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Bibliometric Analysis of Yam Production Literature on Sub-Saharan Africa Listed in AGORA and TEEAL Databases between 2003 and 2017

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BIBLIOMETRIC ANALYSIS OF YAM PRODUCTION LITERATURE ON SUB-SAHARAN AFRICA LISTED IN AGORA AND TEEAL DATABASES BETWEEN 2003 AND 2017

By

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ABSTRACT

Objective - This paper reports the findings from a study designed to investigate the following traits on white guinea yam publications for fifteen years: information outlets, trend of scientific productivity, degree of author's collaboration, prolific authors and their institutional affiliations, journal bibliographic coupling and co-citation analysis. The main aim of the paper is to examine patterns in yam research literature with a view to enhancing the development of yam production research by collating indexed information.

Methods - Scholarly citation data of yam production literature on Sub-Saharan Africa from AGORA and TEEAL databases between 2003 and 2017 were collected. Network analysis and descriptive bibliometric research design was adopted to analyse the citation data of yam production literature on Sub-Saharan Africa listed in AGORA and TEEAL. The data obtained was analysed using frequency and percentages, co-citation analysis and bibliographic coupling. VOS viewer was used for bibliographic coupling and co-citation analysis.

Results - Findings showed that journal articles are published more in journals (93.5%) than other outlets. Collaboration index was 0.8% which indicates that 80% journal articles were written by 2 or more authors. Journal articles are mostly published in Nigeria Agricultural Journal (21 articles) and the citation network contains 36 items (authors) with 11 clusters and a total link strength of 136. The journal bibliographic coupling citation network contains 8 items (journals) including journals with 3 clusters, 8 links and a total link strength of 31. Food Chemistry, Soil and Tillage Research and Field Crops Research which were journals published in Netherlands have the highest ranking JIF (above 3.0) and H-Index (between 109 and 204). Publications from Economics of production accounted for 40 articles (31 journals, 6 reports and 3 Technical Notes).

Conclusion – The study has been able to identify the principal forms of sources; degree of author's collaboration; first 25 prolific authors; geographical location of journals; top 20 journals; study areas of publications; trend of scientific productivity; impact factors and H-index of publication outlets; institutional affiliations of authors; co-cited authors; and co-cited journals in Sub-Saharan yam literature listed in AGORA and TEAL databases between 2003 and 2017.

Keywords: Yam production, Bibliometrics, Citation network, Co-citation, Bibliographic Coupling, Journal Impact Factor (JIF), H-Index.

INTRODUCTION

Yam is a major food crop in the diet of the people of sub-Saharan Africa. Among the various yam types cultivated, the white Guinea species (Dioscorea rotundata) is considered as a major component of the socio-economic life of the people (Agbaje, Ogunsumi, Oluokun, Akinlosotu, 2005). Yam is indigenous to the forest areas of West Africa and it is originally cultivated in the forest areas and the forest fringes of the savannah belts in Nigeria. However, it has extended into the Guinea savannah belts in Nigeria. The introduction of yam to the savannah belts and the increased urbanization in Nigeria has opened a wider market for local consumption and demand for yam tubers and products (Agbaje, et al, 2005). Yam production has increased significantly over the years due to larger area cultivated and improvement in tuber yield. The area harvested in the world has increased from 1.15 million (Ha) in 1961 to 5.04 million (Ha) in 2012. Yield (T/Ha) in the world also increased from 72.35

thousand metric tonnes in 1961 to 116.65 thousand metric tonnes in 2012. Over 58.8 million tonnes of yams were produced in the world in 2012, out of which 92.2% were from West Africa. Nigeria accounted for over 65% (38 million metric tonnes) of the world yam production from 2.9 million hectares with a market value of $7.75 billion in 2012 (FAO, 2014). Thus, research efforts had not only benefitted farmers in expanding yam production across agro-ecologies it has also increased productivity and national income.

Yam researchers have enormous information at their disposal and many are added on a daily basis to the yet unutilized information that is on the shelf. One method for tracking, evaluating and effectively utilizing the research articles is through citation analysis (Olatokun & Makinde, 2009b). Citation analysis is a technique of bibliometric study of literature which can be used to identify the periodicals that are most productive in a particular field of knowledge. It can also identify the frequently cited authors, assess the coverage of library collections, trace the history of research topics of interest and know the interrelationship between authors. From the analysis, the core journal title for acquisition, watershed publications in particular disciplines and prolific authors are determined. The earliest citation analysis was carried out by Gross and Gross in the year 1927 in which he ranked the journals in Chemistry (Kittur, 2017).

According to Bellis, (2009), the term bibliometrics was coined by Alan Pritchard in 1969 to describe the application of mathematics and statistical methods to books and other media of communication (Edewor, 2013). Swain (2011) stated that bibliometric study on single journal is a promising area of research in the field of Library and Information Science. In this type of study data is collected from a single journal covering a particular period and vividly analyzed from different directions to find out authorship pattern, bibliographical forms of citations, chronological distributions of citations and publication half life, core authors, core journals, and journal impact factor. The findings from such studies provide some interesting and useful facts to researchers, authors, and editors regarding various crucial aspects of scholarly communication of the source journal.

Janeving (2009), says that 'bibliometrics methods may be applied for the mapping of different aspects of science and technology systems and contribute to information research, political decisions, and the management of research.' Bibliometrics offers a range of methods for evaluating research productivity (Borgman & Furner, 2002), for individuals and institutes. Ritchie (1978) divided bibliometric studies into two broad groups: descriptive studies (dealing with characteristics or features of a body of literature), and behavioural studies, sometimes referred to as citation studies, but not restricted to them (dealing with the relationships formed between components of the literature). In agreement, Nicolaisen (2007) stated that citation analysis is a well-established investigational method, falling into the category of bibliometrics.

Citation analysis as a bibliometric technique has been applied to examine the coverage of library acquisition and a tool to develop core literature for collection development (Karisson, 1994; Enger, 2009; Cooke & Rosenthal, 2011). It is also a useful instrument to identify scholars who may be behind a particular subject area and apparently the most frequently cited authors (Garfield 1992). As observed by Hoang, Kaur and Menzcer (2010), data from citation analysis can be used to determine the popularity and impact of specific articles, as well as gauge the importance of an author's work. Citation analysis has been used to quantitatively assess the core journal titles and watershed publications in particular disciplines; interrelationship between authors from different institutions and schools of thought (Sommer, 2005). According to Ocholla and Ocholla (2007) journals provide a platform on which the research output and impact of individual authors, institutions or countries are measured. This is because journals are veritable sources of scholarly research findings that are of interest to researchers, corporate bodies, librarians, donor agencies, publishers, editors, database producers, information brokers, universities, research institutes, etc.

Rapid economic growth and increased agricultural productivity over the past two decades have seen the number of undernourished people drop by almost half. Many developing countries that used to suffer from famine and hunger can now meet the nutritional needs of the most vulnerable. Central and East Asia, Latin America and the Caribbean have made huge progress in eradicating extreme hunger (UNDP, 2018). These are all huge achievements in line with the targets set out by the first Millennium Development Goals. Unfortunately, extreme hunger and malnutrition remains a huge barrier to development in many countries. Seven hundred and ninety-five million people are estimated to be chronically undernourished as of 2014, often as a direct consequence of environmental degradation, drought and loss of biodiversity. Over 90 million children under the age of five are dangerously underweight. And one person in every four still goes hungry in Africa. The Sustainable Development Goals (SDGs) aim to end all forms of hunger and malnutrition by 2030, making sure all people – especially children – have access to sufficient and nutritious food all year round. This involves promoting sustainable agricultural practices: supporting small scale

farmers and allowing access to land, technology and markets. It also requires international cooperation to ensure investment in infrastructure and technology to improve agricultural productivity (UNDP, 2018).

