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Case Report

Advancing Organic Agriculture Research in Africa—A Case Study of the Science Track of the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs)

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Abstract: The development of certified organic agriculture in Africa has been partly impeded by limited sound science-based information to tackle multifarious challenges facing the subsector along the value chains. Robust and well-articulated research strategies are key to driving this desired development. Therefore, a case study was carried out to appraise the science track of the last four African Organic Conferences (AOCs) with a view to identifying the direction of research activities in the continent across the regions and suggest areas presently being overlooked. Out of the 251 research papers evaluated, the majority were dealing with agronomy (41.4%) and socioeconomic (16.3%) aspects during the four editions of AOC. Research areas largely overlooked include organic aquaculture, policy issues, standards and certification, cross-disciplinary and participatory research methods, health and safety of organic products and research methodology. Papers presented at the AOCs were spread across the regions and outside Africa as follows: West (48.6%), East (28.2%), Southern (7.1%), North (<1%), Central (<1%) and outside the continent (14.3%). The paper also discusses strategies that can be adopted in moving organic agriculture research forward in the continent.

Keywords: funding; organic agriculture; policy; region; research agenda; research area

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1. Introduction

Africa is both the second largest and most crowded continent in the world after Asia. The population of Africa is 1.3 billion and equivalent to 16.72% of the total world population [1]. Globally, it has been projected that about 840 million people will be undernourished by 2030 in the world partly because of COVID-19 pandemic complications, and beyond undernourishment, over two billion people had no regular access to nutritious and sufficient food in 2019 [2]. About 25% of the world's arable land is in Africa, but the continent produces just 10% of the global agricultural output [3]. Despite the continent's endowment with natural resources, the Sub-Saharan Africa (SSA) region remains in food insecurity, and the poverty rate is increasing instead of reducing [4]. Strategies to feed the ever-increasing population of Nigeria, the most populous country in the continent, were recently suggested [5]. Several challenges confronting the agriculture sector of the continent and their proffered solutions have been documented by McIntyre [6]. While comparing continents, Niggli et al. [7] reported that limited evidence about the productivity and profitability of organic agriculture under African conditions, limited access to organic seeds, equipment, biopesticides and other inputs, as well as access to information and technology transfer, among others, are obstacles for farmers who want to convert to organic. Worthy

of note is the current underinvestment in agricultural research and innovation by African states [8]. This is against the backdrop of earlier agreement that a minimum of 10% of the annual budget be allocated to agriculture based on the Maputo Declaration on Agriculture and Food Security in Africa (Assembly/AU/Decl. 7(ii)) in July 2003 in Maputo [9]. In a study by Benin et al. [10], most Sub-Saharan African countries allocated less than five percent of their agricultural budget to research over the period from 2010 to 2015.

It has been documented that commensurate investment in agricultural research and development (R&D) is one of the most important drivers of agricultural productivity growth of any country or continent [11–13]. Even in parts of the developed world, the overall funding for organic research is less than 1% of the total fund allocated to agricultural research, even though the organic farmland in the continent of Europe is above 4% of the total farmland [14] against 0.2% in Africa [15]. This trend was reiterated in a research survey that recorded the highest perceived level of unmet funding needs in Africa and access to research grants as one of the least available instruments to aid development of organic agriculture in [16]. Similarly, in an earlier study on how organic agriculture contributes to economic development in Africa, it was reported that limited research outputs and organic inputs are key development issues [17]. Consequently, organic agriculture research is still at a low ebb in the continent with an average research expenditure of USD 2.94 per hectare against USD 14.17 (Europe) and USD 20.00 (North America) as reported by Niggli et al. [18]. An overview of organic agriculture in Africa and steps to improving it was recently documented by Olowe [19].

Earlier reports and findings have demonstrated that the returns of agricultural R&D investments are huge [20–22]. For example, it is estimated that every US dollar spent on national agricultural R&D generates average returns in the order of USD 3 [13,23]. Moreover, sustained spending on agricultural research is critical given the time lag between investments and expected returns—about 10 years, according to a study by Alene [24]. However, many African nations cannot wait this long to reap their returns on investment (ROI) in agriculture. This was confirmed by a report of a decade between 2000 and 2011 according to which half of all Sub-Saharan countries experienced near-zero or negative growth in agricultural R&D spending [25]. As a result, the performance of the research systems has been unsatisfactory. Furthermore, a report by the International Food Policy Research Institute on agricultural research investments in Sub-Saharan Africa showed that agricultural investment intensity (expenditure in agricultural R&D expressed as a share of agricultural GDP) has declined since 2014 [26].

Although organic agriculture is about two decades old in the continent of Africa, we believe there is a need to identify the direction where research efforts are being concentrated by prospective scientists using the science track of the past editions (1st, 2nd, 3rd and 4th African Organic Conferences (AOCs)) as a case study. A similar exercise was successfully done on papers presented at the Organic World Congress Science track of the 2nd, 3rd, 4th and 5th editions [27] and difference on research relevance between articles and proceedings [28]. The AOC is the continental forum where scientists from different disciplines meet every three years to present research findings and interact with colleagues, and it is regarded as the largest gathering of organic agriculture scientists in Africa. Similar meetings also take place in some subregions of the continent. Therefore, the aim of this paper was to carry out content analysis of the scientific papers distributed across fourteen broad research areas and five regions of the continent with the objective to identify the direction of research activities, suggest presently understudied areas and articulate strategies that will move organic agriculture research forward in the continent.

