the pressure to feed them (Hollinger & Staats, 2015; Hossain et al., 2020). Farming practices have expanded, diversified, and, in many cases, intensified to support viable crop and livestock production (Herrmann et al., 2020; Hollinger & Staats, 2015; Hossain et al., 2020; Sarfo et al., 2022). Examples include an increase in peri-urban farming practices where small holdings and subsistence farming occur on the fringes of the large, densely populated, and heavily polluted cities (Anges et al., 2014; Hollinger & Staats, 2015). Intensive farming methods, such as the use of genetically modified crop strains (Kavhiza et al., 2022) and antibiotics as growth promoters and prophylaxis in crops and livestock (Andrew Selaledi et al., 2020), are becoming more common. The climate crisis and resulting changes in weather patterns are exacerbating pressures on farming systems to respond to less predictable rainfall, growing seasons, and pest patterns (Carr et al., 2022). Finally, West Africa faces unique challenges in expanding its agricultural enterprises into virgin forests and other habitats

CONTACT Muiz O. Akinyemi  m.o.akinyemi@leeds.ac.uk, tosin2667@gmail.com  Nuffield Centre for International Health and Development, Leeds Institute of Health Sciences, University of Leeds, Woodhouse, Leeds, LS2 9JT.

 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/23311932.2025.2552287>.

© 2025 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

(Ouedraogo et al., 2010), which provide ideal opportunities for the (re)emergence and spillover of diseases among humans, wildlife, domesticated animals, and plants, including livestock and crops (Otu et al., 2021).

Farming, globally and in West Africa is a diverse practice, thus, its associated terminology is broad (Giller, 2013). Agriculture (Bjornlund et al., 2020), small holdings (Otekunrin, 2022), subsistence farming (Palli & Deb, 2020), agroecological methods (Gliessman, 2018), and nature-based solutions (Artmann & Sartison, 2018) are all frequently-used terms to describe methods of food production in Western African literature (De La Fuente et al., 2020; Karst et al., 2020; Ouedraogo et al., 2010; Sarfo et al., 2022). Such terminology is loosely defined and may embody different meanings within different stakeholder communities, sectors, and academic disciplines.

The One Health risks linked to farming practices are also diverse. Commonly discussed concerns include the spread of communicable diseases within and between species (Ejeromedoghene et al., 2020). Zoonotic spillover events between animals and humans are a key concern (Baker et al., 2022), and there is growing discussion on how farming practices may drive the spread of drug-resistant infections or Antimicrobial Resistance (AMR) (Butcher et al., 2021; Caudell et al., 2020). The role of pollution, particularly from agricultural chemicals, pesticides, and livestock medication, is discussed in relation to drivers of AMR (Kimera et al., 2020), as well as contamination of water and food sources, while climate change-induced shifts in pest and disease patterns are also prevalent in this literature (Otekunrin, 2022).

A feedback loop often exists between drivers and the impact of such health issues. Ebola and COVID-19, for example, both contributed to declines in harvest success, overall food production, and household welfare during recent outbreaks across Western Africa (De La Fuente et al., 2020; Ejeromedoghene et al., 2020). As such, there is a growing body of peer-reviewed and gray literature, such as guidance documents, action plans, and investment strategies, to support climate-smart agricultural changes that can provide food resources for growing populations under such climatic pressures. However, these documents use a range of languages, which can make it challenging to determine their alignment and differences. It is also unclear how holistic such documents are in the broader health field. Do they simply focus on the challenges of food production and agricultural reforms? Alternatively, do they also consider wider One Health challenges such as (re)emerging zoonotic diseases, biodiversity losses, and Antimicrobial Resistance (AMR)?

The URBANE consortium is an European Union (EU) Horizon-funded research project that aims to explore the links between farming practices and health in relation to the intensification of peri-urban agriculture using case study sites across five West African countries (Benin, Burkina Faso, Ghana, Nigeria, and Senegal) and Morocco. URBANE seeks to promote sustainable and climate-smart agricultural solutions that are locally appropriate to the countries and case study sites of use. However, it recognizes the huge differences in language around agriculture, One Health, and climate smart farming that currently exist between countries and styles of open-access documentation.

Aims

This rapid situation analysis considers the scope and content of openly accessible agricultural guidance documents for Benin, Burkina Faso, Ghana, Morocco, Nigeria, and Senegal. These six countries were selected as they host case study sites for the EU Horizon-funded URBANE consortium, which assesses current farming practices and their associated One Health risks to suggest agroecological solutions that will increase food production in a manner that safeguards One Health across humans, animals, and their environments.

Through an iterative and rapid screening process, this project aims to provide an initial summary of current agricultural guidance for these countries and a commentary on how such documents can support West African countries through the suite of One Health challenges they currently face. Our specific objectives are as follows:

1. Summarize the availability of agricultural guidance documents of Benin, Burkina Faso, Ghana, Morocco, Nigeria, Senegal, and the One Health reach of such documentation.
2. Present the key terminology used in such documents.
3. Consider the contextual differences in One Health language use between the document type, scope, authorship, and country of the intended impact.

4. Discuss the implications of these findings for One Health action on agricultural reform.

Methods

This review was conducted using the Cochrane Handbook for Systematic Reviews of Interventions as its methodological framework. The document selection process involved implementing a search strategy across multiple databases, followed by two levels of screening: title and abstract, where available, and full text based on inclusion and exclusion criteria. Rayyan, a web-based collaborative review software that accelerates the screening process, was used for the title and abstract stages. The process also included data extraction, analysis, and synthesis. During the data extraction stage, two researchers extracted relevant information from the included articles. Conflicts were resolved at each level of screening by the authors until a consensus was reached (Figure 1).

Search strategy and document selection

Between November 2022 and July 2024, freely accessible gray literature and guidance/policy documents related to agricultural reform in the six countries were collated. All relevant records, regardless of publication date, were considered. This collection of gray literature was based on discussions with URBANE consortium members and searches on government agency websites, guideline repositories, and One Health-related international organizations, including the Initiative for Adaptation of African Agriculture

