

## Climate Change Curriculum Development in Some West African Higher Education Institutions: A Call for Action

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### Abstract

West Africa is one of the most vulnerable regions to climate change. Though the education institutions by training well-skilled professionals could contribute to cope with the challenges posed by climate change in the region. This study examines climate change curriculum of some West Africa higher education institutions. Primary data were collected from an online survey from graduates and students who receive climate change and related disciplines education training from some West Africa higher education institutions. Chi-square test was conducted to examine the correlations between some study variables. The study findings showed that there existed significant correlations between; the official language of the graduates'/students' native countries and the host higher education institution one ( $P = 0.001$ ), performing practical internship and the graduated/student host higher education institutions ( $P=0.001$ ), graduates'/students' mastery of statistical and econometric tools and graduated host high education institutions ( $P=0.018$ ). In addition, the study findings showed that there were significant correlations between the number of conducted studies by the graduates/students and host higher education institutions ( $P= 0.001$ ), but there was no significant relationship between the current works of the graduates and their higher education institutions backgrounds ( $P= 0.116$ ). Consequently, West African higher education institutions should not only consider climate change as a key element in their education curriculum but also use efficiently the climate change trained professionals to enhance the adaptive capacity of the region to climate change.

**Keywords:** West African region, climate change, curriculum development

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### Introduction

Climate change is one of the greatest threats to nature and human society. It becomes a great challenge, especially in the West Africa region where it posed numerous negative impacts on the region's economy and ecological systems (Conway, 2008; Epule et al., 2017). The negative impacts of climate change are felt by both West Africa region rural and urban populations (Adesina and Odekunle, 2011; Conway, 2008; Epule et al., 2017) The region vulnerability to climate change is due to the

dependency of the region on rainfed agriculture, the weakness of its governance systems, lack of adequate infrastructures and sufficient human resources (Bidoli et al., 2012; Roudier et al., 2011). In this context Epule et al. (2014; 2017) and Ado et al., (2019) noted that climate change affects negatively the sources of livelihood of West African rural and urban population. Also, Mamadou et al. (2015) and (Watts et al., 2015) mentioned climate change is the cause of floods and other serious deadly diseases such as malaria in many West African regions.

On the other hand, climate change might cause other societal challenges such as rural migration, conflicts that might lead to degrading social and ecological systems, especially in the West African region. Molthan-hill et al. (2019) reported the policy and programs affect either positively or negatively impacts public and private sectors implementation of climate response in the West Africa region.

In this view, higher education institutions should play a key role in training well-skilled professionals to support the region's effort in responding to the adverse impacts of climate change. For instance, the curriculum of the higher education institutions might determine the graduated professionals' skills and therefore their efforts to support the policy and decision-makers. Offorrna (2015) mentioned that curriculum refers to an education plan or program selected by education institutions training people to change their earlier behaviors. Also, as said by Nelson Mandela "Education is the most powerful weapon which you can be used to change the world." Hence, higher education institutions especially Universities might play a key role in supporting society to tackle the challenges it might experience. For instance, Padgham et al. (2013) noted that Universities play a crucial role in climate change education. This could be that these higher education institutions can play an important in combatting climate change and training eco-friendly individuals and society models for a more sustainable future. Accordingly, Anderson (2012) highlighted that Universities have a central role in implementing climate change mitigation and adaptation through climate change education.

However, most of the conducted studies related to the higher education institutions focused on the role of the universities in climate change education (Aksa and Samudra, 2019; Mochizuki and Bryan, 2015; Molthan-hill et al., 2019), especially in Nigeria (Offorrna, 2015) and African region (Padgham et al., 2013). There is a literature scarcity on the climate change curriculum in higher education institutions, especially in the West African region. This study as a pilot one aims to examine the characteristics of the curriculum of West African higher education institutions where climate change is part of education discipline. Especially, the study seeks to: (1) examine the characteristics of the climate change curriculum in West African higher education institutions, (2) the relationship between; official language of the graduates/students' native countries and the host higher education institution language, (3) performance of practical internship and the graduated/studying higher education institutions (4) the graduates/students mastery of statistical and econometric tools and their higher

education institutions, (5) the number of conducted studies by the graduates/students and their higher education institutions, (6) the current works of the graduates and their higher education institutions backgrounds. Then, the study ends up with some recommendations to help the policy and decision makers to update the curriculum of West African higher education institutions. This could contribute significantly to enhance the adaptive capacity of the region to tackle the challenges posed by climate change.

