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CONTENT ANALYSIS OF CLIMATE-SMART AGRICULTURE PUBLICATIONS: ISSUES OF READABILITY AND RICHNESS OF INFORMATION FOR NIGERIAN AUDIENCE

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Abstract

Climate Smart Agriculture (CSA) as a tool for improving agricultural productivity, mitigation and adaptation to climate change is facing conceptual misunderstanding. The study was a Content Analysis of CSA publications purposively selected to capture at least 45% of study locations from Nigeria. Specific objectives were to: identify pillars of CSA in publications; identify focus/themes covered in CSA publications; determine the ease of reading and extent of information obtainable from CSA publications. Online search engines were used to select CSA publications between 2014 – 2019. Descriptive and inferential statistics were used for data analysis. Text analyzer software was used to determine readability and complexity factors of CSA publications. Results showed that 19% of publications were on crop production, while the least was on agricultural policy (4%). Resilience and adaptation were the most published pillars of CSA (39%) followed by agronomic and economic productivity (27%). Readability values showed that published materials on CSA were “not easy” to read by non-scientists. Complexity factor scores showed that 85% of journals and 56% of reports were “highly informative”. Correlation result showed that there was no significant relationship between readability and complexity of CSA publications. Analysis of Variance (ANOVA) revealed that there was no significant variation between readability and complexity factor of CSA publications. The study concluded that CSA publications were mostly on crop production. Adaptation and mitigation were the most published CSA pillars. The study recommended CSA researches should be conducted in the areas of agricultural inputs, policy, soil/land management, climate information services, and fisheries. Extension services/activities should make available CSA publications more readable for a wider audience.

Keywords: content analysis, ClimateSmart Agriculture, publications, readability, richness, information.

Introduction

Climate-Smart Agriculture (CSA) is used as a mitigation and adaptation option to reduce impact of climate and improve agricultural productivity (Gwambene, *et. al* (2015). There is no

doubt that for Nigeria to tackle food insecurity, it is imperative that CSA practices be incorporated into the farming systems. Parthey, *et al* (2018) reported that CSA still faces a number of challenges, including: lack of clear conceptual understanding, limited enabling policy and financing. Available information (knowledge) base on CSA should be easy to read and understood as well as contain a volume of information (highly informative) to enable a wider participation of all stakeholders in agricultural development.

Analysis of the total studies carried out in a particular field of agriculture will be useful for researchers in making use of these studies and facilitating their application (Cohen and Manion, 2015). Content Analysis is a research method for studying documents and communication artifacts, which could be texts of various formats, pictures, audio or video (Byrman, 2012). McDermott and Redish (2009) observed that examining and arranging studies in a single study will enable researchers to benefit from those studies and will be a guide for those who want to carry out studies. It is important that available publications on CSA be easy to read and also highly informative which is reported as complexity factor. Text complexity is the level of difficulty in reading and understanding a text based on readability (quantitative measure), the levels of measuring or purpose in the text, the structure of the text, the conventionality and clarity of the language and the knowledge demands of the text (quantitative) (Johansson, 2008). In other words that complexity factor represents how informative a text material is to the reader. Climate-Smart Agriculture (CSA) is a relatively new concept in agriculture. The Food and Agriculture Organization (FAO) introduced the concept of Climate-Smart Agriculture (CSA) at the Hague Conference on Agriculture, Food Security and Climate Change in 2010 (FAO, 2017). With this current concept, there is yet to be a full understanding of the concepts by professionals whose work revolves around it. Rosenstock, *et al*, (2016) posited that, there is lack of information on CSA given its novelty as a concept, its inclusion of a wide variety of food system/rural livelihood practices, lack of common understanding of the outcomes of CSA, and relevant information residing in disparate literature ranging from agronomy to atmospheric science to social sciences.

Problem Statement

With the collapse of public extension system, farmers are increasingly depending on the use of the internet or the World Wide Web to gather information. An increasing number of Nigerians are using the internet to get information including agricultural information. CSA is promoted as a tool to address. Parthey, *et al*, (2018) reported that CSA still faces a number of challenges, including: lack of clear conceptual understanding, limited enabling policy and financing. Whatever information that is obtained by the farmer is useful based on the ease of reading such material and how informative the materials are. As a relatively new concept, there is need to review available information for which stakeholders especially in the agricultural sector may require in implementing CSA practices. Available studies hardly pay attention to how informative CSA literature could be neither do studies evaluate the size of audience that are served in this very important aspect of global agricultural development (Rosenstock, *et al*, 2016; Gwambere, *et al*, 2015; Zougmore, *et al*, 2016). This study intends to address these gaps by investigating the themes covered, pillars of CSA discussed and the ease of understanding CSA publications available as well as how informative the materials are to the audience.