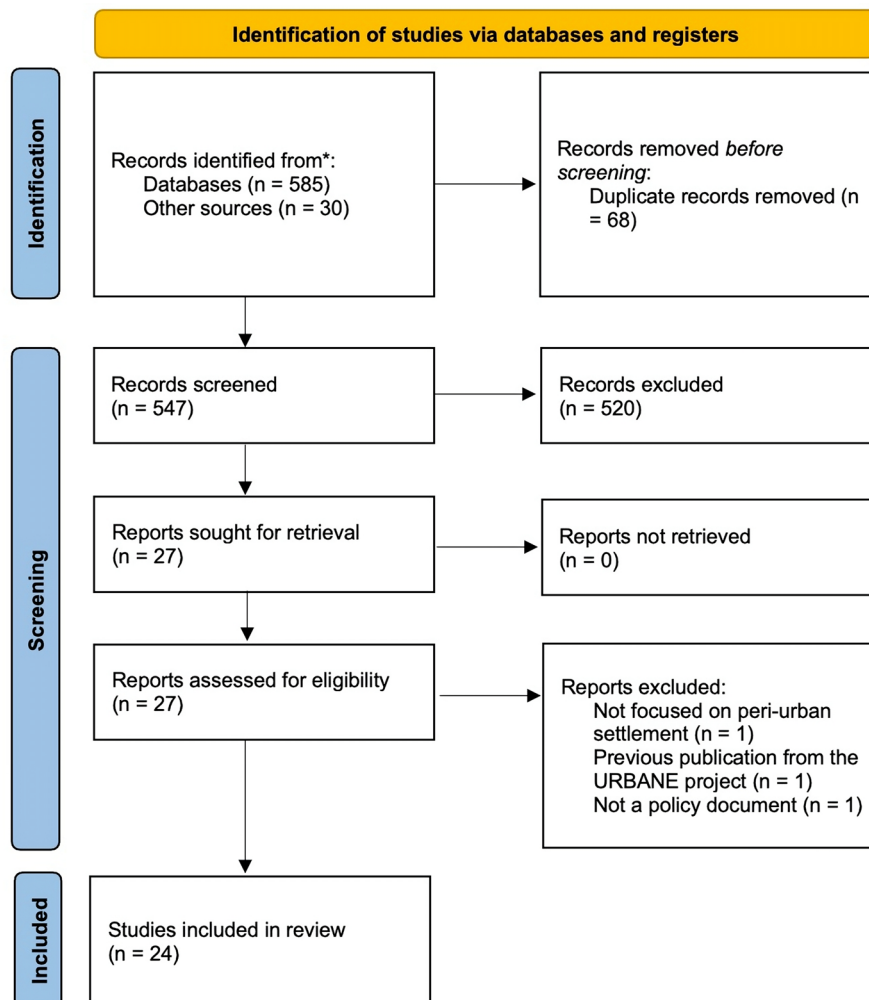


Figure 1. Flow diagram of document screening and selection process.

(AAA) to Climate Change, Food and Agriculture Organization (FAO), One Health Commission, the World Health Organisation (WHO), and the World bank. Peer reviewed documents were collected from journal databases such as Scopus and Web of Science, were also used in the search using the following search string: 'One Health' OR 'One Health approach' OR 'One Health framework' OR 'One Health initiatives' AND 'Agriculture' OR 'Agricultural practices' OR 'Agricultural policy' OR 'Farming' OR 'Livestock management' OR 'Agricultural reform' OR 'Sustainable agriculture' OR 'Agroecology' OR 'Climate-smart agriculture' OR 'Sustainable farming practices' AND 'Guidance' OR 'Policy' OR 'Regulatory' OR 'Government' OR 'Guidelines' OR 'Best practices' OR 'Manuals' OR 'Policy analysis' OR 'Governance' OR 'Regulatory frameworks' OR 'Policy implementation' OR 'Institutional frameworks' OR 'Government policy' AND 'Morocco' OR 'Nigeria' OR 'Ghana' OR 'Senegal' OR 'Burkina Faso' OR 'Benin'.

Inclusion and exclusion criteria: Documents were included if they

1. addressed the One Health approach, which integrates human, animal, and environmental health, specifically in the context of agriculture.
2. related to agricultural practices, policies, and guidelines that impact the public, animal, or environmental health in peri-urban settlements.
3. focused on six countries, Benin, Burkina Faso, Ghana, Morocco, Nigeria, and Senegal, which are also case study sites within the URBANE consortium, and
4. were available in English or French given the predominance of these languages in the selected countries.

Documents were excluded if it:

1. did not focus on or include relevant policies for peri-urban settlements,
2. did not address the intersection of agriculture and One Health (e.g. documents focused solely on the economic aspects of agriculture without One Health consideration),
3. was an opinion piece, editorial, news article, and non-scholarly blog.
4. was not available in English or French,
5. is not related to or written by the six selected countries.

Following the deduplication of database outputs, two reviewers independently reviewed each article against the inclusion and exclusion criteria for title and abstract review. Three screeners participated in the screening process across the entire body of citations.

Documents included in this review can be divided into two categories. First, what we refer to as *Agri-One Health documents* are policy or guidance documents that primarily address agricultural practices and reforms within changing environmental contexts (climatic, economic, and socioeconomic); examples include climate-smart agricultural investment plans. The second is the *Wider One Health documents* such as the National Action Plans on Antimicrobial Resistance (NAPs), which focus on holistic health security issues that include food production systems. The final list of the 24 documents is presented in [Table 1](#).

Search terms

A single researcher used the URBANE project's Case for Support (Grant Agreement Number 101059232) to create a list of key terms to search for within these national-level documents ([Table 2](#)). These terms refer specifically to farming practices, climate-induced changes to farming, and other emerging health threats, such as Antimicrobial Resistance (AMR) and zoonotic diseases.

Screening process

English translations of French documents were produced using Google Translate and DeepL, an AI-driven online service. The accuracy of these translations was verified by comparing the outputs of both tools using the compare function on Microsoft Excel, and any inconsistencies were rectified. The final English

Table 1. List of documentation screened at part of this analysis.

Country	Document	Authorship	Implementation level	Document style	Language	Link
Benin	Climate Smart Agriculture Pdf	International organizations Agriculture (including CGIAR), food systems (including FAO) Norwegian Ministry of Foreign Affairs, international crop research institute.	National	Agri-One Health	English	https://www.fao.org/3/ca1323en/CA1323EN.pdf
	National AMR Action Plan	Benin government following guidance of tripartite AMR group (now quadripartite) FAO, WHO, OIE (now WOAHI).	National	Wider One Health	French	Benin: National multisectoral action plan against antimicrobial resistance 2019–2024 (French) (who.int)
	Joint external evaluation of International Health Regulations core capacities: Republic of Benin	WHO with Benin government and The World Organisation for Animal Health (OIE), the Food and Agriculture Organization of the United Nations, the Centre for Disease Control and the United States Department of Agriculture (USDA) for their contribution of experts and expertise.	National	Wider One Health	English	https://extranet.who.int/sph/sites/default/files/document-library/document/JEE%20Report%20Benin%202017.pdf
	Climate Smart Agriculture Plan	Burkina Faso Government with International input from World Bank, Adaptation of African Agriculture, Biodiversity international, World Agroforestry organization, CGIAR, EU funding, Norwegian Ministry of Foreign Affairs.	National	Agri-One Health	English	https://documents.worldbank.org/en/publication/documents-reports/documentdetail/981211592305059381/climate-smart-agriculture-investment-plan-for-burkina-faso-draft-for-decision-meeting
Burkina Faso	National AMR Action Plan	Burkina Faso Government	National	Wider One Health	French	https://www.who.int/publications/m/item/burkina-faso-national-multisectoral-strategic-plan-to-combat-antimicrobial-resistance-(french)
	One Health Zoonotic Disease Prioritization for Multisectoral Engagement in Burkina Faso	Workshop summary led by Burkina Faso government with support from USAID, FAO, and CDC	National	Wider One Health	English	https://www.who.int/publications/m/item/burkina-faso-national-multisectoral-strategic-plan-to-combat-antimicrobial-resistance-(french)
	National AMR Action Plan	Government of Ghana.	National	Wider One Health	English	https://www.who.int/publications/m/item/ghana-national-action-plan-for-antimicrobial-use-and-resistance
	National Climate-Smart Agriculture and Food Security Action Plan of Ghana: Working Paper.	CGIAR with Ghanaian individuals named as authors from the Ministry of Food and Agriculture.	National	Agri-One Health	English	https://leap.unep.org/sites/default/files/legislation/gha169288.pdf
Ghana	Climate Smart agriculture Investment Plan for Ghana	Ghana Government with international Adaptation of African Agriculture, Biodiversity international, World Agroforestry organization, CGIAR, EU funding, World Bank.	National	Agri-One Health	English	https://documents1.worldbank.org/curated/en/300161592374973849/pdf/Climate-Smart-Agriculture-Investment-Plan-for-Ghana.pdf
	Strengthening Pandemic Preparedness in Ghana	Based on workshop with national and international participants across One Health Sphere including FAO, Ghanaian Ministry of Environment, Science, Technology, and Innovation, Ghana school of public health.	National	Wider One Health	English	https://www.ecohealthalliance.org/wp-content/uploads/2022/06/Ghana_Workshop-Report.pdf
	Predict: Ghana	USAID	National	Wider One Health	English	FINAL+REPORT+COUNTRY-GHANA-full.pdf (squarespace.com)

(Continued)

Table 1. Continued.