There is no known study that has been carried out on citation analysis on Sub-Saharan Africa yam literature in spite of enormous research on yam and the importance of yam to the socio-economic life of people in this area. This study intends to fill the literature gap with the aim of exploiting citation analysis tool to understand the available information in Sub-Saharan Africa yam literature and how to utilize it to further increase yam productivity to achieve Sustainable Development Goals 2 (Zero Hunger). This will also assist in focussed research agenda for further development of yam in sub-Saharan Africa through improved collaborative research among scientists. It is on this premise that this study will be carried out to give the citation analysis of yam production in sub-Saharan Africa in articles archived in AGORA and TEEAL databases. AGORA (Access to Global Online Research on Agriculture program) is a bibliographic database launched by Food and Agriculture Organization (FAO) of the United Nations while TEEAL (The Essential Electronic Agricultural Library) a project of Cornell University's Alberta R. Mann Library; is an offline database which institutions subscribe to. This study outcome would help researchers to identify prolific authors with whom they can collaborate which will help their future research to improve yam productivity, quality journal outlets, extent of research in the different areas of specialization and the degree of collaboration in yam research.

Based on the above objective, the study is driven by the following research questions:

1. What are the principal forms of sources in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?
2. What is the degree of authors' collaboration in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?
3. Who are the first 25 prolific authors and their institutional affiliation?
4. What is the geographical location of journals in which Sub-Saharan authors published their articles?
5. Which top 20 journals are the publication outlets for authors publishing Sub-Saharan yam literature?
6. What are the study areas in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?
7. What is the trend of scientific productivity in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?
8. What are the impact factors and H-index of publication outlets for authors publishing Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?
9. What are the institutional affiliations of the authors of Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?
10. Who are the co-cited authors in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017; and
11. Which journals were co-cited in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017?

The rest of this paper is organized as follows: the next section presents review of previous studies followed by the methodology adopted in the execution of the study; the results from the study are presented next followed by a discussion of the findings. The conclusions and suggestions for further studies finalized the paper.

PREVIOUS STUDIES

Adesina & Opesade (2018), conducted a study on "Bibliometric Analysis of sickle cell anaemia literature on Nigeria, listed in PubMed between 2006 and 2016". Findings showed that Journal publications were the most common sources cited with 87.3% (6308) of all the cited materials; the highest number of article publication was recorded in 2013 followed by 2014, 2010 and 2016 with 32, 31, 30 and 30 articles respectively. Also, result showed that the degree of collaboration between authors of sickle cell anaemia literature on Nigeria listed in PubMed during the period (2006 and 2016) ranged from 0.85 to 1 and the average degree of collaboration is 0.93. Majority of the authors are affiliated to Nigerian institutions while other authors are affiliated to United Kingdom institutions and United States institutions. It was observed that 10% (132) of the contributions is from the "University of Nigeria Teaching Hospital, Enugu, Nigeria". Fagbola and Adejoro (2012), carried out a study on the, "Citation Pattern of the Nigerian Journal of Horticultural Science from 1990-2005". Findings showed that Ahmadu Bello University

contributed the highest number of articles 72(30%) between 1990 and 2005; Volume 2 (1994) has the highest number of contributors while the least number of contributors was in Volume 10. The National Horticultural Research Institutes (NIHORT) has the highest number of contributors among the Research Institutes 45 (72.6%). From the affiliation of the authors, none of the foreign authors is from African countries; this implies that other African countries have not been able to access the journal as an avenue to disseminate information on horticultural crops, though the journal is listed on AJOL (African Journal online).

Findings from a study carried out by Fasae (2012) show that nearly one-third of total citations were made to journal articles (34.97%), the highest citations were recorded in 2006 with 1370 citation counts. About types of authorship cited, slightly more than half of the total citations where from single authorship (52.21%). Olatokun & Makinde (2009a), conducted citation analysis of doctoral works submitted to the Department of Animal Science, University of Ibadan, Nigeria. Findings showed that journals were the most utilized reference materials in the dissertations. The most cited journals in the dissertations were Poultry Science Journal (926 citations). Poultry nutrition works had the highest number of dissertations followed by agricultural biochemistry and nutrition. The oldest cited item was a periodical.

Ezema & Eze (2011) carried out a study on "Analysis of cited information sources in Nigerian agricultural research with emphasis on animal health and production". Fifty-eight percent of the publications are journal while books and monographs accounted for 24%. The findings also reveal that more than 31% of the cited sources were published between 1991 and 2000. There is also a very low citation to electronic sources which would have provided citations to more current materials. Similarly, authorship pattern reveals that multiple authors dominate the cited sources. About 21 journals were identified as the most frequently cited journals while most frequently researched animal is poultry. Findings from a study carried out by Kittur (2017) on citation analysis of an open access journal, International Journal of Agronomy showed that there were 66 articles published with 15.71% of the articles cited in the journal being single authored. The statistics shows that Journals are most preferred with 78.34% of citations.

METHODOLOGY

This study employed descriptive bibliometric research design. Data was sourced from AGORA, a bibliographic database launched by Food and Agriculture Organization (FAO) of the United Nations and TEEAL, a project of Cornell University's Alberta R. Mann Library which is an offline database which institutions subscribe to. The H-Index and impact factors of journals were retrieved from 2018 Journal Impact Factor List (JCR) which was published by Scijournal (https://www.scijournal.org).

The entire Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017 formed the body of data analysed. A total of 395 articles were published on yam, in TEEAL; 500 articles were published on yam, in AGORA and 170 articles were on sub-Saharan Africa within the citation window. A total of 68 documents (with a total of 1,582 references of which there were 849 journal references) were eventually used for co-cited authors and co-cited journals analysis. The analysis of the overall collaboration in Sub-Saharan yam literature listed in AGORA and TEEAL databases was calculated using Subramanyam (1983) formula. Microsoft Excel, Statistical Package for Social Sciences Software, Bibexcel and VOS Viewer software were the tools used to analyse the data collected.

AGORA AND TEEAL databases were accessed by initiating a search in the search box using the search term ((yam) AND ("2003: 2017")). After accessing the results, articles that did not discuss white guinea yam (Dioscorea rotundata) production in sub-Saharan Africa were manually excluded during data entry.

The frequency distribution of principal forms was carried out using Statistical Package for Social Science (SPSS) as well as the most prolific authors. The H-Index and Journal Impact Factor were retrieved from 2018 Journal Impact Factor List (JCR) which was published by Scijournal. Journal Impact Factor was used to determine the quality of Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017. For author co-citation and bibliographic coupling, 68 author's details and 849 journal reference details were extracted from each Sub-Saharan yam literature listed in AGORA and TEEAL databases to Microsoft Notepad (.txt format) which was later imported into Bibexcel where the data was converted from Web of Science format to network file (.net). Analysis was carried out with VOS Viewer.

RESULTS

The results of the study are presented in this section starting with the format of the publications as shown in Table 1.