Research Questions

This study is designed to provide answers to the following research questions:

- (i) What are the pillars of Climate Smart Agriculture that are found in publications?

- (ii) What is the focus/themes/enterprises covered in CSA publications?
- (iii) What is the ease of reading CSA publications?(iv) How informative are CSA publications?
- (v) Is there any significant relationship between readability and complexity of climate-smart agriculture publications?
- (vi) Is there any significant variations between readability and complexity of climate-smart agriculture publications?

Objectives of the Study

The study adopted both the broad objectives and specific objectives as follows:

- a) **General objective:** To conduct Content Analysis of Climate Smart Agriculture publications.
- b) **Specific objectives:**
 1. to identify pillars of climate smart agriculture in published materials;
 2. to identify focus/themes covered in climate smart agriculture publications;
 3. to determine the ease of reading and extent of information obtainable from climate smart agriculture publications.

Hypotheses of the Study

Two hypotheses were used to guide the study as follows:

Ho1: there is no significant relationship between the ease of reading and extent of information obtainable from Climate Smart Agriculture publications.

Ho2: there is no significant variation between the ease of reading and extent of information obtainable from Climate Smart Agriculture publications.

2.0 Literature Review

Totin, *et al*, (2018) reported that available CSA publications did not address the three pillars of productivity, adaptation and mitigation in an integrated way. The study further revealed that the level of development of the study location had a strong relationship with the pillars promoted. Accordingly, themes of mitigation were covered in high income countries while productivity and adaptation were more important for middle and low-income countries. FAO (2017) sourcebook using scientific evidence across different locations presented CSA themes that discussed all the three pillars in all the agricultural sectors. Relationship between CSA and Sustainable Development Goals (SDGs) were analyzed.

Through content analysis of several literatures on CSA, themes covered innovative practices in single or a combination of pillars can be identified. Davis and Franzel, (2018) used comparative case studies of reviewed literature where data were drawn for analysis of extension institutions of ten(10) countries. The research concluded that findings were not generalized rather insights and innovative practices of institutional structures (that is indispensable to facilitate CSA) and policies were yet to be developed in some countries. Rosenstock, *et al*(2016) proposed a framework for systematic review of literature to establish evidence of CSA practices. The proposed framework suggested 73 farm-level management practices across five categories namely agronomy, agroforestry, livestock, post-harvest management and energy systems were adequate to assess their contributions to CSA pillars. The CSA pillars were framed specified as follows:

- (i) agronomic and economic productivity
- (ii) resilience and adaptive capacity and

(iii) –climate change mitigation in developing countries.

FAO (2018) Climate-Smart Agriculture Report is based Content Analysis of case studies of successful implementation of CSA across five regions. The report showed that in Africa, soil management, agroforestry and livestock production were the themes in focus; while Asia and the Pacific regions were found to successfully implement CSA in tree crop production and agro-technology. Livestock production and forestry were enterprises reported in Europe and Central Asia. In America and the Caribbean, agroforestry and food production systems were the main themes on CSA while water scarcity was the major concern in CSA in the near East and North Africa.

Zougmore, et al (2016) reported that available literature were too general to understand the magnitude of the impact and to inform adaptation strategies and policy development efforts that are tailored to promoting CSA in west Africa. This is consistent with the assertion that CSA practices should be location specific to fully optimize their benefits (FAO, 2017). A Content Analysis CSA practices in 15 countries of the world revealed categorized adaptation into two namely: intensification and diversification (Chen, *et.al*, 2018). The research used adoption of more and of different practices as classification basis for intensification and diversification respectively which were found to be influenced by access to weather information by farmers.

3.0. Methodology

Scope/Area of Study: The study was designed to analyze at least 45% of Climate –Smart Agriculture (CSA) publications using Nigeria as their study location. The remaining 55% were to be selected from other parts of Africa and the rest of the other continents.