2. Materials and Methods

This paper adopted a case study method to appraise the scientific papers documented in the Book of Proceedings of the Science track of the African Organic Conference (AOC) organized during the 1st, 2nd, 3rd and 4th AOCs held in Kampala, Uganda (2009), Lusaka, Zambia (2012), Lagos, Nigeria (2015) and Saly Portudal, Senegal (2018), respectively. The case study method is very appropriate for this study because it is useful in understanding the dynamics present within a single setting [29] and concerned with the complexity in terms of the disciplines involved and the nature of the case in question [30]. The case study method also allows the use of a variety of methods to explore and understand certain trends within a particular context [31]. We did a content analysis of 251 scientific papers published in the Book of Proceedings of the four Africa Organic Conferences (AOCs) along the following 14 broad research areas:

i. Agronomy (crops and soil research areas including plant health, plant breeding, fruit and vegetable cultivation, cropping systems and techniques, rotation studies, soil fertility, nutrient and weed management);
ii. Livestock (animal production, breeding and genetics, and health);
iii. Socioeconomics (organic consumers, farm economics of production and marketing, agricultural extension and analysis of production systems);
iv. Agroforestry, environment and biodiversity agroecology studies, impact assessment of organic agriculture on the environment, greenhouse gas (GHG) emission studies, crop diversity studies;
v. Aquaculture (fish and shrimp production);
vi. Cross disciplinary and participatory research methods (multi- and transdisciplinary studies;
vii. Food systems and quality (changing food systems, food quality studies that compare organic and conventional foods);
viii. Standards and certification (cost of certification, compliance with standards, appraisal of the PGS scheme, etc.;
ix. Policy issues including legislation of organic production, promulgation of policies, etc.;
x. Knowledge transfer and dissemination (studies on knowledge transfer to end users);
xi. Research methodology (novel methodologies in organic agriculture);
xii. Advocacy and training;
xiii. Health and safety of organic products (nutrition and food safety studies);
xiv. Basic organic agriculture concepts.

The papers were divided into five regions of Africa (Central Africa—7 countries, East Africa—13 countries, North Africa—7 countries, West Africa—16 countries and Southern Africa—19 countries). Out of the 14 key research areas identified, some key research areas were further partitioned into major components such as crop production (vegetables, arable crops (oilseeds, pulses and cereal), fruits (olives, grapes, coffee, cocoa and citrus), agroecology, pest and disease management and weed management), livestock production (animal welfare, animal feed, animal health and multicriteria assessment of livestock systems) and socioeconomics (agricultural policy, consumer research, organic market and certification and livelihoods) across six continents. Overall, the papers were quantified using descriptive statistics across research areas and continents.

3. Results

3.1. Africa's Key Organic Agriculture Indicators as of 2019

Africa has about 2.0 million hectares of farmland dedicated to organic agriculture, and that translates to just 3% of the global organic farmland as of 2019. However, about 27% of the global organic producers live in the continent of Africa. The organic share of total farmland is extremely low at 0.2 and 1.5% in Africa and the world, respectively. Organic retail sales in Africa are at EUR 17.0 million as against EUR 106.404 million billion in the world as of 2019 (Table 1).

Table 1. Key organic agriculture indicators of Africa as of 2019.

Key Indicators	Africa	World
Total organic area (ha)	2,030,830	72.3 million
Share of global organic farmland (%)	3	100
Organic share of total farmland (%)	0.2	1.5
Organic producers	850,490	3,135,120
Share of total producers (%)	27.0	100
Organic retail sales (millions of euros)	17.0	106.404

Source: Willer et al., 2021 [15].

3.2. Overview of Papers across Research Areas

In this study, we did a content analysis of a total of 251 papers published in the Proceedings of the Science track of the 1st, 2nd, 3rd and 4th African Organic Conferences. The 2nd AOC held in Lusaka, Zambia in 2012 recorded the highest number (106) of papers (Table 2). The lowest number (40) of papers was recorded at the maiden edition held in Kampala, Uganda in 2009. The 3rd and 4th editions recorded 53 and 52 papers, respectively. Contributions from agronomy (crop and soil research areas) were the highest across the four AOCs, accounting for 104 papers (41.4%) and followed by contributions from socioeconomic studies (41; 16.3%) during the AOCs. Agroforestry, agroecology, environment and biodiversity also accounted for 26 papers (10.3%) of the contributions. Much fewer papers were presented from livestock research (17; 6.7%) compared to those of agronomy across the four editions. In fact, no contribution was made on organic livestock production in 2009. The bulk of the contributions focused on the production phase of the value chains of most agricultural commodities and largely overlooked the postproduction phase of the value chains. The research areas with a very limited number of papers include aquaculture, policy issues, standards and certification. In fact, research areas such as cross-disciplinary and participatory research methods, health and safety of organic products and research methodology are yet to receive any research attention (Table 2).

Table 2. Distribution of papers across research areas during the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs).