Country	Document	Authorship	Implementation level	Document style	Language	Link
Morocco	Concept Note: Morocco Digital and Climate Smart Agriculture Program.	World Bank	National	Agri-One Health	English	https://documents1.worldbank.org/curated/en/648291567624827368/pdf/Concept-Stage-Program-Information-Document-PID-Morocco-Digital-and-Climate-Smart-Agriculture-Program-P170419.pdf
	Promoting investment climate reforms in Morocco's agri-food sector Issues paper for the first private sector dialogue.	EU	National	Agri-One Health	English	https://www.oecd.org/mena/eu-oecd-mediterranean-investment/EU-issue-paper-agri-food-Morocco-EN.pdf
	Morocco Climate-Smart Agriculture Investment Plan	International led by World Bank with Adaptation of African Agriculture, FAO.	National	Agri-One Health	English	https://www.aaainitiative.org/sites/default/files/2021-01/CSAIP-Morocco.pdf
	National AMR Action Plan	Morocco Government	National	Wider One Health	French	https://www.who.int/publications/m/item/morocco-national-strategic-plan-for-prevention-and-control-of-antimicrobial-resistance-(fr)
Nigeria	National AMR Action Plan	Nigeria Government	National	Wider One Health	English	https://www.who.int/publications/m/item/nigeria-national-action-plan-for-antimicrobial-resistance
	Climate-Smart Agriculture in Borno state of Nigeria	FAO are lead producers with other international support. CGIAR, CIAT, Norwegian Ministry of Foreign Affairs, international crops research for the semi-arid and tropics, CIAT.	State Level	Agri-One Health	English	https://www.fao.org/3/ca5416en/ca5416en.pdf
	Climate-Smart Agriculture in Adamawa state of Nigeria.	FAO are lead producers with other international support. CGIAR, CIAT, Norwegian Ministry of Foreign Affairs, international crops research for the semi-arid and tropics, CIAT.	State Level	Agri-One Health	English	https://cgispace.cgiar.org/handle/10568/106101
	Nigeria National Action Plan for Health security	Nigerian Government with overseas development partners including WHO, World Bank, USAID, Public Health England.	National	Wider One Health	English	https://extranet.who.int/sph/sites/default/files/document-library/document/Nigeria%20National%20Action%20Plan%20for%20Health%20Security.pdf
Senegal	National One Health Strategic Action Plan	Nigerian Government	National	Wider One Health	English	https://ncdc.gov.ng/themes/common/docs/protocols/93_1566785462.pdf
	Climate smart Agriculture Senegal	USA funded and produced.	National	Agri-One Health	English	https://climateknowledgeportal.worldbank.org/sites/default/files/2019-06/SENEGAL_CSA_Profile.pdf
	National AMR action Plan	Senegalese Government	National	Wider One Health	French	https://www.who.int/publications/m/item/senegal-multisectoral-national-action-plan-against-antimicrobial-resistance-2017
	Rapid assessment of Global Health Security Agenda project: Strengthening multisectoral community event-based surveillance of zoonotic diseases in Senegal	Internationally produced by USAID and Measure Evaluation	National	Wider One Health	English	https://www.measureevaluation.org/resources/publications/tr-18-255/at_download/document
Regional/Global or multi-country	Climate smart agriculture Case studies from around the world. *Focus on Senegal and Ghana	Food and agriculture Organization (FAO) supported document	Global	Agri-One Health	English	https://www.fao.org/3/cb5359en/cb5359en.pdf

version was screened alongside all other documents. The authors cross-checked the key terms with French-first-language speaking colleagues to minimize any loss of integrity during the translation process. Two researchers used the F4 search function and the text mining tool in Orange software version 3.37 to screen each document for the terminology listed in Table 2.

The presence or absence of each term (Tables 3a and 3b) and the context in which the terms appeared in each document were recorded. Example quotes and reference links were extracted into an Excel file to allow for a more detailed analysis of terminology and usage across the document.

Once all documents were screened, the usage, frequency, and context of key terms within each document were assessed relative to the type of document (*Agri-One Health* or *Wider One Health documentation*), country of intended impact, and scope. This was an iterative process following a thematic assessment of contextual factors.

Results

The Agri-One Health documentation of Benin, Burkina Faso, Ghana, Morocco, Nigeria, and Senegal

None of the six countries considered had an identical set of health documents. All had some form of climate-smart agricultural investment plan or policy guidance document, and all had a National Action Plan (NAP) on Antimicrobial Resistance (AMR). Although there is a global repository for the One Health Strategic Action Plan, the format of such documents differs among countries (One Health Commission, 2023). For example, Burkina Faso's links direct to news articles and posters about its One Health platform, while Nigeria has a comprehensive Strategic Action Plan. Senegal features a document titled *Strengthening Multisectoral Surveillance of Zoonotic Diseases*. In contrast, Morocco, Benin, and Ghana had no available documentation in this repository at the time of analysis.

Additional documents, such as pandemic preparedness, food security strategies, and zoonosis action plans, were present in some countries and absent in others (Table 1). Nigeria was the only country that had rapidly accessible documents specific to the state level; all others were national. Some documents followed international guidelines, such as the NAPs, which are formatted in line with the Quadripartite alliance on AMR. Climate smart agriculture plans supported by International Organizations and funders maintained a consistent use of language and appearance based on the Food and Agriculture Organization's (FAO) template. Other documents, such as zoonosis action plans, pandemic preparedness strategies, and agricultural investment reforms, took different formats. However, all the documents were supported, co-authored, or endorsed by international agencies beyond country-specific governments.

Key terminologies used in the Agri-One Health documentation of Benin, Burkina Faso, Ghana, Morocco, Nigeria, and Senegal

Screening of these documents first clarified the presence or absence of each key term (Table 3). *Agri-One Health* documents used terms and stems *agri**, *agro**, *aqua**, *farm**, *livestock*, and *smallholding* more frequently than the *Wider One Health* documents. However farming and agricultural sectors were discussed in these latter documents and many signatories and endorsements came from those in the farming and agricultural sector. The *Wider One Health* documents language focuses on One Health, zoonotic infectious, disease transmission, and surveillance of diseases. Figure 2 presents a word cloud that highlights the most frequently used terms. Such terms are less commonly used in *Agri-One Health* documents. Interestingly, the terms *climate-smart*, *nature-based*, *strain*, *pollution*, and *damage/degradation* were used across all documents. There was no obvious differentiation of language used between countries; rather, the scope of documents appeared to determine the presence/absence of key terms and the context in which they were used.

Contextual use of key terms in the Agri-One Health documentation of Benin, Burkina Faso, Ghana, Morocco, Nigeria, and Senegal

Agriculture was used to refer to crop farming and aquatic and terrestrial animals across the *Agri-One Health* documents, although many have also discussed aquaculture of fisheries specifically. The *Wider One*

Table 2. Key words which were searched for across the agroecological and One Health documents.