Table 1:   **Format of Publication**

YEAR OF PUBLICATION	DATABASE	FORMAT OF PUBLICATION				Total	Percentage
		Journal	Magazine	Report	Technical Note		
2003	AGORA	2	0	0	0	11	6%
	TEEAL	9	0	0	0		
2004	AGORA	4	0	0	0	8	5%
	TEEAL	4	0	0	0		
2005	AGORA	9	0	0	0	13	8%
	TEEAL	3	1	0	0		
2006	AGORA	8	0	0	0	12	7%
	TEEAL	4	0	0	0		
2007	AGORA	13	0	0	0	17	10%
	TEEAL	4	0	0	0		
2008	AGORA	5	0	0	0	9	5%
	TEEAL	4	0	0	0		
2009	AGORA	2	0	0	0	15	9%
	TEEAL	13	0	0	0		
2010	AGORA	3	0	0	0	8	5%
	TEEAL	5	0	0	0		
2011	AGORA	8	0	0	0	15	9%
	TEEAL	6	0	0	1		
2012	AGORA	8	0	0	0	14	8%
	TEEAL	2	0	4	0		
2013	AGORA	8	0	0	0	20	12%
	TEEAL	9	0	1	2		
2014	AGORA	12	0	0	0	14	8%
	TEEAL	0	0	2	0		
2015	AGORA	6	0	0	0	6	4%
	TEEAL	0	0	0	0		
2016	AGORA	4	0	0	0	4	2%
	TEEAL	0	0	0	0		
2017	AGORA	4	0	0	0	4	2%
	TEEAL	0	0	0	0		
	AGORA	94	0	0	0		
	TEEAL	65	1	7	3		100%
	TOTAL	159	1	7	3	170	

Table 1 shows that four (4) types of sources namely Journals, Magazines, Reports and Technical notes were identified as the forms of publication in AGORA and TEEAL databases in this study. It also shows the distribution of these sources in the databases per year. Journal publications were the most common sources cited with 159 documents (93.5%); AGORA contained 94 documents while TEEAL had 65 documents, followed by Reports with 7 documents (4.1%) from TEEAL, Technical Notes with 3 documents (1.8%) from TEEAL and Magazines with 1 document (0.6%) from TEEAL. The number of Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017 ranged from 4 to 20 (2% - 12%).

Degree of Authors' Collaboration in Sub-Saharan Yam Literature

Table 2 presents the results on the degree of authors' collaboration in sub-Saharan yam literature between 2003 and 2017.

Table 2 Degree of authors' collaboration in Sub-Saharan yam literature.

YEAR OF PUBLICATION	DATABASE	TYPE OF AUTHORSHIP			Total (Nm+Ns)	Degree of Collaboration (Nm/Total)
		Single Author (Ns)	Joint Author (Nm)	Corporate Body (Nm)		
2003	AGORA	0	2	0	2	
	TEEAL	3	6	0	9	
	Total	3	8	0	11	**0.72**
2004	AGORA	2	2	0	4	
	TEEAL	0	3	1	4	
	Total	2	5	1	8	**0.75**
2005	AGORA	2	7	0	9	
	TEEAL	1	1	2	4	
	Total	3	8	2	13	**0.69**
2006	AGORA	3	5	0	8	
	TEEAL	1	3	0	4	
	Total	4	8	0	12	**0.67**
2007	AGORA	1	12	0	13	
	TEEAL	1	3	0	4	
	Total	2	15	0	17	**0.88**
2008	AGORA	0	5	0	5	
	TEEAL	1	3	0	4	
	Total	1	8	0	9	**0.89**
2009	AGORA	0	2	0	2	
	TEEAL	2	11	0	13	
	Total	2	13	0	15	**0.87**
2010	AGORA	0	3	0	3	
	TEEAL	1	4	0	5	
	Total	1	7	0	8	**0.88**
2011	AGORA	3	3	0	6	
	TEEAL	1	6	2	9	
	Total	4	9	2	15	**0.67**
2012	AGORA	1	7	0	8	
	TEEAL	0	2	4	6	
	Total	1	9	4	14	**0.93**
2013	AGORA	1	7	0	8	
	TEEAL	0	9	3	12	
	Total	1	16	3	20	**0.85**
2014	AGORA	2	10	0	12	
	TEEAL	0	0	2	2	
	Total	2	10	2	14	**0.71**
2015	AGORA	2	4	0	6	
	Total	2	4	0	6	**0.67**
2016	AGORA		4	0	4	
	Total		4	0	4	**1**
2017	AGORA		4	0	4	
	Total		4	0	4	**1**
Total	AGORA	17	77	0	94	
	TEEAL	11	51	14	76	
	Total	28	128	14	170	**0.80**

Table 2 shows that the degree of collaboration between authors of Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017 ranged from 0.67 to 1 and the average level of collaboration is 0.80. The highest articles were collected in the following years: 2013 (20 articles) with collaborative index of 0.85; 2007 (17 articles) with collaborative index of 0.88; 2009 (15 articles) with collaborative index of 0.87; 2011 (15 articles) with collaborative index of 0.67. The least articles were collected in 2016 & 2017 (4 articles) with a collaborative index of 1.

Prolific Authors and their affiliation

Table 3 presents the results on the first 25 prolific authors and their institutional affiliation in sub-Saharan yam literature between 2003 and 2017.

Table 3   First 25 prolific authors and their institutional affiliation

S/N	NAME	No. of articles	Percentage (%)	Institutional affiliation
1.	ASEIDU, R	19	3.63	International Institute of Tropical Agriculture (IITA), Oyo, Nigeria
2.	HUGHES, J.D'A	7	1.34	International Rice Research Institute
3.	OGBONNA, M.C.	6	1.15	National Roots Crops Research Institute, Umudike, Abia State
4.	OKOYE, B.C.	5	0.96	National Roots Crops Research Institute, Umudike, Abia State
5.	ORKWOR, G.C.	5	0.96	National Roots Crops Research Institute, Umudike, Abia State
6.	ANO, A.O.	4	0.76	National Roots Crops Research Institute, Umudike, Abia State
7.	ASUMUGHA, G.N.	4	0.76	National Roots Crops Research Institute, Umudike, Abia State
8.	ENI, A.O.	4	0.76	International Institute of Tropical Agriculture(IITA)
9.	EZE, S.C	4	0.76	University of Nigeria, Nsukka
10.	IBEAWUCHI, I.I.	4	0.76	Federal University of Technology, Owerri
11.	IKEORGU, J.E.G	4	0.76	National Roots Crops Research Institute, Umudike, Abia State
12.	KUMAR, P.L.	4	0.76	University of Witwatersrand, Johannesburg
13.	REY, M.E.C	4	0.76	University of Witwatersrand, Johannesburg
14.	CHINAKA, E.C.	3	0.57	National Roots Crops Research Institute, Umudike, Abia State
15.	DURUIGBO, C.I.	3	0.57	Federal University of Technology Owerri, Imo State, Nigeria.
16.	EZEH, C.I.	3	0.57	National Roots Crops Research Institute, Umudike, Abia State
17.	KIKUNO, H.	3	0.57	International Institute of Tropical Agriculture (IITA), Oyo, Nigeria
18.	MIGNOUNA, H.D.	3	0.57	African Agricultural Technology Foundation (AATF),Nairobi, Kenya
19.	OBIEFUNA, J.C.	3	0.57	Federal University of Technology, Owerri, Imo State, Nigeria
20.	ODU, B.O.	3	0.57	International Institute of Tropical Agriculture (IITA), Oyo, Nigeria
21.	ONYENOBI, V.O.	3	0.57	National Roots Crops Research Institute, Umudike, Abia State
22.	OTEGBAYO, B.O.	3	0.57	Bowen University, Iwo, Osun State
23.	OTOO, E.	3	0.57	CSIR-Crops Research Institute, Kumasi, Ghana
24.	SARTIE, A.	3	0.57	Massey University, Palmerston North, New Zealand
25.	SHOYINKA, S.A.	3	0.57	International Institute of Tropical Agriculture (IITA), Oyo, Nigeria

Table 3 shows the first 25 prolific authors of Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017. The most prolific author was Aseidu, Robert from IITA, Ibadan with 19 (3.63%) published articles followed by Hughes, J.D'A from International Rice Research Institute with 7 (1.34%) published articles, Ogbonna, M.C. from National Root Crops Research Institute (NRCRI) with 6 (1.15%) published articles, Okoye, B.C. from NRCRI with 5 (0.96%) published articles, Orkwor, G.C. from NRCRI with 5 (0.96%) published articles. Ano A.O. from NRCRI, Asumugha G.N. from NRCRI, Eno A.O. from IITA , Eze S.C. from University of Nigeria, Nsukka, Ibeawuchi I.I. from Federal University of Technology, Owerri, Ikeorgu J.E.G., Kumar P.L. from National Roots Crops Research Institute and Rey M.E.C. from University of Witwatersrand have 4 published articles. Other authors published 3 articles each.