Method of Data Collection

The study used Google search engine, and Scopus. The search used key words such as “climate” smart” agriculture” “weather” “practices” “Nigeria” “livestock” “crop” “mitigation” “productivity” “and “ adaptation” in the search to search for available publications to identity climate smart agriculture publications. A purposive selection of publications between 2014 – 2019 was to ensure currency of information on the subject matter. The search considered peer-reviewed journals (50%), scientific reports from international organizations that fund research on climate smart agriculture subjects as well as published books on the subject.

Selection Criteria for Publications

Repeated searches were carried out on the World Wide Web using Google and Scopus. Selection of publications were based on dates of publications (2014-2019), location (Nigeria 45%, Africa and general 55%), inclusion of at least one pillar of climate smart agriculture, evidence of peer-review and text was contained data analysis. These criteria for selected is similar to approach used by Totin, et al, (2018) on systematic literature review on Climate Smart Agriculture.

Table 1: Basis for Selection of Publication for the Study

S/N	Item for Selection	Basis for Selection
1	Year of publication	Must be published between years 2014-2019
2	Location	Nigeria (at least 45%) Africa and others (55%)
3	Climate Smart Agriculture(CSA) Pillar included in Publication	Must carry information on at least one pillar of CSA: farm production or productivity or adaptation or and resilience and or mitigation
4	Data Requirement	Publication provided sufficient detail to carry out data analysis.
5	Language	Material is published in English
6	Other considerations	Location that includes Nigeria e.g. West Africa, Africa and other parts of the world. Some materials did not discuss location but dwelt on pillars of climate smart were selected

Data Analysis:

Description statistics was used to analyze focus/themes as pillars of climate smart agriculture captured in objectives one and two. Percentages means and frequency counts were used. Ease reading of (readability) and extent of information obtainable from climate smart agriculture publications (complexity factor) were analyzed by use of text analyzer ease of reading was captured by readability values defined as follows: easy (1-6), fairly easy (7-12) and not easy (13-20%) which corresponds with the type of audience than can be easily served correspondingly as follows; general, restricted (with moderate knowledge of science). Extent of information obtained (complexity factor) from climate publication was analyzed as follows: not informative (13-20%), moderately informative (40-60%) and highly informative (70-100%).

Hypotheses were using Pearson Product Moment Correlation (PPMC) and analysis of variance. The relationship between readability and extent of information obtained from climate smart publications were analyzed using PPMC while variation between readability and complexity of publications were analyzed by means of analysis of variance (ANOVA).

4.0 Results and Discussions**4.1 Distribution of Publication by Year of Publication and Study Location**

More than a quarter of the research materials (47%) were published between 2016 and 2017. The most current publications (2018-2019) made up 37% of the materials in the study. This implies that there is growing interest in CSA research since the first FAO publication on the subject (FAO, 2018). Study location of the research documents was mostly sought from Nigeria (47%) to highlight the areas of CSA and information available for the immediate Nigerian audience especially farmers. A good mix of publications from Africa (23%) and on general/global (23%) discussion of the subject matter helped in providing information on CSA themes/focus and pillars from other places.. This study's result also represents what FAO (2018) consider the most successful implementation of CSA (pillars) across specific regions.

Table 1: Distribution of Publications by Study Location /Scope and Year of Publication

S/N	Range of Years	No of Publications Selected (f)	(%)	Scope/Location	No of Publications Selected (f)	(%)
1	2014-2015	5	17	Nigeria	14	47
2	2016-2017	14	47	Africa	7	23
3	2018-2019	11	37	General/Global	7	23
4				Africa, Asia	2	7

				&America		
5	Total	30	100	Total	30	100

4.2. Focus of Climate Smart Agriculture Publications

Climate smart agriculture publication that carried any one or more of the sectors or listed focus was selected in the study for which the frequency represents the number of times a particular theme/sector were found in the research material. The study revealed that 19% of publications were on crop production followed by materials on livestock farming (16%) and farmers' welfare (socioeconomic) (16%). (Table 2) The least number of publications was on agricultural policy. This finding is supported by Totin, *et.al*, (2018) who observed that productivity and adaptation themes CSA literature were mostly found among important for middle and low-income countries. Research efforts in Nigeria on themes of mitigation of greenhouse emission with respect to agriculture are scarce. The least of the theme was on agricultural policy with respect to CSA. This requires that a lot of research evaluating existing policies related to CSA will be required not only in Nigeria but globally.