Key word/word stem	Rationale for inclusion	Key word/word stem	Rationale for inclusion
Agri*/Aqua*	Searching for the prefaces Agri* and Aqua* can allow determination of which species are involved in food production in each setting. What actors have contributed to each report and what sector they are based in.	One Health	What does One Health mean in each document, is it considered and to what extent?
Agro*	The prefix <i>Agro*</i> can be used in many contexts around food production and farming. <i>Agroecology</i> is considered the interaction between traditional knowledge and high intensity farming practices. However, the prefix can be used with specific practices such as Agroforestry for example.	Zoo*	This stem is designed to capture discussion of zoonotic diseases. Allows consideration of the one Health approach to zoonoses and how this may differ between setting and sectors.
Farm*	What do farming and farming personnel look like in this setting? How are their health needs valued and considered? What are the One Health challenges within this sector and within each setting?	Pandemic	Included to capture information relating to the diseases within farmed resources but also between these resources, humans, the environment, and other species - international level of concern.
Livestock	What do livestock look like in each setting, how are their One Health needs valued and considered?	Epidemic	Included to capture information relating to the diseases within farmed resources but also between these resources, humans, the environment, and other species – national level of concern.
Nature-based	Nature-based solutions refer to climate and ecologically responsive practices – this term is key to the URBANE consortium proposal and as such we are interested to understand how the term is used in country specific documents.	Resist*	Included to capture information relating to disease and antimicrobial resistance but also drought, heat and climate resistant strains of crops and livestock varieties.
Climate-smart	Again, this term is key to the URBANE consortium proposal and as such we are interested to understand how the term is used in country specific documents.	Strain	Included to capture information relating to the diseases within farmed resources but also between these resources, humans, the environment, and other species.
Pollut*	Chemical pollution is a key area of One Health concern for farming practices, it is included to understand how different settings and sectors engage with pollution in farming.	Transmi*	Included to capture information relating the spread and transmission of diseases within farmed resources but also between these resources, humans, the environment, and other species.
Degradation/Destruction	Habitat degradation and destruction is a key area of One Health concern for farming practices, it is included to understand how different settings and sectors engage with pollution in farming.	Biosecurity	This is a key area of One Health concern for farming practices, it is included to understand how different settings and sectors engage with pollution in farming.
Small hold	This term is used in addition to the farm* stem as URBANE is particularly interested in the expansion of peri-urban farming practices which predominantly include small holders.		
Surve*	This stem captures reference to laboratory and One Health surveillance programmes as well as surveys to understand changes in farming practices, changes in One health risks etc.		

Health documents tended to use the term *agriculture* to refer to all forms of food production, but some (such as Nigeria's National AMR Action Plan) had signatories of endorsement from the fishery sector. Livestock is typically used to describe terrestrial animals, while fish and aquatic species are frequently mentioned separately in *Agri-One Health* documents.

The farming language was relatively consistent across the *Agri-One Health* documents. Most specified targets and actions are based on farm size. Many had specific discussions on the need to provide financial support and training for smallholder farmers. Documents did not always use the term smallholder, but rather SME (small, medium-sized enterprises) or simply small farmers. *Wider One Health* documents

Table 3a. Matrix of terminology used across the Agri-One Health and wider One Health documents screened (1 = presence of term, 0 = absence of term).

	Agri*	Agro*	Aqua* or Fish*	Climate- smart	Nature based solution	Farm*	Livestock	Biosecurity	Small hold*	Pollution
Benin										
Climate smart agriculture Benin	1	1	1	1	0	1	1	0	1	0
Benin National AMR Action Plan	1	1	1	0	0	1	1	1	0	0
Joint External evaluation of International Health Regulations core capacities: Republic of Benin	1	0	1	1	0	1	0	0	1	0
Burkina Faso										
Climate-Smart Agriculture Investment Plan for Burkina Faso	1	1	1	1	0	1	1	1	1	1
Burkina Faso National AMR Action Plan	1	0	1	0	0	0	1	1	0	0
One Health Zoonotic Disease Prioritization for Multisectoral Engagement in Burkina Faso	1	0	1	0	0	1	1	0	0	0
Ghana										
Climate smart agricultural investment plan for Ghana	1	1	1	1	0	1	1	0	1	1
Predict Ghana: One Health in Action	1	0	1	0	0	1	1	1	0	0
Ghana National AMR action plan	1	0	1	0	0	1	1	1	0	0
Strengthening Pandemic Preparedness in Ghana	1	1	1	0	0	1	1	1	0	1
National Climate-Smart Agriculture and Food Security Action Plan of Ghana: Working Paper	1	1	1	0	0	1	1	0	1	1
Morocco										
Morocco Climate-Smart Agriculture Investment Plan	1	1	1	1	0	1	1	0	1	1
Morocco National AMR action plan	1	1	1	0	0	0	0	1	0	0
Concept Note: Morocco Digital and Climate Smart Agriculture Program	1	0	1	1	0	1	0	0	1	0
Promoting investment climate reforms in Morocco's agri-food sector	1	1	1	1	0	1	1	0	1	0
Nigeria										
One Health Strategic Plan: Nigeria	1	1	0	0	0	0	1	1	0	1
Climate smart agriculture plan for Nigeria (State specific - Borno)	1	1	1	1	0	1	1	0	1	1
Climate-Smart Agriculture (State specific - Adamawa)	1	1	0	1	0	1	1	0	1	0
Nigeria National AMR action plan	1	0	0	0	0	1	1	1	0	0
National Action plan for health security - Federal Republic of Nigeria	1	0	0	0	0	0	0	1	0	0
Senegal										
Rapid assessment of Global Health Security Agenda project: Strengthening multisectoral community event-based surveillance of zoonotic diseases in Senegal	1	1	1	1	0	1	1	0	1	1
Climate smart agriculture Senegal	1	1	1	1	0	1	1	0	1	1
Senegal National AMR Action Plan	1	1	1	0	0	1	1	1	0	1
Regional/Global or multi-country										
Climate smart agriculture Case studies from around the world. *Focus on Senegal and Ghana	1	1	1	1	0	1	1	0	1	0

mentioned farming less often than *Agri-One Health* documents. However, farming was mentioned in relation to *biosecurity* practices in Ghana's *Strengthening pandemic preparedness report* and the Nigeria National AMR Action plan with specific reference to minimizing zoonotic spillover and the spread of Antimicrobial Resistance.

Table 3b. Continuation of matrix of terminology used across the Agri-One Health and wider One Health documents screened (1 = presence of term, 0 = absence of term).