Geographical Location of Journals

Table 4 presents the results on the distribution of geographical location of journals in sub-Saharan yam literature between 2003 and 2017.

Table 4   Distribution of Geographical Location of Journals

Location where Journal is published	YEAR OF PUBLICATION															Total
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Brazil	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
Cameroon	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Canada	0	0	1	0	0	0	0	0	1	0	1	2	0	0	0	5
Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Ghana	0	1	2	0	2	2	1	0	0	0	2	0	0	0	1	11
India	0	0	0	0	0	0	0	0	2	0	4	0	0	0	0	6
Italy	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Kenya	0	1	0	0	1	0	2	1	1	1	1	1	1	0	0	10
Netherlands	0	3	0	2	0	0	0	0	0	1	1	0	0	0	0	7
Nigeria	6	2	7	8	12	5	11	4	8	9	8	9	3	2	3	97
Pakistan	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Sri-Lanka	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Togo	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Tokyo	1	0	1	0	2	1	0	0	0	0	0	0	0	0	0	5
Uganda	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	3
United Kingdom	1	1	2	0	0	0	1	3	2	0	0	0	0	0	0	10
USA	1	0	0	1	0	1	0	0	0	2	0	0	1	0	0	6
Total	11	8	13	12	17	9	15	8	15	14	20	14	6	4	4	170

Table 4 shows the countries (19) in which the assessed journals are geographically located. It is observed that 57 % (91 articles) of the assessed journals were published in Nigeria while that from, USA, Netherlands, United Kingdom, and Ghana were 7, 7, 9 and 11 articles respectively. Other countries including India, Nairobi, Canada, Tokyo, Kenya, Brazil, Uganda, Italy, Cameroon, Cote d'Ivoire, Korea, Pakistan, Sri-Lanka and Togo had between 1 and 6 articles in their journal outlets. Also, Nigeria was the only country that publications every year between 2003 and 2017.

Distribution of articles in Publication Outlets
Table 5 presents the results on the distribution of articles in publication outlets in sub-Saharan yam literature between 2003 and 2017.

Table 5   Distribution of articles in Publication Outlets

JOURNALS	YEAR OF PUBLICATION															Total
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Nigerian Agricultural Journal(Nigeria)	4	0	0	2	1	0	6	1	0	2	0	3	1	0	1	21
African Journal of Biotechnology(Nigeria)	2	0	1	2	0	0	1	1	3	1	1	1	0	1	0	14
African Journal of Food Agriculture Nutrition and Development(Kenya)	0	0	0	0	1	0	2	1	0	1	1	1	1	0	0	8
African Journal of Agricultural Research(Nigeria)	0	0	0	0	0	1	2	0	2	0	3	0	0	0	0	8
Global Approaches to Extension Practice: A journal of Agricultural Extension(Nigeria)	0	0	0	1	4	1	0	0	0	1	0	0	0	0	0	7
Journal of Development and Agricultural Economics(India)	0	0	0	0	0	0	0	0	2	0	4	0	0	0	0	6
Agricultural Mechanization in Asia, Africa, and Latin America(Tokyo)	1	0	1	0	2	1	0	0	0	0	0	0	0	0	0	5
International Journal of Agricultural and Rural Development(Nigeria)	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	5
Nigerian Food Journal(Nigeria)	0	0	2	0	0	0	0	0	0	0	0	1	1	1	0	5
The Bill and Melinda Gates Foundation(Canada)	0	0	0	0	0	0	0	0	1	0	1	2	0	0	0	4
African Crop Science Journal(Uganda)	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	3
Agro-Science(Nigeria)	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	3
Field Crops Research(Netherlands)	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	3

Food Chemistry(Brazil)	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
Ghana Journal of Agricultural Science(Ghana)	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	3
Nigerian Journal of Biotechnology(Nigeria)	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	3
Monitoring African Food and Agricultural Policies project (MAFAP)(Italy)	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2
Annals of Applied Biology(United Kingdom)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Communications in Soil Science and Plant Analysis(United Kingdom)	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2
Evans School Policy Analysis and Research (EPAR)(USA)	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2

Table 5 shows the distribution of articles in publication outlets for Sub-Saharan yam researchers. Nigerian Agricultural Journal has 21 articles, followed by African Journal of Biotechnology with 14 articles; African Journal of Food Agriculture Nutrition and Development, African Journal of Agricultural Research had 8 articles; Global Approaches to Extension Practice: Journal of Agricultural Extension had 7 articles; Journal of Development and Agricultural Economics had 6 articles; Agricultural Mechanization in Asia, Africa, and Latin America, International Journal of Agricultural and Rural Development and Nigerian Food Journal had 5 articles each. Other journals had 4 articles and below. One hundred and seventy articles were published in 75 journal outlets in 19 countries. 35 journal outlets are from Nigeria with Nigerian Agricultural Journal and African Journal of Biotechnology publishing 20.6% of the articles assessed between 2003 and 2017.

Study areas of Sub-Saharan yam literature
Table 6a presents the results on the study areas in sub-Saharan yam literature between 2003 and 2017.
Table 6a   Study areas of Sub-Saharan yam literature

S/N	STUDY AREAS	NAME OF DATABASE		Number of Articles	Percentage (%)
		AGORA	TEEAL		
1.	Economics of yam production	16	24	40	23.5
2.	Agronomy/crop husbandry	15	15	30	17.6
3.	Pathology	16	5	21	12.4
4.	Biotechnology of Yam production	9	9	18	10.6
5.	Preservation of Yam	11	7	18	10.6
6.	Genetic study	7	6	13	7.6
7.	Extension services	8	2	10	5.9
8.	Mechanization of yam production	3	6	9	5.3
9.	Nutrition	6	0	6	3.5
10.	Entomology of yam production	3	2	5	2.9
	Total			170	100.0

A total of 10 areas of study were identified (Table 6a). Publications from Economics of production accounted for 23.5 % (16 articles from AGORA and 24 articles from TEEAL) of the journals published while Agronomy/crop husbandry had 17.6 % (15 articles each from AGORA and TEEAL), pathology 12.4 % (16 articles from AGORA and 5 articles from TEEAL), biotechnology (9 articles from AGORA and 9 articles from TEEAL) and preservation of yam (11 articles from AGORA and 7 articles from TEEAL) had 10.6 % each. The lowest percentages of publications are from entomology, nutrition, Mechanization, Extension services and Genetic study ranging from 2.9 % to 7.6 %.

Table 6b presents the results on the study areas in sub-Saharan yam literature between 2003 and 2017.
Table 6b   Study areas of Sub-Saharan yam literature and format of publication

STUDY AREA OF PUBLICATION	FORMAT OF PUBLICATION				Total
	Journal	Magazine	Report	Technical Note	
Agronomy of yam production	30	0	0	0	30
Biotechnology of Yam production	17	1	0	0	18
Economics of yam production	31	0	6	3	40
Entomology of yam production	5	0	0	0	5
Extension services	10	0	0	0	10
Genetic study	13	0	0	0	13
Mechanization of yam production	8	0	1	0	9
Nutrition	6	0	0	0	6
Pathology	21	0	0	0	21

Preservation of Yam	18	0	0	0	18
Total	159	1	7	3	170

As shown in Table 6b, publications from Economics of production accounted for 40 articles (31 journals, 6 reports and 3 Technical notes) of the journals published while all of Agronomy/crop husbandry's 30 articles are journals, all of pathology's 21 articles are journals, biotechnology (17 journals, 1 magazine) and all of preservation of yam's 30 articles are journals. Biotechnology of Yam production, Economics of yam production, Entomology of yam production and Mechanization of yam production have publications in other formats apart from journals. Other study areas have publications in journals only.