Table 2: Distribution of Publication by Area of Focus/Theme

S/N	Focus/Theme	Number of Publications	Fraction of Total Publications	% of total Publications
1	Crop production	13	6	19
2	Livestock farming	11	5	16
3	Fisheries	7	3	10
4	Soil/land management	5	2	7
5	Agroforestry	5	2	7
6	Climate information services	5	2	7
7	Welfare	5	2	7
8	Socioeconomic/farmers	11	5	16
9	Agricultural inputs	4	2	6
10	Agricultural policy	3	1	4
	Total	69*	30	100

**Multiple Responses*

4.3 Frequency of climate smart agriculture Pillars covered by CSA Publications.

The most frequent climate change pillar carried in CSA publications is resilience and adaptation(39%) followed by climate change mitigation(34%). This suggest that for the Nigerian farmers and or audience, the least volume of information on CSA that can be obtained via publications are those that consider agronomic and economic productivity themes(27%). This findings is partially in tandem with Zougmore, *et al*, (2016) who reported that available literature were too general to understand and promote Climate Smart Agriculture.

Table 4: Distribution of Publications by Number of Climate Smart Agriculture Pillars Covered.

S/N	Climate Smart Agriculture Pillars	No of Publications	Fraction of Total Publications	Percent (%)
1	Agronomic and Economic productivity	12	8	27
2	Resilience and Adaptation	17	12	39

3	Climate Change Mitigation	15	10	34
	Total	*44	30	100

***Multiple Responses**

This result (Table 4) is also in agreement with Rosenstock, et.al (2016) who posited that, there is lack of information on CSA given its novelty as a concept. Most importantly the findings confirm Totin, *et.al*, (2018) who noted that available CSA publications did not address the three pillars of productivity, adaptation and mitigation in an integrated way.

4.5 Readability and Complexity Factor Values of Climate Smart Agriculture by Type of Publication.

Among the CSA publications, 85% of journal, 78% of reports and 100% of books were classified as “not easy “to understand (readability) by the audience without a technical or science background. This implies that only 37% of the CSA publications could be easily understood by non-science background readers.

(Table 5): Complexity factor considered how informative the materials were. The largest proportion of complexity factor were recorded for the journals (85%) and followed by reports (56%). This implies that journals were the most informative source of CSA information. This was expected as the interest in the subject is promoted mainly through research and yet to be documented in books. Rosenstock, *et.al*, (2016) had earlier pointed out that, there is lack of information on CSA given its novelty as a concept, its inclusion of a wide variety of food system/rural livelihood practices, lack of common understanding of the outcomes of CSA, and relevant information residing in disparate literature ranging from agronomy to atmospheric science to social sciences. However, with most of the publications being fairly readable i.e. understood by the non-scientists, a large population (most engaged in agriculture) that should be engaged in CSA implementation will not likely participate and or benefit from available knowledge in the short and medium term.

Table 5: Readability and Complexity Factor Values of Climate Smart Agriculture by Type of Publication.

S/N	Type of Publication	Readability				Total	Complexity Factor				Total
		Fairly easy (7-12)		Not easy (13-20)			Moderately informative (40-60)		Highly informative (70-100)		
		f	%	F	%		f	%	f	%	
1	Journal	3	15	17	85	20	3	15	17	85	20
2	Reports	2	22	7	78	9	4	44	5	56	9
3	Book	00	00	1	100	1	1	100	00	00	1

*Mean

This result supports the report by Gwambene, *et.al*, (2015) who noted that adoption (of CSA) is largely dependent on farmers' understanding of climate change impacts and their proclivity on climate smart agricultural practices. In a world of increasing access to information through the internet, highly informative publications on CSA and a low readability of such materials will amount to poor utilization of such information. Issue of awareness is fundamental to adoption of innovation in agriculture.

Results of Hypotheses Tested

4.6 Relationship between Ease of Reading and Extent of Information Obtainable From Climate Smart Agriculture Publications.