Research Areas	1st AOC, 2009		2nd AOC, 2012		3rd AOC, 2015		4th AOC, 2018	
	Papers	%	Papers	%	Papers	%	Papers	%
Agronomy	14	35.0	37	35.0	31	58.5	22	42.3
Livestock	0	0	9	8.5	4	7.5	4	7.7
Socioeconomics	10	25.0	24	22.6	5	9.4	2	3.8
AAE&B	8	20.0	8	7.5	2	3.7	8	15.4
Aquaculture	2	5.0	0	0	1	1.9	4	7.7
CD&PRM	0	0	0	0	0	0	0	0
FS&Q	0	0	0	0	0	0	0	0
S&C	1	2.5	9	8.5	0	0	0	0
Policy issues	2	5.0	6	5.7	0	0	0	0
KT&D	1	2.5	3	2.8	3	5.7	4	7.7
RM	0	0	0	0	0	0	0	0
A&T	1	2.5	2	1.9	4	7.5	2	3.8
H&S	0	0	0	0	0	0	0	0
Basic OA concepts	1	2.5	8	7.5	3	5.7	6	11.5
Total	40	100	106	100	53	100	52	100

FS&Q food systems and quality, S&C standards and certification, AAE&B agroforestry, agroecology, environment and biodiversity, KT&D knowledge transfer and dissemination, CD&PRM cross-disciplinary and participatory research methods, H&S health and safety of organic products, OA organic agriculture, RM research methodology, A&T advocacy and training.

The paper contribution from the five regions and outside Africa is presented in Table 3. In all the editions, the host region contributed the highest number of papers, except at the 2nd AOC hosted by Zambia (Southern Africa region), and East Africa contributed the highest number (42). Contributions from countries outside Africa stood at 13, 15, 3 and 5 during the 1st, 2nd, 3rd and 4th AOCs, respectively. Central Africa, which comprises seven countries, is the only region that has contributed just one paper to the science track of the AOC since inception. Contributions from North Africa have been very minimal between 2012 and 2018. Overall, at the four editions of the AOCs, the regions contributed papers as follows: West (122; 48.6%), East (71; 28.2%), Southern (18; 7.1%), North (3; 0.01%), Central (1; 0.0.03%) and others (36; 14.3%).

Table 3. Distribution of scientific papers across the regions of Africa during the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs).

Regions of Africa	1st AOC, 2009		2nd AOC, 2012		3rd AOC, 2015		4th AOC, 2018	
	Papers	%	Papers	%	Papers	%	Papers	%
Central	0	0	0	0	1	0.01	0	0
East	16	40.0	42	39.6	5	9.4	8	15.4
North	0	0	1	0.9	1	1.9	1	1.9
Southern	0	0	16	15.1	1	1.9	1	1.9
West	11	27.5	32	30.2	42	79.2	37	71.2
Others	13	32.5	15	14.2	3	5.7	5	9.6
Total	40	100	106	100	53	100	52	100

3.3. Distribution of Papers across Crop Production Components and Regions

Seven key components of crop production were reviewed as listed in Table 4 across the four AOCs and regions of the continent. Papers on arable crops dominated the contributions during the 1st, 2nd and 4th editions of the AOCs. Studies on pests and diseases were also prominent and on par with arable crops during the 1st and 4th AOCs, even more so at the 3rd AOC. Paper contributions on pomology and soil fertility peaked during the 3rd AOC at 22.6 and 32.3%, respectively. West Africa has been dominating the contributions on agronomy, followed by the East Africa region during the four editions of the AOCs. No contributions came from Central, North and Southern regions during the 1st AOC. To date, the Central Africa region is yet to register any contributions under agronomy at any AOC.

3.4. Distribution of Papers across Livestock Production Components and Continents

The study reviewed animal welfare, livestock feed, animal health and livestock systems' assessment as the key areas of livestock production (Table 5). No contribution was made in livestock production at the maiden edition of the Conference in 2009 at Uganda.

However, in 2012, the bulk of the papers were on livestock system assessment (LSA) and animal health (AH). Similarly, in 2015, there were equally few contributions on LSA and AH. In 2018 however, only three papers were presented on AH and one on Animal Feed (AF). Consistently, the majority of the contributions were from the West, East and Southern regions of the continent. Up to now, Central and North regions have not made any contributions to livestock production at the AOCs.

3.5. Distribution of Papers across Socioeconomic Components and Regions during the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs)

Table 6 contains the details of paper distribution across agricultural policy, consumer research, marketing, certification and organic systems/concepts during the AOCs. Marketing and consumer research studies dominated the presentations at the four editions, except in 2018, when no presentation was made on marketing. The 14 papers presented in 2009 were equally contributed from East Africa and outside Africa. However, at subsequent

editions, papers were presented from West, North, Southern and Central Africa. To date, only one paper has been presented from Central Africa on marketing.

Table 4. Distribution of scientific papers across crop production components and regions during the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs).