Trend of scientific productivity of Sub-Saharan yam literature

Figure 1 presents the results on trend of scientific productivity in sub-Saharan yam literature between 2003 and 2017.
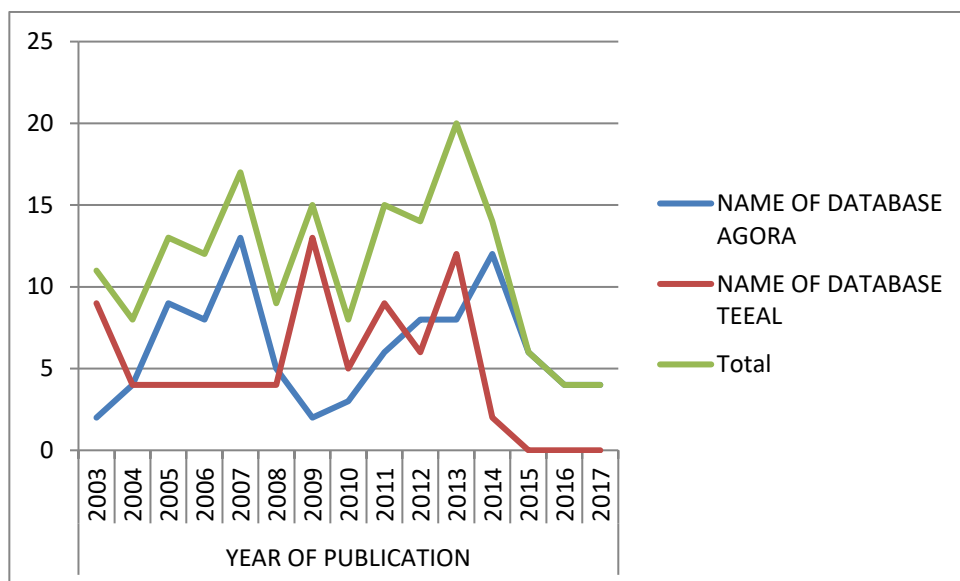
Figure 1: Trend of scientific productivity in sub-Saharan yam literature

The publication trend of sub-Saharan yam literature presented in Figure 1 showed the highest per year to range from 12 being highest and 7 lowest between 2003 and 2012. This peaked to 20 articles (8 from AGORA, 12 from TEEAL) in 2013 but nose dived to 4 articles in 2017(from AGORA).

Impact factors and H-Index of publication outlets
Table 7 presents the results on impact factors and H-Index of publication outlets in sub-Saharan yam literature between 2003 and 2017.

Table 7: Impact factors and H-Index of publication outlets

S/N	NAME OF JOURNAL	Geographical Location	JIF	H-Index
1.	Food Chemistry	Netherlands	4.946	204
2.	Soil and Tillage Research	Netherlands	3.824	109
3.	Field Crops Research	Netherlands	3.127	118
4.	Plant Disease	USA	2.941	91
5.	Journal of Biotechnology	USA	2.533	133
6.	Plant Pathology	United Kingdom	2.303	70
7.	Annals of Applied Biology	United Kingdom	2.046	65
8.	Genome	Canada	1.892	89

9.	Stored products research	Netherlands	1.825	65
10.	NJAS-Wageningen Journal of Life Sciences	Netherlands	1.585	34
11.	Weed Technology	USA	1.246	56
12.	Acta Agriculturae Scandinavica Section B - Soil and Plant science	United Kingdom	0.894	29
13.	Journal of Agriculture and food sciences	USA	0.58	0
14.	African Journal of Biotechnology	Nigeria	0.573	68
15.	Journal of Plant Nutrition	United Kingdom	0.565	63
16.	Communications in Soil Science and Plant Analysis	United Kingdom	0.54	55
17.	Nigerian Agricultural Journal	Nigeria	0	0
18.	African Journal of Food Agriculture Nutrition and Development	Kenya	0	2
19.	African Journal of Agricultural Research	Nigeria	0	23
20.	Global Approaches to Extension Practice: A journal of Agricultural Extension	Nigeria	0	2
21.	Agricultural Mechanization in Asia, Africa, and Latin America	Tokyo	0	9
22.	Archives of Phytopathology and Plant Protection	United Kingdom	0	16
23.	Journal of New Seeds	United Kingdom	0	16
24.	Nigerian Journal of Parasitology	Nigeria	0	2

Table 7 shows that three of the subscribed journals from Netherlands (Food Chemistry, Soil and Tillage Research and Field Crops Research) have highest ranking in JIF above 3.0 and H-Index between 109 and 204. Plant Disease and Journal of Biotechnology published in USA and Plant Pathology and Annals of Applied Biology from UK have JIF of above 2.0. However, only one journal (African journal of Biotechnology) out of 31 published in Nigeria has both rating in JIF and H-Index. Fifty one (51) journals have neither JIF nor H-Index in which 30 are from Nigeria, 13 are from other African countries and 8 are from non-African countries.

Institutional affiliation of contributing authors
Table 8 presents the results on Institutional affiliation of contributing authors in sub-Saharan yam literature between 2003 and 2017.

Table 8 Institutional affiliation of contributing authors

S/N	Institutional Affiliation	Frequency	Percent
1.	National Root Crops Research Institute (NRCRI), Abia State, Nigeria.	20	11.8
2.	International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria	16	9.4
3.	Federal University of Technology, Owerri, Imo State, Nigeria	9	5.3
4.	Federal University of Agriculture, Abeokuta, Nigeria	6	3.5
5.	Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria.	6	3.5
6.	Unknown	6	3.5
7.	CSIR-Crops Research Institute, Kumasi, Ghana	5	2.9
8.	University of Nigeria, Nsukka, Enugu State, Nigeria	5	2.9
9.	Bowen University, Iwo, Osun State, Nigeria	4	2.4
10.	The Bill and Melinda Gates Foundation	4	2.4
11.	University of Abomey-Calavi. Cotonou, Benin Republic	4	2.4
12.	University of Ghana, Legon, Accra, Ghana	4	2.4
13.	Federal University of Technology, Minna, Niger State, Nigeria	3	1.8
14.	Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria	3	1.8
15.	University of Agriculture, Makurdi, Benue State, Nigeria.	3	1.8
16.	University of Ibadan, Oyo State, Nigeria.	3	1.8
17.	University of Ilorin, Ilorin, Kwara State	3	1.8
18.	Abia State University, Umuahia Campus, Umuahia, Abia State	2	1.2
19.	Delta State University, Asaba, Delta State	2	1.2
20.	Ebonyi State University, Ebonyi State, Nigeria	2	1.2
21.	Food and Agriculture Organization(FAO)	2	1.2
22.	Kwame Nkrumah University of Science and Technology, Kumasi, Ghana	2	1.2
23.	Massey University, Palmerston North, New Zealand	2	1.2
24.	Nnamdi Azikiwe University, Awka, Anambra State, Nigeria	2	1.2
25.	Olabisi Onabanjo University, Ago Iwoye, Ogun State, Nigeria	2	1.2
26.	Rivers State University of Science and Technology, Nkpolu, Port Harcourt, Rivers State, Nigeria	2	1.2
27.	University of Benin, Benin City, Edo State, Nigeria	2	1.2
28.	University of Calabar, Cross River State, Nigeria	2	1.2
29.	University of Science and Technology, Ghana	2	1.2
30.	University of Washington	2	1.2

Table 8 shows the distribution of contributing institutions. It is observed that the highest contribution of 11.8% (20) came from "National Root Crops Research Institute (NRCRI), Abia State, Nigeria", followed by "International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria" with 9.4% (16), "Federal University of Technology, Owerri, Imo State, Nigeria" with 5.3% (9) contributions. "Federal University of Agriculture, Abeokuta, Nigeria and Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria with 3.5% (6) contributions each; followed by "CSIR-Crops Research Institute, Kumasi, Ghana and University of Nigeria, Nsukka, Enugu State, Nigeria" with 2.9% (5) contributions each. Other institutions have a percentage ranging from 2.4 % to 0.6 %.