	One health	Zoono*	Epidemic	Pandemic	Resistance	Strains	Transmi* (or spread)	Degradation (destruction)
Benin								
Climate smart agriculture Benin	0	0	0	0	1	0	1	1
Benin National AMR Action Plan	1	0	1	0	1	0	1	0
Joint External evaluation of International Health Regulations core capacities: Republic of Benin	1	0	0	1	0	0	0	0
Burkina Faso								
Climate-Smart Agriculture Investment Plan for Burkina Faso	0	0	0	1	1	0	0	1
Burkina Faso National AMR Action Plan	1	0	1	0	1	0	1	0
One Health Zoonotic Disease Prioritization for Multisectoral Engagement in Burkina Faso	1	1	0	0	0	0	1	0
Ghana								
Climate smart agricultural investment plan for Ghana	0	1	0	0	1	0	0	1
Predict Ghana: One Health in Action	1	1	1	1	0	1	1	0
Ghana National AMR action plan	1	1	0	0	1	1	1	0
Strengthening Pandemic Preparedness in Ghana	1	1	1	1	1	0	1	1
National Climate-Smart Agriculture and Food Security Action Plan of Ghana: Working Paper	0	0	0	0	0	0	0	0
Morocco								
Morocco Climate-Smart Agriculture Investment Plan	0	0	0	0	0	0	1	1
Morocco National AMR action plan	1	1	1	0	1	0	1	1
Concept Note: Morocco Digital and Climate Smart Agriculture Program	1	1	1	1	1	0	0	0
Promoting investment climate reforms in Morocco's agri-food sector	1	0	0	1	0	0	0	0
Nigeria								
One Health Strategic Plan: Nigeria	1	1			1			
Climate smart agriculture plan for Nigeria (state specific - Borno)	0	0	0	0	1	0	0	1
Climate-Smart Agriculture (State specific - Adamawa)	0	0	0	0	0	0	0	0
Nigeria National AMR action plan	1	0	1	0	1	0	1	0
National Action plan for health security - Federal Republic of Nigeria	0	0	0	0	0	0	0	0
Senegal								
Rapid assessment of Global Health Security Agenda project: Strengthening multisectoral community event-based surveillance of zoonotic diseases in Senegal	0	0	0	0	1	0	1	1
Climate smart agriculture Senegal	0	0	0	0	1	0	0	1
Senegal National AMR Action Plan	1	1	1	1	1	0	1	0
Regional/Global or multi-country								
Climate smart agriculture Case studies from around the world. *Focus on Senegal and Ghana	0	0	0	0	0	0	0	0

The stem Agro* was rare and only apparent in two *Wider One Health* documents. When used in the *Agri-One Health* documents, it mainly referred to agroforestry practices as a method to increase farming productivity in an environmentally conscious manner. The term agroecology only appeared in reference to agroecological zones, rather than agroecological practices.

Climate Smart Language was absent across documents that did not include *climate smart* as part of their title. Benin's climate-smart agriculture plan provides an accessible definition of climate smart agriculture (CSA), *an ambition to improve the integration of agriculture development and climate responsiveness. It aims to achieve food security and broader development goals under a changing climate and increasing food demand. CSA initiatives sustainably increase productivity, enhance resilience, and reduce/remove greenhouse gases (GHGs)* however, the term *Nature-Based Solution* was absent from all the documents screened across the six countries.

One Health terminology was apparent throughout the documents screened, but was used more holistically, repetitively, and contextually within the *Wider One Health* documents rather than in *Agri-One*



Figure 2. Word cloud showing the most used terms in the policy documents analysed.

Health documents. Interestingly, none of the climate-smart agricultural investment/action plans mentioned the term One Health'. Across all the documents mentioned, One Health issue appeared in discussions around joining-up communications and strategies between sectors, especially in the context of surveillance. Equally, epidemic and pandemic terminology was almost completely absent from *Agri-One Health* documents. Senegal's rapid assessment of Global Health security issues discussed both the terms epidemic and pandemic in relation to its six priority zoonotic diseases and their detailed surveillance and action plans. However, Benin's climate smart agriculture plan and Morocco's investment in climate reform paper only discuss the term pandemic in reference to COVID-19 and its economic impact. In contrast, the *Wider One Health* documents take a more holistic approach to discuss epidemics and pandemics. Many discuss pandemic potential in natural reservoirs such as bats and references, expanding their current surveillance programs to capture changes in (re)emerging diseases in wild species as well as livestock.

The term resistance, discussed in isolation, did appear in many *Agri-One Health* documents in terms of describing crops and livestock varieties with improved drought, heat, and climatic resistance. However, disease-resistant varieties have not yet been discussed. In contrast, the National AMR Action Plans and Pandemic Preparedness plans used the term resistance to refer to drug-resistant infections in humans and animals, and the risk of spread within and between sectors.

The terms pollution and degradation/destruction were discussed together in many documents as they tended to refer to habitat loss and damage and their impacts on wider ecosystem health. Climate-smart agriculture documents focus on soil degradation, which includes the loss of minerals and biodiversity at the microbiological level. *Wider One Health* documents also discussed degradation in reference to wider habitats, linking these terms to urbanization and the resulting loss of wildlife. The most common context in which the term *pollution* appeared was in reference to on-farm pollution, including when linked to the use of fertilizers, pesticides, and animal waste. Nigerian documents also specifically mentioned fossil fuel pollution in terms of greenhouse gas emissions, particularly oil spills, and their impacts on fisheries, and Nigeria is the only country to discuss the development of a framework for pollution and chemical hazards in their National Action Plan for Health Security. Ghana and Nigeria considered water pollution in terms of its impact on irrigation of crops and agricultural yield, but also on humans, domestic animals, and wider ecosystem health. Ghana's mining industry is responsible for Mercury and Cyanide leaching

into ground water, but also for clearing land, which is then used for agriculture rather than being regenerated for wildlife.

The impact of authorship teams on One Health terminology

Trends within this rapid analysis suggest that documents with West African Academics and Institutions in the authorship list (rather than just signatories) present a more cohesive One Health overview than those commissioned by the United States of America/EU/Global North funders. For example, all Ghanaian documents in this analysis include in-country co-authors or contributors. They also have the highest level of terminology crossover between *Agri-One Health* and *Wider One Health* documentation. Morocco, on the other hand, whose documents are primarily produced by external funders, shows a more siloed terminology between *Agri-One Health* and *Wider One Health* documentation.

Discussion

Differential usage of agricultural and One Health language

This rapid situation analysis revealed key differences in the terminology of the 24 West African agricultural reforms and One Health documents. *Agri-One Health* documents focused on the linkages between farming practices and changing environmental conditions, predominantly climatic change, but also soil erosion, habitat loss, and land-use changes linked to increased urbanization. They also focused on the need to re-imagine agricultural practices that can provide larger yields with less intensive resources in terms of water use, chemical fertilizers, and pesticides. However, the health metrics linking animal and human diseases to the use of such chemicals have rarely been discussed. Terms such as zoonosis, epidemic, pandemic, transmission, and Antimicrobial Resistance were sparse or absent across these documents, suggesting a greater focus on environmental and climatic factors, socioeconomic gain, and productivity than holistic One Health.

In contrast, the *Wider One Health documents* placed emphasis on terms such as One Health, zoonoses, Antimicrobial Resistance, transmission of disease, epidemic, pandemic, degradation/destruction, and pollution. These documents took a holistic One Health focus to discuss the agricultural practices and changes needed within the scope of wider ecosystem health. In this sense, *Wider One Health documents* linked the productivity of farming practices to (re)emerging disease threats and the resistance of crop and livestock pests to antimicrobials, including fertilizers, pesticides, prophylactic antibiotics, and growth promoters. While farming and agriculture-related language were equally common in this second set of documents, it was discussed as a key component of the overall One Health approach rather than the sole focus of One Health action. However, the *Wider One Health* documents did not discuss climatic changes, global heating, or pollution in as much detail as the *Agri-One Health* documents did.

Siloing agricultural and One Health language

None of the Climate-smart agricultural action/investment plans in the West African subregion mentioned the term One Health. These are usually short two-page PDFs that focus on agricultural reforms in a changing climate. As such, there is not a vast amount of space to discuss holistic action. However, considering the international and multisectoral engagement with these documents (FAO, World Bank, United States Agency for International Development etc. see [Table 1](#)) it is surprising that the One Health lens is not supported. The One Health approach recognizes the interdependence of human, animal, and environmental health and is particularly important for food production (Bonilla-Aldana et al., 2020; Mackenzie & Jeggo, 2019). The One Health divide is further illustrated by the absence of bio-interventions in CSA plans. Yet recent global syntheses show for example that cyanobacteria-based biofertilizers can reduce synthetic Nitrogen demand by 20–50%, simultaneously lowering nitrous-oxide emissions and runoff-associated AMR hotspots (Nawaz et al., 2025).