Crop Production Components	Total Number of Papers	Regions					
		Central	**East**	**North**	**South**	**West**	**Others**
		1st AOC (2009)					
Vegetables	0 (0)	0	0	0	0	0	0
Arable crops	4 (26.7)	0	2	0	0	2	0
Pomology	2 (13.3)	0	0	0	0	2	0
Agroecology	1 (6.7)	0	0	0	0	0	1
PDM	4 (26.7)	0	3	0	0	0	1
WM	0 (0)	0	0	0	0	0	0
Soil fertility	4 (26.7)	0	1	0	0	3	0
Total	15 (100)	0 (0)	6 (40)	0 (0)	0 (0)	7 (46.7)	2 (13.3)
		2nd AOC (2012)					
Vegetables	4 (10.5)	0	0	0	0	4	0
Arable crops	19 (50.0)	0	5	0	1	13	0
Pomology	3 (7.9)	0	2	0	0	1	0
Agroecology	1 (2.6)	0	0	0	1	0	0
PDM	8 (21.1)	0	2	0	1	5	0
WM	1(2.6)	0	0	0	0	1	0
Soil	2 (5.3)	0	1	0	0	1	0
Total	38 (100)	0 (0)	8 (21.1)	0 (0)	3 (7.9)	25 (65.8)	0 (0)
		3rd AOC (2015)					
Vegetables	4 (12.9)	0	0	0	0	4	0
Arable crops	4 (12.9)	0	0	0	0	4	0
Pomology	7 (22.6)	0	1	0	0	6	0
Agroecology	0 (0)	0	0	0	0	0	0
PDM	6 (19.3)	0	0	0	0	6	0
WM	0 (0)	0	0	0	0	0	0
Soil fertility	10 (32.3)	0	1	0	0	9	0
Total	31 (100)	0 (0)	2 (6.5)	0 (0)	0 (0)	29 (93.5)	0 (0)
		4th AOC (2018)					
Vegetables	4 (17.4)	0	1	0	0	3	0
Arable crops	6 (26.1)	0	0	0	0	6	0
Pomology	3 (13.0)	0	0	0	0	3	0
Agroecology	1 (4.3)	0	0	0	0	1	0
PDM	6 (26.1)	0	1	0	0	5	0
WM	0 (0)	0	0	0	0	0	0
Soil fertility	3 (13.0)	0	1	0	0	2	0
Total	23 (100)	0 (0)	3 (13.0)	0 (0)	0 (0)	20 (87.0)	0 (0)

PDM pest and disease management, *WM* weed management, Note: percent in parentheses.

Table 5. Distribution of scientific papers across livestock production components and regions during the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs).

Livestock Production Components	Total Number of Papers	Regions					
		Central	East	North	South	West	Others
1st AOC (2009)							
AW	0	0	0	0	0	0	0
AF	0	0	0	0	0	0	0
AH	0	0	0	0	0	0	0
LSA	0	0	0	0	0	0	0
Total	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
2nd AOC (2012)							
AW	0 (0)	0	0	0	0	0	0
AF	1 (11.1)	0	1	0	0	0	0
AH	2 (22.2)	0	0	0	0	2	0
LSA	6 (66.7)	0	2	0	4	0	0
Total	9 (100)	0 (0)	3 (33.3)	0 (0)	4 (44.4)	2 (22.2)	0 (0)
3rd AOC (2015)							
AW	0 (0)	0	0	0	0	0	0
AF	0 (0)	0	0	0	0	0	0
AH	2 (50.0)	0	0	0	0	2	0
LSA	2 (50.0)	0	1	0	0	1	0
Total	4 (100)	0 (0)	1 (25.0)	0 (0)	0 (0)	3 (75.0)	0 (0)
4th AOC (2018)							
AW	0 (0)	0	0	0	0	0	0
AF	1 (25.0)	0	0	0	0	1	0
AH	3 (75.0)	0	0	0	0	3	0
LSA	0 (0)	0	0	0	0	0	0
Total	4 (100)	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	0 (0)

AW animal welfare, AF animal feed, AH animal health, LSA livestock system assessment, Note: percent in parentheses.

Table 6. Distribution of scientific papers across socioeconomic components and regions during the 1st, 2nd, 3rd and 4th African Organic Conferences (AOCs).

Socio Economics Components	Total Number of Papers	Regions					
		Central	East	North	South	West	Others
1st AOC (2009)							
Agric. Policy	2 (13.3)	0	0	0	0	0	2
Consumer res.	4 (26.6)	0	4	0	0	0	0
Marketing	6 (40.0)	0	2	0	0	0	4
Certification	1 (6.7)	0	1	0	0	0	0
Organic sys/concepts	1 (6.7)	0	0	0	0	0	1
Total	14 (100)	0 (0)	7 (50.0)	0 (0)	0 (0)	0 (0)	7 (50.0)
2nd AOC (2012)							
Agric. Policy	6 (12.2)	0	3	0	1	0	2
Consumers	10 (20.4)	0	6	0	2	2	0
Marketing	14 (28.6)	0	12	1	0	1	0
Certification	9 (18.4)	0	7	0	0	0	2
Organic sys/concepts	8 (16.3)	0	6	0	1	1	0
Total	47 (100)	0 (0)	34 (72.3)	1 (2.1)	4 (8.5)	4 (8.5)	4 (8.5)

Table 6. *Cont.*

Socio Economics Components	Total Number of Papers	Regions					
		Central	East	North	South	West	Others
		3rd AOC (2015)					
Agric. Policy	0 (0)	0	0	0	0	0	0
Consumers	3 (25.0)	0	1	0	0	2	0
Marketing	2 (16.7)	1	1	0	0	0	0
Certification	0 (0)	0	0	0	0	0	0
Organic sys/concepts	3 (25.0)	0	0	0	0	0	3
Total	8 (100)	1 (12.5)	2 (25.0)	0 (0)	0 (0)	2 (25.0)	3 (37.5)
		4th AOC (2018)					
Agric. Policy	0 (0)	0	0	0	0	0	0
Consumer res.	2 (20.0)	0	0	0	0	2	0
Marketing	0 (0)	0	0	0	0	0	0
Certification	0 (0)	0	0	0	0	0	0
Organic sys/concepts	6 (60.0)	0	1	0	0	3	2
Total	8 (100)	0 (0)	1 (12.5)	0 (0)	0 (0)	5 (62.5)	2 (25.0)

Note: Percent in parentheses.