## **Methodology**

### **Data collection**

The study used primary data collected from an online google form designed survey. Accordingly, the questionnaire was sent to various social media groups of students and employees who graduated from West African higher education institutions. The questionnaire included the sociodemographic characteristics and native language of the respondents, some characteristics of the West African higher education institutions (education languages, internship mandatory, duration of education cycle, practical training before graduation, duration of the practical internship, mastery of the statistical and econometric tools) and the satisfaction of the respondents towards these higher education institutions (ability to recommend their graduated/studying institutions to relatives and friends).

### **Study data analysis**

Descriptive statistics such as frequency and percentage were used to shape the socio-demographic profiles of the responds. In addition, Chi-square test was conducted to examine the relationships between the native countries of the graduates/students and preferred high education institutions, mandatory of the practical internship and higher education institutions, the trainee mastery of statistical and econometric tools and high education institutions, the number of conducted studies by the graduates/students and their host high education institutional and then the fitness of the current works of the graduates and high education institution's back grounds.

## **Results**

### **Sociodemographic characteristics of the respondents**

Table 1 presents the sociodemographic characteristics of the respondents. It showed that most respondents (86.89%) were male, most of them were married (40%) and most of them (75.41%) were more than over 30 years old and most of the respondents (70.49%) was originated from French speaking countries.

**Table 1.** Sociodemographic characteristics of the respondents

Variables		Frequencies	Percentage (%)
Gender	Male	53	86.89
	Female	8	13.11
Marital status	Single	19	31.15
	Married	40	65.57
	Divorced	2	3.28
Age	18-21	1	1.64
	22-25	2	3.28
	26-29	12	19.67
	Over 30	46	75.41
Official languages of the native country of the graduates/students	French	43	70.49
	English	18	29.51

**Features of the climate change curriculum of the higher education institutions**

Table 2 presents the characteristics of the host high education institution's curriculum of the graduates/students. It showed that most of the respondents (44.26%) had a master education level from the Abdou Moumouni University in the Niger Republic (27.87%) and the KNUST University from Ghana (27.87%) and most of them obtained their Master Degree after two academic years (42.62%). In addition, most of the respondents (83.61%) performed a practical internship and most of them 60.66% performed this practical internship during their education cycle. Furthermore, for most of the respondents (60.66%) the practical internship took less than one, most of the respondents (40.98%) mastered only statistical and econometric programs.

**Table 2.** Features of the climate change curriculum of the higher education institutions

Variables		Frequencies (n)	Percentage (%)
Education level	Doctorate	16	26.23
	Master	27	44.26
	Undergraduate	18	29.51
Studying Institutions	University Abdou Moumouni of Niamey	17	27.87
	KNUST	17	27.87
	Bayero university	6	9.84
	University of Ouagadougou	2	3.28
	University of Zinder	6	9.84
	Jos university	2	3.28
	Gambia College	1	1.64

	LUND	3	4.92
	Ghana	1	1.64
	Lomé	1	1.64
	ISAV/Guinea	1	1.64
	University Cheick Anta Diop	1	1.64
	FUTA, Akure	1	1.64
	University of Ouagadougou	1	1.64
	Jos university	1	1.64
Duration of the education cycle	2 years	26	42.62
	3 years	12	19.67
	4 years	19	31.15
	More than 4 years	4	6.56
Performance of practical internship	Yes	51	83.61
	No	10	16.39
The place of the practical internship	Within the university	37	60.66
	Out the university	24	39.34
Duration of practical internship	Less than one year	37	60.66
	One year	24	39.34
Number of statistical and econometric programs mastered by the trainee	None	17	27.87
	1 program	25	40.98
	2 programs	5	8.20
	3 programs	10	16.39
	4 programs	2	3.28
	10 programs	1	1.64
	15 programs	1	1.64

The symbols UAMN, KNUST, ISAV, and FUTA refer respectively to the Abdou Moumouni University of Niamey in the Niger Republic, Kwame Nkrumah University of Science and Technology, Higher agronomic and veterinary institute and the Federal University of Technology, Akure

### Relationship between the official language of the graduates'/students' native countries and the host higher education institution language

Table 3 presents the correlation between the official language of the graduates'/students' native countries and the host higher education institution language. The results of the Chi-square test showed that the existence of an evident relationship between the official language of the native country of the graduates/students and the language of their higher education institutions ( $P=0.000$ ). Hence, most of the respondents (47.54%) who originated from French-speaking countries preferred the high education institution with French as education.