Healthy environments support healthy food-producing animals and plants, which in turn support human health through the production of nutritious food. Climate change impacts environmental, animal, and human health directly through heat stress, drought, and flooding, but also indirectly affects animals and soils via human decisions regarding agrochemical usage, farming practices, and animal husbandry (Cataldo et al., 2023; Herrmann et al., 2020; Ouedraogo et al., 2010; Reverter et al., 2020; Sarfo et al., 2022). The lack of One Health focus in climate smart investment and action plans could encourage climate-induced action, which is misinformed by the potential to result in unintended harm. On the other hand, pandemic preparedness, zoonosis action plans, and National Action Plans on Antimicrobial Resistance rarely use language around climate change. Again, this is concerning, as mounting evidence suggests that changes in temperature and humidity are changing the behaviour or disease-causing pests, particularly vectors, but also the biomechanics of infection (Bruguera et al., 2020; El-Sayed & Kamel, 2020; Reverter et al., 2020; Skendžić et al., 2021). For example, mechanisms of Antimicrobial Resistance in bacteria are accelerated by increased temperature (Cavicchioli et al., 2019; Fernández Salgueiro et al., 2024; Kaba et al., 2020).

Thus, although West Africa has clearly invested in the development of policy documents to support a range of health metrics, their language is siloed. Language differences between documents that focus solely on agricultural health and those that take a broader One Health lens may not be problematic, as contextually specific languages and targets are needed to reform specific systems and support specific stakeholders within different farming sectors. However, the long-term validity of such documents may be restricted, as siloing of data into agricultural health versus wider One Health could prevent cohesive monitoring and evaluation of agricultural practices and make it more challenging to determine what success looks like in the rapidly changing One Health landscape of Western Africa.

One health synergies across documents

It is clear from the authorship lists, contributors, signatories, and endorsers that the same stakeholder groups are involved in some of the same documents within each country. While there are obvious silos (as discussed), synergies also exist. Of the five Ghanaian documents screened in this analysis, many engaged a similarly diverse group of signatories, endorsers, and contributors from across the Ministries of Health, Agriculture, Fisheries, Environment and National Parks. The National AMR Action Plan was frequently referenced within the *Strengthening Pandemic Preparedness* document and the *Predict: Action Plan*. Thus, Ghana appears to be a strong example of how diverse One Health documents can feed into each other to ensure that farming practice changes are planned and implemented alongside other One Health deliverables.

Implications for one health and agricultural action

Maintaining One Health and agricultural language siloed across documents could limit West Africa's ability to implement One Health action. The rapid increase in population size in this region will, of course, negate and expand farmland and change to practice (CILSS., 2016; Herrmann et al., 2020; Ouedraogo et al., 2010; United Nations DoEaSA, Population Division, 2021). However, without considering the ecological implications of this on other species (including mammals, insects, birds, and plants), countries could see a plethora of One Health challenges derailing their efforts to increase food production. Spillover over of (re)emerging zoonotic diseases from wildlife to livestock and people, and increases in vector-borne disease outbreaks are of key concern (Anges et al., 2014; Otu et al., 2021); however, the risks of increased agrochemical and pharmaceutical use due to climate change and yield-loss need to be considered with regard to the effect on wider ecosystem function (El-Sayed & Kamel, 2020; Bean et al., n.d; Reddy et al., 2022). Such issues cannot be holistically addressed if the metrics linking animal and human diseases to the use of such chemicals are not discussed in easily accessible guidance documents.

Within this analysis, there is also evidence to suggest that documents produced by international organizations and funders show a more siloed language. This may reflect the stringent funding requirements of international organizations and strategic interest in certain issues such as climate change, food

production, and Antimicrobial Resistance. Yet when these challenges are framed and financed as stand-alone problems, resources risk being channelled into narrow fixes that miss the broader picture: safeguarding whole-ecosystem health, preparing for yield-loss, and delivering integrated One Health outcomes. This is a particular concern for West African countries in this analysis, as all are considered low- or lower-middle-income countries (LMIC) (NADA HAMADEH CVR et al., 2022). As such, any changes in practice need to be appropriate to LMIC budgets, evidence-based and value for money, but also holistic in terms of troubleshooting wider One Health issues and mitigating unintentional harm (Ige et al., 2020). The Ghanaian documents provide a best-practice example within this analysis, as documents across the Agri-One Health and Wider One Health lists reference each other and adopt a cross-cutting language. This should ensure that actions resulting from such guidance are reflective of holistic One Health aims to incorporate human, animal, and environmental health, in addition to climate-conscious reforms to food production. Even in Ghana, where documents cite one another, they remain silent on acceptable yield-loss ceilings during extreme events. By contrast, China's latest National Climate Change Assessment Report obliges all regions to prepare contingency plans that cap drought- and flood-related losses at $\leq 10\%$ (Rahman et al., 2025). Incorporating comparable risk thresholds into West African Agri-One Health plans would help in the assessment of One Health co-benefits, for instance, fewer zoonotic spillovers when grain shortfalls are pre-empted.

Limitations

The review is confined to West Africa and Morocco; consequently, we cannot determine whether the documented siloing of One Health language is continent-specific. A future systematic comparison of policy documents from East and Southern Africa is therefore recommended to test the universality of these findings. In addition our screening processes could be refined and enhanced to include a wider One Health focus, such as looking at specific zoonotic and crop diseases. However, this rapid approach has uncovered significant differences in the One Health reach of the identified documents based on authorship and their specific One Health scope. A full systematic review of One Health agricultural reform in West Africa could now be conducted to provide more contextual insights into the focus and exemptions of our identified documents. The key terms used in this rapid situation analysis will support the development of thorough search strategies and direct larger thematic and gap analyses.

Conclusion

Agri-One Health documentation within and between West African countries is diverse. Key terms relating to agriculture, farming, climate-smart investment, zoonotic, infectious, and (re) emerging diseases, as well as pandemic and epidemic risk factors, are used differently. Differences often appear based on the scope of One Health and the country of the intended impact. There is no single One Health Action Plan that deals directly with environmental and climatic pressures on food systems and disease risks across human, animal, and environmental sectors. Rather, climate-smart agricultural investment guidance should be paired with the zoonosis, pandemic preparedness, or antimicrobial resistance action plans to appropriately consider and address One Health risk. This mismatch in documentation may limit the impact of such work, and there is a need for holistic and simpler guidance that accurately reflects the One Health challenges facing West Africa. However, there is clearly extensive knowledge, practice, and discussion across Western Africa with respect to agricultural reform, which is likely to spearhead contextually informed and specific actions to address food production in the region. Ensuring that such knowledge, practices, and actions are interlinked with wider One Health interventions, such as pandemic preparedness, zoonosis, and Antimicrobial Resistance, is the next logical step in agroecological reform.

Acknowledgments

We thank the wider members of the URBANE consortium who reviewed and provided commentary on this manuscript prior to submission.

Author contributions

CRedit: **Jessica Mitchell**: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft; **Muiz O. Akinyemi**: Data curation, Formal analysis, Methodology, Validation, Writing – review & editing; **Bassey Ebenso**: Conceptualization, Project administration, Supervision.