4. Discussion

Conferences are scholarly avenues for scientists to present and discuss preliminary results of their research and stay abreast of current research trends in their field and learn about cutting-edge developments in their areas of research interest [28]. Sometimes, papers presented at conferences are further extended to journal articles by the authors, since such articles carry more weight than proceedings in many research assessment procedures across several disciplines. Consequently, papers in conference proceedings receive far fewer citations than journal articles, probably due to the lesser dissemination and visibility of conference proceedings [32]. Nonetheless, authors can get their conference proceedings published faster than by following the standard publication process in journals [33].

The findings of the content analysis of the 251 papers presented at the 1st, 2nd, 3rd and 4th editions of the AOC revealed that the majority of the papers came from studies on agronomy and socioeconomics, especially at the first three editions. However, this trend is not peculiar to Africa alone but has been reported for papers presented at four editions of the Organic World Congress Science Track organized by the International Society of Organic Agriculture Research (ISOFAR) by Olowe and Somefun [27]. The overlooked research areas in Africa include organic weed management, aquaculture, policy issues, standards and certification. Meanwhile, research findings on cross-disciplinary and participatory research methods, health and safety of organic products and research methodology areas have never been reported at any AOC. Organic breeding of plants and animals have been totally disregarded at the first editions of the AOC. According to Kumar et al. [34], organic plant breeding is a system that develops varieties of crops that are high-yielding under organic conditions in position at maintaining the health of the environment and human beings around. It has been reported that numerous local varieties, possessing properties suitable for organic and low-input practices, have been lost [35], whereas some of them are more adaptable to the different environmental conditions and management practices [36]. This has propelled breeders to start new programs for producing new varieties that meet the criteria of organic practices. The inclusion in the breeding programs of local varieties and landraces that are carriers of valuable traits should not be limited by organic seed regulations [37]. Furthermore, in this study, the gradual decrease in the number of scientific publications on plant disease management from 2009 to 2015 could be attributed to the development of botanicals that are effective in controlling pests and diseases in organic production systems [38,39]. Weeds constitute a major constraint to crop production in the tropics and can account for about 77–90% or even total crop failure depending on the nature,

density and periodicity of occurrence [40,41]. This scenario underscores the urgent need for the development of affordable organic herbicides for the resource-constrained farmers in the tropics. More attention should also be devoted to research in the areas of agroforestry, agroecology, environment and biodiversity, as they are not adequately addressed.

Even though Africa possesses one third of the total world population of livestock [42] this subsector is still being undervalued in both conventional and organic production systems. This is evident in the low output of research papers presented on organic livestock at the AOCs. Therefore, efforts should be pitched towards improving the productivity of animal husbandry and practices in Africa as suggested by [8]. Africa's diverse livestock are well-adapted to the harsh conditions under which they live [43]. This should be explored under an organic livestock production system to improve the productivity of the sector. It has been reported that the genetic diversity represented within Africa's indigenous breeds offers a unique resource to meet increased demand and tackle forthcoming challenges such as climate change [44]. A similar trend was recorded for organic aquaculture during the AOCs. According to Willer et al. [15], organic aquaculture production stood at 690,000 metric tons in 2019, with Africa's production excluded since there was no record. According to FAO [45], the global fish production as of 2018 was 179 million metric tons, with aquaculture responsible for 46% (82.34 million metric tons). Correspondingly, organic aquaculture (690,000 metric tons) translated to 0.008% of global aquaculture. This confirmed an earlier report with 0.1% of organic aquaculture relative to global aquaculture [46]. Therefore, research efforts should be towards exploring the potential of aquaculture to complement the overexploited marine and inland fisheries. Furthermore, the shortage of research papers on other areas such as consumer studies, standards and certification, policy issues and health and safety issues of organic foods should now inform qualitative research projects that can culminate in empirical science-based findings that policy makers can use to articulate policies for the subsector. At present, only Morocco, Tunisia and Uganda have national policies on organic agriculture in place [47,48]. The 1st EU/North-African Conference on Organic Agriculture was successfully held in Marrakesh, Morocco on 11–12 November 2019, and the second edition is slated for Tunisia in 2023 [49].

To date, the limited research efforts in organic agriculture research in Africa have been reported mainly from the West (48.6%) and East Africa (28.2%) regions. Contributions from outside Africa diminished markedly after the 2nd AOC from fifteen (15) papers to three. The three other regions (North, Southern and Central) have not been participating actively in AOCs due to insufficiently trained and experienced staff with relevant postgraduate qualifications [23]. There is an urgent need for capacity development of scientists in different areas of organic agriculture [18,50] Another angle to the present situation of organic agriculture research in Africa could be the African agricultural research system (ARS), which is dominated by a public sector research approach with little or no private sector participation. The lead organization in the ARS in Africa is the Forum for Agricultural Research in Africa (FARA). The objective of FARA is to promote and coordinate collaboration in agricultural research, and development of partnerships and strategic alliances is considered one of FARA's core practice areas, as a part of its networking support functions [51]. Organic agriculture should occupy a prime position in the framework of agricultural innovation platforms of FARA as outlined by Fatunbi et al. [52] if the subsector must truly evolve in the continent. The following four subregional research organizations (SROs) have been established to coordinate agricultural R&D efforts across Africa's regions: North Africa Research Organization (NARO), West and Central African Council for Agricultural Development (CORAF/WECARD), Center for Coordination of Agricultural Resources and Development for Southern Africa (CCARDESA) and the Association for Strengthening Agricultural Research in East and Central Africa (ASARECA). Unfortunately, both FARA and the SROs depend heavily on donor funding, which may be unsustainable [8], and most SROs and national research institutions also fail to acknowledge organic agriculture as a potential lever for agricultural development in the continent.