Co-citation among Authors

The total link strength is the total strength of the citation links. A link in an author co-citation network involving authors is the number of coupling connection between a given author with other authors. The total link strength is the total strength of the coupling links, in this case, a given author with other authors. The author co-citation network for this data frame was mapped using authors as the unit of analysis. All 36 co-cited authors were chosen. For each of the 36 selected authors, the total strength of the co-citation links with the other sources was calculated and all authors were selected. Figure 2 and 3 presents the co-citation table and co-citation network among authors respectively.
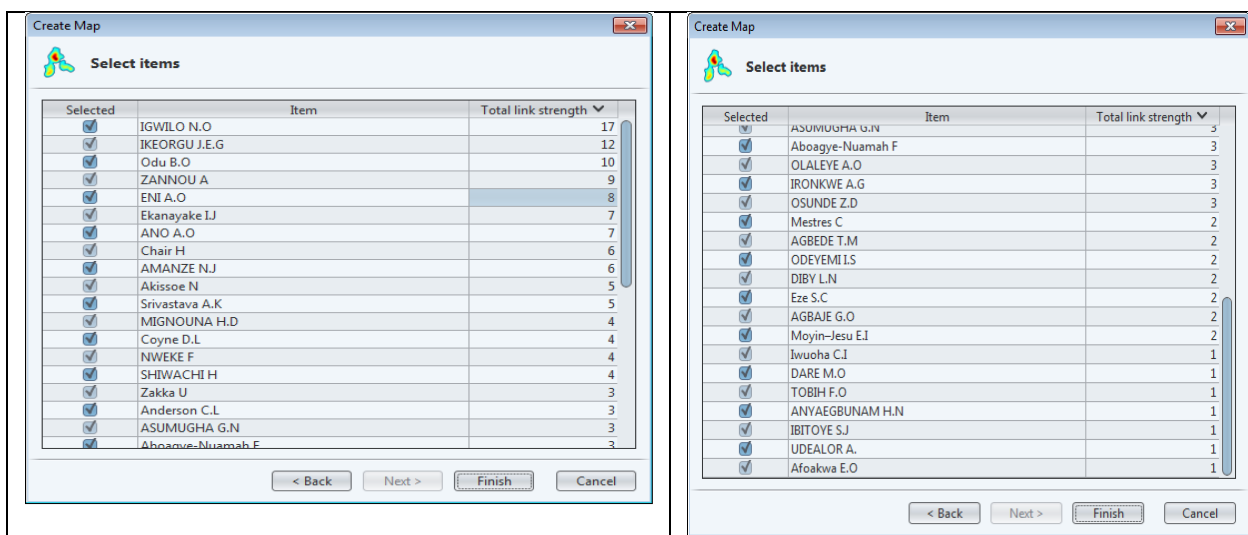
Fig 2: Sample author co-citation table

Shiwachi H. 2008 cited himself 3 times, Ikeorgu J.E.G. 2003 cited himself 2 times in the same article.

Fig 3: Author's co-citation network

The citation network presented in Figure 3 is divided into clusters of different colours. These clusters contain sets of items (authors) sharing similar citations or patterns. A member of a particular cluster may also connect with other colour clusters. The citation network contains 36 items (authors) with 11 clusters and a total link strength of 136. Figure 4 presents an expanded author's co-citation network
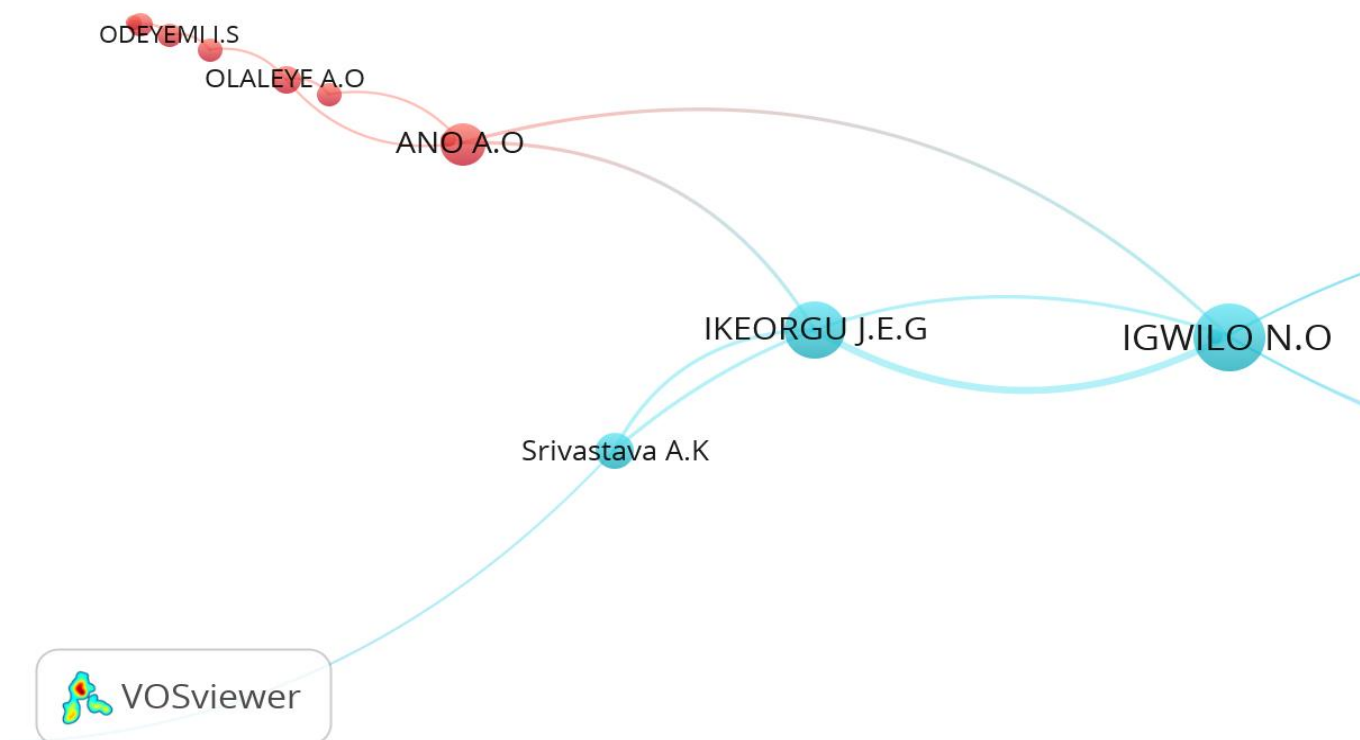

Fig 4: Author's co-citation network - Expanded

Drilling into the citation network, a piece of the network is displayed above, Srivastava A.K. cited Igwilo N.O., 1988; Ikeorgu J.E.G. cited Igwilo N.O., 1988, Ano A.O. cited Ikeorgu J.E.G. 1989 and Igwilo N.O. 1988. It is important to note that the bigger the size of the nodes (circles), the more the citations of the nodes (authors). Authors with more citations have bigger circles.