Declaration of funds

This work was funded by the EU Horizon's Grant agreement number 101059232 as part of the URBANE consortium, work package 3. <https://urbane-project.eu/wp-urbane/>

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by European Union's Horizon Europe research and innovation programme.

About the authors

Jessica Mitchell (PhD) has expertise in Behavioral Ecology (humans and other animals) Antimicrobial Resistance One Health Community Engagement Youth-Led solutions to global challenges whose research interest is in the areas of antimicrobial resistance and zoonoses.

Muiz O. Akinyemi (PhD) has expertise in Microbiology, Bioinformatics, Food security and Food safety whose research interest is in areas on One-health approaches, AMR, Probiotic and Pathogenic microorganisms.

Bassey Ebenso is an Associate Professor of International Health with expertise in Health systems strengthening; Digital health technologies; Nutrition security; One-Health approaches; Health workforce; Community engagement. His research interests are in health policy and systems strengthening in Africa, Asia and the Western Pacific Region.

ORCID

Jessica Mitchell  <http://orcid.org/0000-0002-2892-4630>
 Muiz O. Akinyemi  <http://orcid.org/0000-0002-0734-686X>
 Bassey Ebenso  <http://orcid.org/0000-0003-4147-0968>

Data availability statement

This study did not generate any new data. All information analyzed was obtained from publicly available sources.

References

- Andrew Selaledi, L., Mohammed Hassan, Z., Manyelo, T. G., & Mabelebele, M. (2020). The current status of the alternative use to antibiotics in poultry production: An African perspective. *Antibiotics*, 9(9), 594. <https://doi.org/10.3390/antibiotics9090594>
- Anges, Y., Raphael, N., & Martin, A. (2014). The impact of the expansion of urban vegetable farming on malaria transmission in major cities of Benin. *International Journal of Infectious Diseases*, 21, 144. <https://doi.org/10.1016/j.ijid.2014.03.724>
- Artmann, M., & Sartison, K. (2018). The role of urban agriculture as a nature-based solution: A review for developing a systemic assessment framework. *Sustainability*, 10(6), 1937. <https://doi.org/10.3390/su10061937>
- Baker, R. E., Mahmud, A. S., Miller, I. F., Rajeev, M., Rasambainarivo, F., Rice, B. L., Takahashi, S., Tatem, A. J., Wagner, C. E., Wang, L.-F., Wesolowski, A., & Metcalf, C. J. E. (2022). Infectious disease in an era of global change. *Nature Reviews. Microbiology*, 20(4), 193–205. <https://doi.org/10.1038/s41579-021-00639-z>
- Bean, T. G., Chadwick, E. A., Herrero-Villar, M., Mateo, R., Naidoo, V., & Rattner, B. A. (n.d) Do pharmaceuticals in the environment pose a risk to wildlife? *Environmental Toxicology and Chemistry* 43(3), 595–610. <https://doi.org/10.1002/etc.5528>

- Bjornlund, V., Bjornlund, H., & Van Rooyen, A. F. (2020). Why agricultural production in sub-Saharan Africa remains low compared to the rest of the world—a historical perspective. *International Journal of Water Resources Development*, 36(Sup1), S20–S53. <https://doi.org/10.1080/07900627.2020.1739512>
- Bonilla-Aldana, D. K., Dhama, K., & Rodriguez-Morales, A. J. (2020). Revisiting the One Health approach in the context of COVID-19: A look into the ecology of this emerging disease. *Advances in Animal and Veterinary Sciences*, 8(3), 234–237. <https://doi.org/10.17582/journal.aavs/2020/8.3.234.237>
- Brugueras, S., Fernández-Martínez, B., Martínez-de la Puente, J., Figuerola, J., Porro, T. M., Rius, C., Larrauri, A., & Gómez-Barroso, D. (2020). Environmental drivers, climate change and emergent diseases transmitted by mosquitoes and their vectors in southern Europe: A systematic review. *Environmental Research*, 191, 110038. <https://doi.org/10.1016/j.envres.2020.110038>
- Butcher, A., Cañada, J. A., & Sariola, S. (2021). How to make noncoherent problems more productive: Towards an AMR management plan for low resource livestock sectors. *Humanities and Social Sciences Communications*, 8(1), 1–10. <https://doi.org/10.1057/s41599-021-00965-w>
- Carr, T. W., Mkuhlani, S., Segnon, A. C., Ali, Z., Zougmore, R., Dangour, A. D., Green, R., & Scheelbeek, P. (2022). Climate change impacts and adaptation strategies for crops in West Africa: A systematic review. *Environmental Research Letters*, 17(5), 053001. <https://doi.org/10.1088/1748-9326/ac61c8>
- Cataldo, C., Bellenghi, M., Masella, R., & Busani, L. (2023). One Health challenges and actions: Integration of gender considerations to reduce risks at the human-animal-environmental interface. *One Health (Amsterdam, Netherlands)*, 16, 100530. <https://doi.org/10.1016/j.onehlt.2023.100530>
- Caudell, M. A., Dorado-García, A., Eckford, S., Creese, C., Byarugaba, D. K., Afakye, K., Chansa-Kabali, T., Fasina, F. O., Kabali, E., Kiambi, S., Kimani, T., Mainda, G., Mangesho, P. E., Chimpangu, F., Dube, K., Kikimoto, B. B., Koka, E., Mugara, T., Rubegwa, B., & Swiswa, S. (2020). Towards a bottom-up understanding of antimicrobial use and resistance on the farm: A knowledge, attitudes, and practices survey across livestock systems in five African countries. *PloS One*, 15(1), e0220274. <https://doi.org/10.1371/journal.pone.0220274>
- Cavicchioli, R., Ripple, W. J., Timmis, K. N., Azam, F., Bakken, L. R., Baylis, M., Behrenfeld, M. J., Boetius, A., Boyd, P. W., Classen, A. T., Crowther, T. W., Danovaro, R., Foreman, C. M., Huisman, J., Hutchins, D. A., Jansson, J. K., Karl, D. M., Koskella, B., Mark Welch, D. B., ... Webster, N. S. (2019). Scientists' warning to humanity: Microorganisms and climate change. *Nature Reviews. Microbiology*, 17(9), 569–586. <https://doi.org/10.1038/s41579-019-0222-5>
- CILSS. (2016). Landscapes of West Africa—A Window on a Changing World U.S. Geological Survey EROS, Garretson SD. <https://eros.usgs.gov/westafrica/population#:~:text=Not%20only%20has%20West%20Africa%E2%80%99s%20population%20been%20growing,annual%20growth%20rates%20of%20up%20to%209%20percent>
- De La Fuente, A., Jacoby, H. G., & Lawin, K. G. (2020). Impact of the West African Ebola epidemic on agricultural production and rural welfare: Evidence from Liberia. *Journal of African Economies*, 29(5), 454–474. <https://doi.org/10.1093/jae/ejaa002>
- Ejeromedoghene, O., Tesi, J. N., Uyanga, V. A., Adebayo, A. O., Nwosisi, M. C., Tesi, G. O., & Akinyeye, R. O. (2020). Food security and safety concerns in animal production and public health issues in Africa: A perspective of COVID-19 pandemic era. *Ethics, Medicine, and Public Health*, 15, 100600. <https://doi.org/10.1016/j.jemep.2020.100600>
- El-Sayed, A., & Kamel, M. (2020). Climatic changes and their role in emergence and re-emergence of diseases. *Environmental Science and Pollution Research International*, 27(18), 22336–22352. <https://doi.org/10.1007/s11356-020-08896-w>
- Fernández Salgueiro, M., Cernuda Martínez, J. A., Gan, R. K., & Arcos González, P. (2024). Climate change and antibiotic resistance: A scoping review. *Environmental Microbiology Reports*, 16(5), e70008. <https://doi.org/10.1111/1758-2229.70008>
- Giller, K. E. (2013). *Can we define the term 'farming systems'? A question of scale* (p. 149–153). SAGE Publications Sage UK. <https://doi.org/10.5367/oa.2013.0139>
- Gliessman, S. (2018). *Defining agroecology* (pp. 599–600). Taylor & Francis. <https://doi.org/10.1080/21683565.2018.1432329>
- Herrmann, S. M., Brandt, M., Rasmussen, K., & Fensholt, R. (2020). Accelerating land cover change in West Africa over four decades as population pressure increased. *Communications Earth & Environment*, 1(1), 53. <https://doi.org/10.1038/s43247-020-00053-y>
- Hollinger, F., & Staatz, J. M. (2015). Agricultural Growth in West Africa. Market and policy drivers FAO, African Development Bank ECOWAS Pobrano październik.
- Hossain, A., Krupnik, T. J., Timsina, J., Mahboob, M. G., Chaki, A. K., Farooq, M., et al. (2020). Agricultural land degradation: Processes and problems undermining future food security. Environment, climate, plant and vegetation growth (pp. 17–61). Springer. https://doi.org/10.1007/978-3-030-49732-3_2
- Ige, G. O., Akinagbe, O. M., Odefadehan, O. O., & Ogunbusuyi, O. P. (2020). Constraints to farmers' choice of climate change adaptation strategies in Ondo state of Nigeria. In *African Handbook of Climate Change Adaptation* (p. 1–15). Springer. https://doi.org/10.1007/978-3-030-42091-8_103-1
- Kaba, H. E., Kuhlmann, E., & Scheithauer, S. (2020). Thinking outside the box: Association of antimicrobial resistance with climate warming in Europe—A 30 country observational study. *International Journal of Hygiene and Environmental Health*, 223(1), 151–158. <https://doi.org/10.1016/j.ijheh.2019.09.008>
- Karst, I. G., Mank, I., Traoré, I., Sorgho, R., Stückemann, K.-J., Simboro, S., Sié, A., Franke, J., & Sauerborn, R. (2020). Estimating yields of household fields in rural subsistence farming systems to study food security in Burkina Faso. *Remote Sensing*, 12(11), 1717. <https://doi.org/10.3390/rs12111717>