In Europe, for example, research efforts are properly being moderated based on well-articulated agendas that clearly define goals and directions in organic farming research, such as Vision for an Organic Food and Farming Research Agenda to 2025 [53] and Strategic Research Agenda for organic food and farming [54]. These documents contain vision themes, research goals and strategic research priorities that guide scientists in their endeavors. A similar document is being prepared by the Network for Organic Agriculture Research in Africa (NOARA), tagged Organic Agriculture Research Agenda for Africa (OARAA 2032). Details of the network are available on www.noara.bio (accessed on 3 May 2022). It is believed that when the document is completed, it will serve as a roadmap for scientists in the continent. It has been suggested that by pooling limited resources and talent, partnerships can facilitate the undertaking of joint research agendas among participating countries in the continent and thereby help improve the effectiveness of agricultural research systems [8].

Moving Organic Agriculture Research Forward in Africa

The following strategies are hereby suggested:

a. At national levels, National Organic Movements (NOAMs) should appraise ongoing research efforts in their respective countries to identify gaps in knowledge.
b. Carry out a skill gap analysis of their faculty to know areas that require capacity development.
c. Do a needs analysis of stakeholders across the value chains of diverse commodities.
d. Articulate people-oriented national policies that will fast-track the development of the subsector.
e. Increase funding of organic agriculture research from national and international donors.
f. Build synergies between research institutes at national, regional and international levels.
g. Share widely the Organic Agriculture Research Agenda for Africa (OARAA 2032) among member countries to key into.
h. Research endeavors in the continent should align as much as possible with the Organic 3.0: Innovation with research [55].

5. Conclusions

A content analysis of the papers presented at the first four editions of AOC revealed that 41.4, 16.3 and 10.3% of the papers were from agronomy (crop and soil), socioeconomic studies and agroforestry, agroecology, environment and biodiversity, respectively. Very few papers (6.7%) were delivered on livestock research. Contributions largely came from the West (48.6%) and East (28.2%) African regions, while very limited paper presentations were recorded for the North, Southern and Central African regions. The overlooked research areas in Africa include organic aquaculture, policy issues, standards and certification, cross-disciplinary and participatory research methods, health and safety of organic products and research methodology. If organic agriculture research must move forward in Africa, the modus operandi of the Agricultural Research System (ARS) must innovate to generate more interest from the policy makers and funds from donors and sponsors in and outside Africa.

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References

1. Worldometer. World Population (Live). 2022. Available online: https://www.worldometers.info/world-population (accessed on 14 April 2022).
2. Food and Agriculture Organization of the United Nations (FAO). International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme, and World Health Organization. The State of Food Security and Nutrition in the World 2020. Transforming Food Systems for Affordable Healthy Diets. FAO. 2020. Available online: http://www.fao.org/3/ca9692en/online/ca9692en.html (accessed on 14 April 2022).
3. Jayaram, K.; Riese, J.; Sanghvi, S. Agriculture: Abundant Opportunities. *McKinsey Q.*. 2010. Available online: https://www.mckinsey.com/featured-insights/middle-east-and-africa/africas-path-to-growth-sector-by-sector (accessed on 3 May 2022).
4. Harsmar, M. Agricultural Development in Sub-Saharan Africa. In Proceedings of the Expert Group on Development Issues Ministry for Foreign Affairs, Workshop, Frösundavik, Sweden, 8–9 March 2006.
5. Olowe, V. Africa 2100: How to feed Nigeria in 2100 with 800 million inhabitants. *Org. Agric.* **2021**, *11*, 199–208. [CrossRef]