Journal Bibliographic Coupling

A link in a bibliographical coupling involving journals is the number of coupling connection between a given journal with other journals. The total link strength is the total strength of the coupling links, in this case, a given journal with other journals.

Fig 5: Sample journal bibliographic coupling table

Fig 6: Journal Bibliographic coupling network

The journal bibliographic coupling citation network presented in Figure 6 is divided into clusters of different colours. These clusters contain sets of items (journals) sharing similar attributes, citations or patterns. A member of a particular colour cluster may also connect with other colour clusters. The journal bibliographic coupling citation

network contains 8 items (journals) including journals with 3 clusters, 8 links and a total link strength of 31.

Trenbath B.R., 1984, Advances In Agronomy

Ijoyah M.O., 2003, Journal Of Sustainable Tropical

Willey R.W., 1980, Explorative Agriculture

Wuhua T.A.T., 1985, Explorative Agriculture

Fig 7: Author's co-citation network - Expanded

Igwilo N.O., 1988, Field Crops Research

Igwilo N.O., 1988, Nigerian Agricultural Journal

VOSviewer

Dumont R.P., 2000, Outlook On Agriculture

Terauchi R., 1992, Theoritical And Applied Genetics

VOSviewer
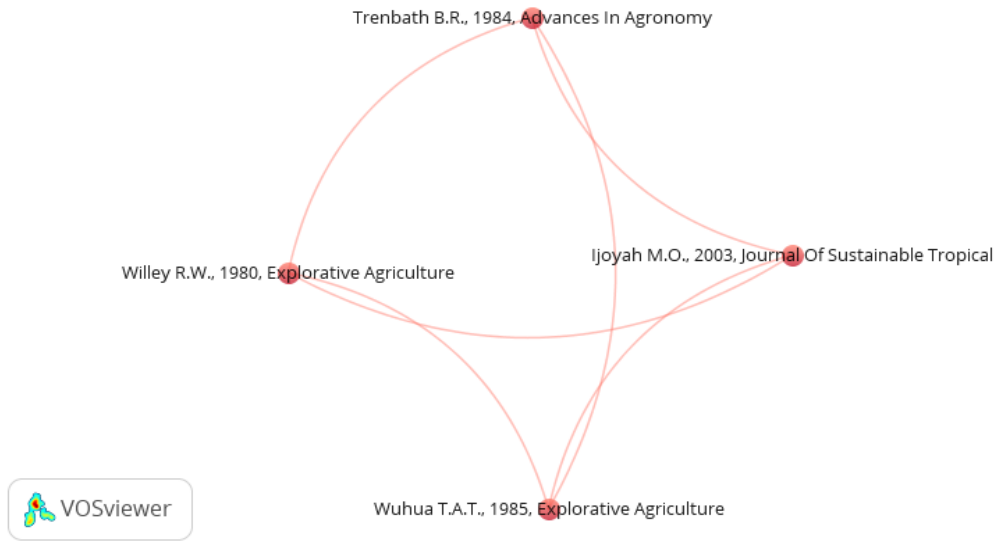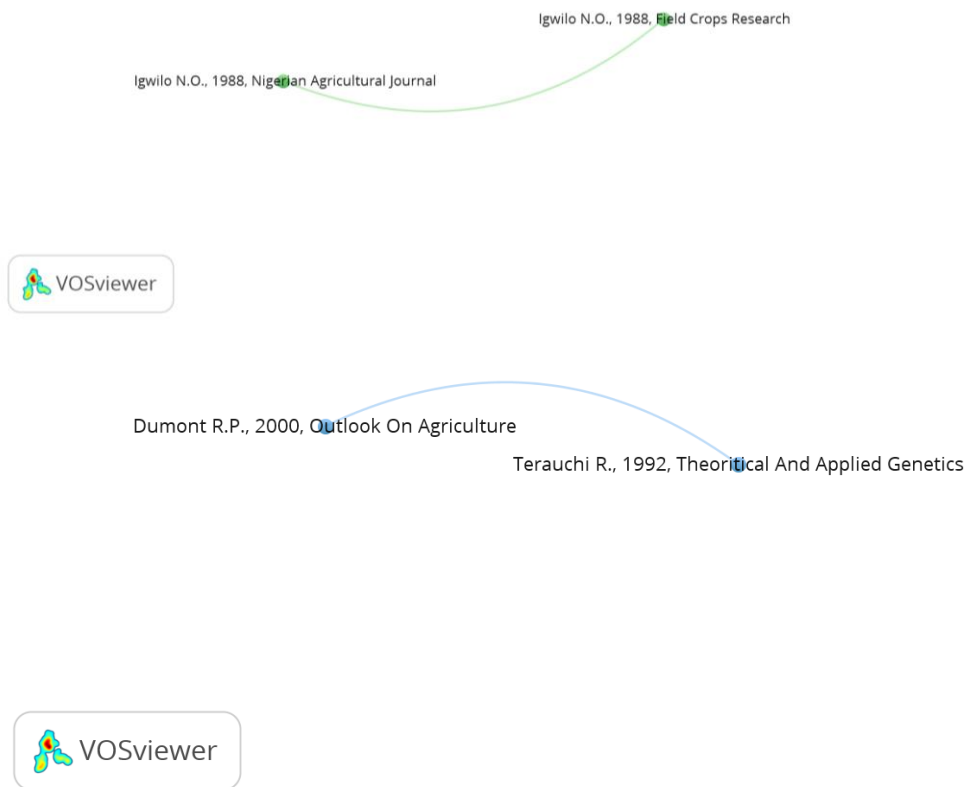
Fig 8: Author's co-citation network - Expanded

Bibliographical coupling is a measure of similarity between two articles or documents where at least one cited source appears in the bibliographies or reference lists of both articles. In this case, these two articles are described as "bibliographically coupled" Igwilo, N.O. 1988 Nigerian Agricultural Journal and Igwilo, N.O. 1988 Field Crops Research has strength link of 4; Dumont R.P. 2000 Outlook on Agriculture and Terauchi R. 1992 Theoretical and Applied genetics have strength link of 3; Wuhua TAT 1985 Explorative Agriculture and Wiley R.W., 1980 Explorative Agriculture have strength link of 4; Wuhua TAT 1985 Explorative Agriculture and Ijoyah M.O. 2003 Journal of Sustainable Tropical Agricultural Research have strength link of 4; Ijoyah M.O. 2003 Journal of Sustainable Tropical Agricultural Research and Trenbath B.R. 1984 Advances in Agronomy have strength link of 4.

DISCUSSION

Findings show that journals are the most prolific source of information having 159 (93.5%) articles; AGORA contained 94 documents while TEEAL had 65 documents, followed by Reports with 7 documents (4.1%) from TEEAL, Technical Notes with 3 documents (1.8%) from TEEAL and Magazines with 1 document (0.6%) from TEEAL. The reason could be because journals are the most recognized outlet for publishing scholarly works. Promotions in universities are based majorly on journal publications. This is because journals are veritable sources of scholarly research findings that are of interest to researchers, corporate bodies, librarians, donor agencies, publishers, editors, database producers, information brokers, universities, research institutes, etc. (Ocholla & Ocholla, 2007). The study shows that 0.2% of the 170 articles assessed were written by single authors while 0.8% of the articles were written by 2 authors and above. In year 2013, the highest number of publications was retrieved from both TEEAL and AGORA. It was observed that AGORA had 1 publication from single authors and 7 publications from joint authors while TEEAL had 9 publications from joint authors and 3 publications from corporate body. In 2016 and 2017, the lowest number of publications was retrieved from both TEEAL and AGORA. It was observed that AGORA had 4 publications from joint authors while TEEAL had no publications in these years. As the degree of collaboration is 0.8, it shows that there is a high level of collaboration in yam research. The reason for high collaboration could be the funding received from funding agencies. The yam research in sub-Saharan Africa is coordinated from IITA, Ibadan and NRCRI, Umudike is financed by FGN and supported by funds from FAO and IFAD. Morrison (2017) affirmed that funding drives collaboration with other academics and researchers.