- Kavhiza, N. J., Zargar, M., Prihodko, S. I., Pakina, E. N., Murtazova, K. M.-S., & Nakhaev, M. R. (2022). Improving crop productivity and ensuring food security through the adoption of genetically modified crops in sub-Saharan Africa. *Agronomy*, 12(2), 439. <https://doi.org/10.3390/agronomy12020439>
- Kimera, Z. I., Mshana, S. E., Rweyemamu, M. M., Mboera, L. E., & Matee, M. I. (2020). Antimicrobial use and resistance in food-producing animals and the environment: An African perspective. *Antimicrobial Resistance and Infection Control*, 9(1), 37. <https://doi.org/10.1186/s13756-020-0697-x>
- Mackenzie, J. S., & Jeggo, M. (2019). The one health approach—Why is it so important? *Tropical Medicine and Infectious Disease*, 4(2), 88. <https://doi.org/10.3390/tropicalmed4020088>
- Nada Hamadeh CVR, Eric Metreau, Shwetha Grace Eapen. (2022). *New World Bank country classifications by income level: 2022-2023 World Bank Blogs: World Bank*. <https://blogs.worldbank.org/opendata/new-world-bank-country-classifications-income-level-2022-2023>
- Nawaz, T., Fahad, S., Gu, L., Xu, L., & Zhou, R. (2025). Harnessing nitrogen-fixing cyanobacteria for sustainable agriculture: opportunities, challenges, and implications for food security. *Nitrogen*, 6(1), 16 6:16. <https://doi.org/10.3390/nitrogen6010016>
- One Health Commission. (2023). One health strategic action plans: One health commission. https://www.onehealthcommission.org/en/resources_services/one_health_strategic_action_plans/
- Otekinrin, O. A. (2022). Investigating food insecurity, health and environment-related factors, and agricultural commercialization in Southwestern Nigeria: Evidence from smallholder farming households. *Environmental Science and Pollution Research International*, 29(34), 51469–51488. <https://doi.org/10.1007/s11356-022-19544-w>
- Otu, A., Effa, E., Meseko, C., Cadmus, S., Ochu, C., Athingo, R., Namisango, E., Ogoina, D., Okonofua, F., & Ebenso, B. (2021). Africa needs to prioritize One Health approaches that focus on the environment, animal health and human health. *Nature Medicine*, 27(6), 943–946. <https://doi.org/10.1038/s41591-021-01375-w>
- Ouedraogo, I., Tigabu, M., Savadogo, P., Compaoré, H., Odén, P. C., & Ouadba, J. M. (2010). Land cover change and its relation with population dynamics in Burkina Faso, West Africa. *Land Degradation & Development*, 21(5), 453–462. <https://doi.org/10.1002/ldr.981>
- Palli, R., & Deb, A. (2020). Defining the concept of ‘family farming’: periphery and history. *Editorial Board*, 9(4), 170. [http://ijmer.s3.amazonaws.com/pdf/volume9/volume9-issue4\(8\)-2020.pdf#page=180](http://ijmer.s3.amazonaws.com/pdf/volume9/volume9-issue4(8)-2020.pdf#page=180)
- Rahman, T. U., Shah, S., Hassan, S., & Fahad, S. (2025). Food security challenges and adaptation strategies in china amidst global climate change. *Journal of Umm Al-Qura University for Applied Sciences*, 1–14. <https://doi.org/10.1007/S43994-025-00226-5/TABLES/1>
- Reddy, S., Kaur, K., Barathe, P., Shriram, V., Govarthanan, M., & Kumar, V. (2022). Antimicrobial resistance in urban river ecosystems. *Microbiological Research*, 263, 127135. <https://doi.org/10.1016/j.micres.2022.127135>
- Reverter, M., Sarter, S., Caruso, D., Avarre, J.-C., Combe, M., Pepey, E., Pouyaud, L., Vega-Heredía, S., de Verdal, H., & Gozlan, R. E. (2020). Aquaculture at the crossroads of global warming and antimicrobial resistance. *Nature Communications*, 11(1), 1870. <https://doi.org/10.1038/s41467-020-15735-6>
- Sarfo, I., Shuoben, B., Otchwemah, H. B., Darko, G., Kedjanyi, E. A. G., Oduro, C., Folorunso, E. A., Alriah, M. A. A., Amankwah, S. O. Y., & Ndafira, G. C. (2022). Validating local drivers influencing land use cover change in Southwestern Ghana: A mixed-method approach. *Environmental Earth Sciences*, 81(14), 367. <https://doi.org/10.1007/s12665-022-10481-y>
- Skendžić, S., Zovko, M., Živković, I. P., Lešić, V., & Lemić, D. (2021). The impact of climate change on agricultural insect pests. *Insects*, 12(5), 440. <https://doi.org/10.3390/insects12050440>
- United Nations DoEaSA, Population Division. (2021). United Nations, Department of Economic and Social Affairs, Population Division World Population Prospects: The 2021Revision (custom data acquired via website). <https://population.un.org/wpp/>