6. McIntire, J.C. Transforming African agriculture. *Glob. J. Emerg. Mark. Econ.* **2014**, *6*, 145–179. [CrossRef]
7. Niggli, U.; Andres, C.; Willer, H.; Baker, B.P. Building a global platform for organic farming research, innovations and technology transfer. *Org. Agric.* **2017**, *7*, 209–224. [CrossRef]
8. Program of Accompanying Research for Agricultural Innovation (PARI). *From Potentials to Reality: Transforming Africa's Food Production*; Centre for Development Research, University of Bonn: Bonn, Germany, 2020.
9. Ebi, B.O.; Amaraihu, O.C. Agricultural expenditure, Maputo declaration target and agricultural output: A case study of Nigeria. *Int. J. Econ. Commer. Manag.* **2018**, *6*, 516–531.
10. Benin, S.; McBride, L.; Mogues, T. *Why Do African Countries Underinvest in Agricultural RD?* International Food Policy Research Institute: Washington, DC, USA, 2016.
11. Evenson, R.E.; Gollin, D. *Crop Variety Improvement and Its Effect on Productivity*; CABI Pub.: New Haven, CT, USA, 2003.
12. McIntyre, B.D.; Herren, H.R.; Wakhungu, J.; Watson, R.T. *Synthesis Report: A Synthesis of the Global and Sub-Global IAASTD Reports*; Island Press: Washington, DC, USA, 2009.
13. Fuglie, K.; Rada, N. *Resources, Policies, and Agricultural Productivity in Sub-Saharan Africa*; Economic Research Report No. 145; United States Department of Agriculture: Washington, DC, USA, 2013.
14. Rahmann, G.; Aksoy, U. Foreword of the 4th Organic World Congress. In Proceedings of the 4th ISOFAR Scientific Conference "Building Organic Bridges" at the Organic World Congress, Istanbul, Turkey, 13–15 October 2014.
15. Willer, H.; Travnicek, J.; Meier, C.; Schlatter, B. (Eds.) *The World of Organic Agriculture. Statistics and Emerging Trends 2021*; Research Institute of Organic Agriculture (FiBL), Frick and IFOAM Organics International: Bonn, Germany, 2021.
16. United Nations Conference on Trade and Development (UNCTAD). Financing Organic Agriculture in Africa: Mapping the Issues. UNCTAD/WEB/DITC/TED/2016/6. 2016. Available online: webditcted2016d6_en(1).pdf (accessed on 3 May 2022).
17. International Centre for Research in Organic Food Systems (ICROFS). *How Organic Agriculture Contributes to the Economic Development of Africa: Market-Driven Development of Organic High Value Chain*; ICROFS Fact Sheet No. 4; International Centre for Research in Organic Food Systems (ICROFS): Viborg, Denmark, 2010.
18. Niggli, U.; Willer, H.; Baker, B.P. *A Global Vision and Strategy for Organic Farming Research*; TIPI—Technology Innovation Platform of IFOAM—Organics International, Research Institute of Organic Agriculture (FiBL): Frick, Switzerland, 2016.
19. Olowe, V. Improving Organic Agriculture in the Developing World: Africa. In *Improving Organic Crop Cultivation*; Köpke, U., Ed.; Burleigh Dodds Science Publishing: Cambridge, UK, 2018; ISBN 978-1-78676-184-2.
20. Gardner, B.L.; Evenson, R.E.; Rausser, G.C.; Pingali, P. *Handbook of Agricultural Economics: Agricultural Development: Farmers, Farm Production and Farm Markets*; Elsevier: Amsterdam, The Netherlands, 2001.
21. Mogues, T.; Fan, S.; Benin, S. Public investments in and for agriculture. *Eur. J. Dev. Res.* **2015**, *27*, 337–352. [CrossRef]
22. Alston, J.M.; Pardey, P.G. Developing-Country Perspectives on Agricultural R&D: New Pressures for Self-Reliance? In *Agricultural R&D in the Developing World: Too Little, Too Late?* International Food Policy Research Institute: Washington, DC, USA, 2017.
23. Lynam, J.; Beintema, N.; Roseboom, J.; Badiane, O. *Agricultural Research in Africa: Investing in Future Harvests*; International Food Policy Research Institute: Washington, DC, USA, 2016.
24. Alene, A.D. Productivity growth and the effects of R&D in African agriculture. *Agric. Econ.* **2010**, *41*, 223–238.
25. World Bank. *Reaping Richer Returns: Public Spending Priorities for African Agriculture Productivity Growth*; The World Bank: Washington, DC, USA, 2016.
26. Beintema, N.; Stads, G.J. *A Comprehensive Overview of Investments and Human Resource Capacity in African Agricultural Research*; ASTI Synthesis Report; International Food Policy Research Institute: Washington, DC, USA, 2017.