The study sought to establish if there was any relationship between ease of reading and extent of information obtainable from Climate Smart Agriculture Publications. A second hypothesis was to determine any statistically significant variation between readability and complexity factor of Climate Smart Agriculture Publications. The results are presented as follows:

Hypothesis 1: there is no significant relationship between the ease of reading and extent of information obtainable from climate smart agriculture publications.

Table 6: Pearson Correlation Result of Readability and Complexity Factor of Climate Smart Agriculture Publications.

Descriptive Statistics	N	Mean	S.D	Standard Error	Mean
Readability	30	74.7667	12.95532	2.36531	
Complexity factor	30	70.2067	8.81918	1.61015	
Pearson Correlation result	Readability		Complexity factor		
Readability					
Pearson correlation	1		0.040		
Significant (2-tailed)			0.835		
N	30		30		
Complexity factor			1		
Pearson correlation	0.040				
Significant (2-tailed)	0.835				
N	30		30		

Pearson Product Moment Correlation(PPMC) result showed that the relationship between *ease of reading* (readability) and amount of information carried on climate smart agriculture publication (complexity factor) was weak ($r=0.040$) and not significant ($p=0.835>0.005$). However, there was larger standard deviation ($SD=12.95532$) in ease of reading and extent of information obtainable from climate smart agriculture publications. This implies that the amount of information that an audience can obtain from smart agriculture publication is not in any way related to the ease of reading the material or vice versa. This study supports the report by Rosenstock, *et.al* (2016) who noted lack of common understanding of the outcomes of CSA. This therefore influences the different perspectives of publication on CSA. For instance, the FAO(2016-2018) promoted implication of mitigation is concerned primarily with reducing Green House Gas emission via smart agricultural practices; but most publications hardly capture mitigation in this context.

4.7: Variation Between Readability and Complexity Factor of Climate

The result of ANOVA between readability and complexity factor of Climate Smart Agriculture Publications is presented in Table 7.

Table 7. ANOVA of Variation between Readability and Complexity Factor of Climate Smart Agriculture Publications

Source	SS	df	MS	
Between treatments	225.0407	1	225.0407	F=1.88326
Within treatments	7195.1953	58	124.0551	
Error	3465.3593	29	119.4951	

The F- ratio value is 1.88326; the P-value is 0.180486. The result is not significant at P<0.05.

ANOVA result showed that readability and extent of information obtainable from climate smart agriculture did not vary significantly ($P=0.180486 > 0.005$) although there was greater variation within (readability and complexity factor) ($SS=7195.195$), the variation between (readability and complexity factor) was quite small ($SS=225.0407$) (Table 7). This means that for the audience reading climate smart agriculture publications, variation in the ease of reading and how informative the materials are purely by chance. Similarly any variation in ease of reading or amount of information obtainable from CSA publication was larger but not significant statistically. Given the established fact that the concept of CSA is novel and diverse, the authors and researchers on the subject will reflect this reality in the text published. This result is supported by Johansson, (2008) who defined text complexity as the levels of measuring or purpose in the text, the structure of the text, the conventionality and clarity of the language and the knowledge demands of the text (quantitative) as well as readability (qualitative).

Conclusion

Most Climate Smart Agriculture publications deal with crop production, livestock and farmers' welfare. The major pillars of Climate Smart Agriculture in most publications are adaptation and mitigation. Similarly, climate smart agriculture publications are not proportionally represented as the other two pillars. Available publications on climate smart agriculture can only serve a restricted audience. This will delay active participation of stakeholders or better still exclude the wider audience to fully appreciate the implementation of climate smart agriculture and active participation of all stakeholders. Very large reading audiences are yet to be reached with climate smart agriculture information as available publications too general and hardly integrate the pillars of productivity, adaptation and mitigation.

Recommendations

Research on climate smart agriculture in the area of agricultural inputs, policy, soil management, climate information service, agroforestry, soil/land management and fisheries should be conducted in Nigeria. Emphasis on research in Nigeria should be conducted to improve farm productivity/production and income of farmers. Extension agencies should scale down available published works on climate smart agriculture to ensure it is easier to read and understand in order for the farmers to benefit from the rich knowledge on the subject locked up in technical jargons. Private extension agencies should engage in ensuring that research findings available on line area further reproduced in form of reports, magazines or videos to make it interesting and attractive to farmers, end-users, the wider reading audience and all stakeholders in the climate smart agriculture implementations and policies.

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