In addition, findings show that the most prolific author is Aseidu, Robert from IITA, Ibadan with 19 published articles followed by Hughes, J.D'A from International Rice Research Institute with 7 published articles, Ogbonna, M.C. from National Root Crops Research Institute (NRCRI) with 6 published articles, Okoye, B.C. from NRCRI with 5 (0.96%) published articles, Orkwor, G.C. from NRCRI with 5 published articles. Ano A.O. from NRCRI, Asumugha G.N. from NRCRI, Eni A.O. from IITA , Eze S.C. from University of Nigeria, Nsukka, Ibeawuchi I.I. from Federal University of Technology, Owerri, Ikeorgu J.E.G., Kumar P.L. from National Roots Crops Research Institute and Rey M.E.C. from University of Witwatersrand have 4 published articles. Other authors published 3 articles and below. The most prolific authors are from institutes that have national mandate and international funding. They also enjoy the sponsorship of the Federal Government which makes research very easy for them. Also, the assessed journals were geographically located in 19 countries. It is observed that 57 % of the assessed journals were published in Nigeria while those from Netherlands, USA, UK and Ghana were 4.1%, 4.1%, 5.3 % and 6.5 % respectively. This shows that Nigeria was the only country that had publications every year between 2003 and 2017; Nigerian journals contain the highest number of published articles on yam production in Sub-Saharan Africa. Salisu and Ojoye (2015) had a similar view that Nigerian authors published more in journals located in Nigeria than journals located in all other countries. The offshore publication requirement for promotion in academic institutions might have encouraged researchers to publish in foreign journals with high impact factors. Unfortunately the articles within those highly rated journals in fifteen years are less than 15 out of 170 assessed. This could mean that the locally published articles are not accepted due to their scope, depth and quality by international journals. The only African journal, African Journal of Biotechnology has only 2 articles. This shows that there a very high percentage of African journals which are not internationally recognized. It was also observed that majority of the articles are not published in journals with good assessment metrics such as H-index and JIF. Okorie, Bockarie, Molyneux & Kelly-Hope (2014) agreed that majority of articles written by Nigerian authors were published in journals with no known impact factor. Yam researchers also need to improve on the quality of their research papers with global outlook and so that it can meet up with the standard of international journals as this will increase quality of research done and also increase visibility of the articles published.

A total of 10 areas of study were identified. Publications from Economics of production accounted for 23.5 % (16 articles from AGORA and 24 articles from TEEAL) of the journals published while Agronomy/crop husbandry had 17.6 % (15 articles each from AGORA and TEEAL), pathology 12.4 % (16 articles from AGORA and 5 articles from TEEAL), biotechnology (9 articles from AGORA and 9 articles from TEEAL) and preservation of yam (11 articles from AGORA and 7 articles from TEEAL) had 10.6 % each. The result from the study shows that publications from Economics of yam production, Agronomy/crop husbandry, biotechnology and preservation of yam have been highly focused on by researchers, but there is need for more attention to be paid to the areas of Entomology, Nutrition, Mechanization, Extension services and Genetic study. This also shows that there are either insufficient experts in those areas with scanty publications or laboratory facilities are not available to produce outstanding articles from these specialized areas. Government intervention in training complimentary experts instead of concentrating on economic studies alone needs to be reviewed. Publications from Economics of production accounted for 40 articles (31 journals, 6 reports and 3 Technical notes) of the journals published while all of Agronomy of yam production's 30 articles are journals, all of pathology's 21 articles are journals, biotechnology (17 journals, 1 magazine) and all of preservation of yam's 18 articles are journals. The publication trend of Sub-Saharan yam literature showed the highest per year to range from 12 being highest and 7 lowest between 2003 and 2012. This peaked to 20 articles (8 from AGORA, 12 from TEEAL) in 2013 but nose dived to 4 articles in 2017(from AGORA). The rise and fall of this trend may be due to unfavourable weather or economic conditions for yam experiments.

Three of the subscribed journals from Netherlands (Food Chemistry, Soil and Tillage Research and Field Crops Research) have highest ranking in JIF above 3.0 and H-Index between 109 and 204. Plant Disease and Journal of Biotechnology published in USA and Plant Pathology and Annals of Applied Biology from UK have JIF of above 2.0. However, only one journal (African journal of Biotechnology) out of 31 published in Nigeria has both rating in JIF and H-Index. Fifty one (51) journals have neither JIF nor H-Index in which 30 are from Nigeria, 13 are from other African countries and 8 are from non-African countries. Okorie, et al (2014) agreed that the majority of articles written by Nigerian authors' were published in journals with no known impact factor.

A total of 20 publications were published by authors from National Root Crops Research Institute (NRCRI), Abia State, Nigeria, 16 publications were published by authors from International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria and 9 publications were published by authors from Federal University of Technology, Owerri, Imo

State, Nigeria. Other institutions published 6 articles and below. Ikeorgu J.E.G. 1989 and Igwilo N.O. 1988 have the biggest nodes in the co-citation network analysis which suggests that at least two articles cited Ikeorgu J.E.G. 1989, Igwilo N.O. 1988, Odu B.O. and other authors in the social network map. These fist three authors are staff of National Root Crops Research Institute (NRCRI), Abia State, Nigeria The behaviour where people from the same universities or with close regional proximities cite themselves was observed. This pattern could be attributable to several factors including affiliations and professional affinity among others. (Adegoke & Oni, 2018). After journal bibliographic coupling, Igwilo, N.O. 1988 Nigerian Agricultural Journal and Igwilo, N.O. 1988 Field Crops Research has strength link of 4; Dumont R.P. 2000 Outlook on Agriculture and Terauchi R. 1992 Theoretical and Applied genetics have strength link of 3; Wuhua TAT 1985 Explorative Agriculture and Wiley R.W., 1980 Explorative Agriculture have strength link of 4; Wuhua TAT 1985 Explorative Agriculture and Ijoyah M.O. 2003 Journal of Sustainable Tropical Agricultural Research have strength link of 4; Ijoyah M.O. 2003 Journal of Sustainable Tropical Agricultural Research and Trenbath B.R. 1984 Advances in Agronomy have strength link of 4. This shows that a lot of journals were co-cited in the collection of Sub-Saharan yam literature analysed.

CONCLUSIONS AND FURTHER STUDIES

This study has been able to identify the principal forms of sources in Sub-Saharan yam literature; determine the degree of authors' collaboration in Sub-Saharan yam literature; determine the first 25 prolific authors and their institutional affiliation; find out the geographical location of journals in which Sub-Saharan authors published their articles; identify the top 20 journals which the publication outlets are for authors publishing Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017. The study has also been able to identify the study areas of Sub-Saharan yam literature; determine the trend of scientific productivity of Sub-Saharan yam literature; determine the impact factors and H-index of publication outlets for authors publishing Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017. Furthermore, the institutional affiliations of the authors of Sub-Saharan yam literature; co-cited authors in Sub-Saharan yam literature; and co-cited journals in Sub-Saharan yam literature listed in AGORA and TEEAL databases between 2003 and 2017 were also identified. Further studies can be carried out on Sub-Saharan yam literature listed in other citation databases on other crops listed in AGORA and TEEAL that is important to the socio-economic life of Africans. Future studies can equally compare scientific productivity with bibliometric laws or examine the frequency distribution of the number of references in the Sub-Saharan yam literature.

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