27. Olowe, V.I.; Somefun, O.T. A synthesis of the 2nd, 3rd, 4th and 5th ISOFAR Scientific Conferences: Pointers to future frontiers of knowledge. *Org. Agric.* **2020**, *10*, 139–147. [CrossRef]
28. Gonzalez-Albo, B.; Bordons, M. Articles vs. proceedings papers: Do they differ in research relevance and impact? A case study in the Library and Information Science field. *J. Informetr.* **2011**, *5*, 369–381. [CrossRef]
29. Eisenhardt, K.M. Building theories from case study research. *Acad. Manag. Rev.* **1989**, *14*, 532–550. [CrossRef]
30. Stake, R.E. *The Art of Case Study Research*; Sage: Thousand Oaks, CA, USA, 1995.
31. Yin, R.K. *Case Study Research: Design and Methods*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2003.
32. Bar-Ilan, J. Web of Science with the conference proceedings citation indexes: The case of computer science. *Scientometrics* **2010**, *83*, 809–824. [CrossRef]
33. Montesi, M.; Mackenzie Owen, J. From Conference to journal publication: How conference papers in software engineering are extended for publication in journals. *J. Am. Soc. Inf. Sci. Technol.* **2008**, *59*, 816–829. [CrossRef]
34. Kumar, A.; Kumar, P.; Singh, L.; Kumar, S. Biomolecule reports. *Int. eNewsletter* **2011**, 1–7. Available online: Organic_plant_breeding_Opportunities_and.pdf (accessed on 3 May 2022).
35. Lammerts van Bueren, E.T.; Jones, S.S.; Tamm, L.; Murphy, K.M.; Myerse, J.R.; Leifertf, C.; Messmer, M.M. The need to breed crop varieties suitable for organic farming, using wheat, tomato and broccoli as examples: A review. *NJAS Wagen. J. Life Sci.* **2011**, *58*, 193–205. [CrossRef]
36. Quiedeville, S.; Barjolle, D.; Mouret, J.C.; Matthias, S. Ex-post evaluation of the impacts of the science-based research and innovation program: A new method applied in the case of farmers' transition to organic production in the Camargue. *J. Innov. Econ. Manag.* **2017**, *1*, 145–170. [CrossRef]
37. Vanloqueren, G.; Baret, P.V. Why are ecological, low-input, multi-resistant wheat cultivars slow to develop commercially? A Belgian agricultural 'lock-in' case study. *Ecol. Econ.* **2008**, *66*, 436–446. [CrossRef]
38. Haldhar, S.M.; Jat, G.C.; Deshwal, H.L.; Gora, J.S.; Singh, D. Insect Pest and Diseases Management in Organic Farming. In *Towards Organic Agriculture*; Gangwar, B., Jat, N.K., Eds.; Today & Tomorrow' Printers and Publishers: New Delhi, India, 2017; pp. 359–390.
39. Mukhtar, Y.; Abdu, K.; Abdulkadir, A.I.; Galalain, A.M.; Maigari, A.K.; Yunusa, U.M. Sustainable use of botanical products in plant protection as a promising panacea to integrated pests management and control: Issues, challenges, benefits and future prospects. *Int. J. Adv. Acad. Res.* **2018**, *4*, 65–77.
40. Imoloame, E.O. Evaluation of herbicide mixtures and manual weed control method in maize (*Zea mays* L.) production in the Southern Guinea agro-ecology of Nigeria. *Cogent Food Agric.* **2017**, *3*, 1375378. [CrossRef]
41. Ajokporise, D.; Ogedegbe, O.; Nwangie, S.E. Effect of weed management methods on growth and yield of soybean (*Glycine max* (L) Merrill) in the wet rain-forest zone of Nigeria. *Int. J. Inn. Agric. Bio. Res.* **2018**, *6*, 18–23.
42. African Union (AU). *The Livestock Development Strategy for Africa (LiDeSA) 2015–2035: The Roadmap to a Successful Livestock Sector. Executive Summary*; Department of Rural Economy and Agriculture, African Union: Addis Ababa, Ethiopia, 2015.
43. Kim, J.; Hanotte, O.; Mwai, O.A.; Dessie, T.; Bashir, S.; Kim, J.; Hanotte, O.; Mwai, O.A.; Dessie, T.; Basir, S.; et al. The genome landscape of indigenous African cattle. *Gen. Biol.* **2017**, *18*, 34. [CrossRef]
44. Mwai, O.; Hanotte, O.; Kwon, Y.J.; Cho, S. African indigenous cattle: Unique genetic resources in a rapidly changing world. Asian Australas. *J. Anim. Sci.* **2015**, *28*, 911–921.
45. Food and Agriculture Organization of the United Nations (FAO). *The State of World Fisheries and Aquaculture 2020: Sustainability in Action*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2020.
46. Dube, K.; Chanu, T.I. *Organic Aquaculture: Way to Sustainable Production. Advances in Fish Research*; Goswami, U.C., Ed.; Narendra Publishing House: Delhi, India, 2012; pp. 219–229.
47. Auerbach, R.M.B.; Oelofse, M.; Mentz-LaGrange, S.; Ross, A.; de Grassi, A. *Assessment for the African Union Commission of North, West, Central and Southern Africa, with a View to Mainstreaming Ecological Organic Agriculture*; Biological Systems Consulting & Research: George, South Africa, 2019.
48. National Organic Agriculture Policy (NOAP). *Ministry of Agriculture, Animal Industry and Fisheries*; National Organic Agriculture Policy (NOAP): Entebbe, Uganda, 2019.
49. Azim, K.; Hafidi, M.; Bouizgarne, B.; Rahman, G. (Eds.) *Book of Abstracts: 1st EU/North-African Conference on Organic Agriculture (EU-NACOA) "Bridging the Gap, Empowering Organic Africa". Proceedings of the 1st EU/North-African Conference on Organic Agriculture (EU-NACOA), Marrakesh, Morocco, 11–12 November 2019*; INRA: Rabat, Morocco, 2019; ISBN 978-9920-787-06-2.
50. Aiyelaagbe, I.O.O.; Harris, P.J.C.; Olowe, V.I.O. Skills gaps in organic agriculture and SWOT analysis in higher educational institutions (HEIs) in Anglophone west Africa. *Org. Agric.* **2016**, *6*, 109–118. [CrossRef]
51. Adekunle, A.A.; Ajuruchukwu, O.; Tunde, A.; Mugabo, J.; Oluwole, F.A. *Lessons and Impact of Partnerships: Experiences from FARA's Initiatives in Africa*; Forum for Agricultural Research in Africa: Accra, Ghana, 2013.
52. Fatunbi, A.O.; Youdeowei, A.; Ohiomoba, S.I.; Adekunle, A.A.; Akinbamijo, O.O. *Agricultural Innovation Platforms: Framework for Improving Sustainable Livelihoods in Africa*; Forum for Agricultural Research in Africa (FARA): Accra, Ghana, 2016.
53. Niggli, U.; Slabe, A.; Halberg, N.; Schmid, O.; Schlüter, M. *Vision for an Organic Food and Farming Research Agenda to 2025*; IFOAM—Organics International EU Group and FiBL: Brussels, Belgium, 2008.

54. Schmid, O.; Padel, S.; Halberg, N.; Huber, M.; Darnhofer, I.; Micheloni, C.; Koopmans, C.; Bügel, S.; Stopes, C.; Willer, H.; et al. *Strategic Research Agenda for Organic Food and Farming*; Technology Platform Organics, IFOAM EU Group: Brussels, Belgium, 2009; 116p.
55. Rahmann, G.; Ardakani, R.; Barberi, P.; Boehm, H.; Canali, S.; Chander, M.; David, W.; Dengel, L.; Erisman, J.W.; Galvis-Martinez, A.C.; et al. Organic Agriculture 3.0 is innovation with research. *Org. Agric.* **2017**, *7*, 169–197. [CrossRef]