**Table 3.** Relationship between the official language of the graduates'/students' native countries and the language of host higher education institutions

The Education language of the host education	Language of host higher education institutions		Total
	French	English	
French	29	14	43
	47.54	22.95	70.49
English	1	17	18
	1.64	27.87	29.51
Total	30	31	61
	49.18	50.82	100.00

Pearson  $\chi^2(1) = 19.4436$   $P = 0.000$

**Relationship between the performance of practical internship and the graduated/student host higher education institutions**

Table 4 presents the relationships between performing practical internship and the graduated/student host higher education institutions. The results of the Chi-square test showed that there was an evident relationship between the performance of practical internship and the graduated/studying higher education institutions ( $P = 0.075$ ). Most of respondents (83.61%) have performed practical internships. In addition, most of these internships included analyzing, aligning, and interpreting the sequences of the gene, learning bioinformatics software, learning the calculation of satellite index, using python software, extracting DNA and analyzing molecular data, etc.

**Table 4.** Relationship between performing practical internship and the graduated/student host higher education institutions

Performing practical training	Higher education institutions															TOTAL
	UAMN	KNUST	Bayero	Ouagadougou	Zinder	Tiajin	Jos	Gambia College	Lund	Ghana	Lomé	ISAV /Guinea	Cheick Anta Diop	FUTA Akure	Felix Houphouet Boigny	
Yes	16 26.23	11 18.03	6 9.84	6 9.84	0 0.00	1 1.64	3 4.92	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	51 83.61
NO	1 1.64	6 9.84	0 0.00	1 1.64	0 0.00	2 3.28	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	10 16.39
TOTAL	17 27.87	17 28.87	6 9.84	2 3.28	6 9.84	2 3.24	1 1.64	3 4.92	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	1 1.64	61 100.00

Pearsonchi2(14) =22.1591P = 0.075

#### Relationship between the graduates'/students' mastery of statistical and econometric tools and graduated host high education institutions

Table 5 presents the relationship between the respondent's mastery of statistical and econometric tools and graduated host high education institutions. Pearson chi-square test on the relative frequencies showed the existence of a significant relationship ( $P=0.018$ ) between the graduates '/students' number of mastered statistical and econometric programs and the graduated host high education institution. In addition, most of the respondents (40.98%) mastered only one statistical and econometric program. These statistical and econometric tools comprised Stata, SPSS, XLStat, remote sensing, GIS, R Software, ARCGIS, Instat+, Ferret, AVL Cruise, Gensat, PFNL, Mapping, HEC-RAS model for simulating flood flows, GR2M model, Gumbel's statistical law, WRF, R Studio, and Nco cdo shell scripting.

**Table 5.** Relationship between the graduates'/students mastery of statistical and econometric tools and host higher education institutions

Number of mastered statistical and econometric tools	Host high education institutions															
	UAMN	KNUST	Bayero	Ouagadougou	Zinder	Tiajin	Jos	Gambia College	Lund	Ghana	Lome	ISAV	CAD	FUTA Akure	FHB	TOTAL
None	7	8	0	0	0	0	0	2	0	0	0	0	0	0	0	17
	11.48	13.11	0.00	0.00	0.00	0.00	0.0	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.87
							0									
1	7	8	3	2	1	0	1	0	1	0	1	0	0	0	1	25
	11.48	13.11	4.92	3.28	1.64	0.00	1.6	0.00	1.64	0.00	1.64	0.00	0.00	0.00	1.64	40.98
							4									
2	0	1	2	0	1	0	0	0	0	0	0	1	0	0	0	5
	0.00	1.64	3.28	0.00	1.64	0.00	0.0	0.00	0.00	0.00	0.00	1.64	0.00	0.00	0.00	8.20
							0									
3	1	0	1	0	4	1	0	1	0	1	0	0	0	1	0	10
	1.64	0.00	1.64	0.00	6.56	1.64	0.0	1.64	0.00	1.64	0.00	0.00	0.00	1.64	0.00	16.39
							0									
4	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	2
	0.00	0.00	0.00	0.00	0.00	1.64	0.0	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	3.28
							0									
10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	1.64	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64
							0									
15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	1.64	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64
							0									
TOTAL	17	17	6	2	6	2	1	3	1	1	1	1	1	1	1	61
	27.87	27.87	9.84	3.28	9.84	3.28	1.6	4.92	1.64	1.64	1.64	1.64	1.64	1.64	1.64	100.00
							4									

Pearsonchi2 (84) =113.4973P = 0.018. The symbols UAMN, KNUST, ISAV, FUTA, FHB and CAD refer respectively to the Abdou Moumouni University of Niamey in the Niger Republic, Kwame Nkrumah University of Science and Technology, Higher agronomic and veterinary institute, the Federal University of Technology, Akure, the Felix Houphouet Boigny University and the Cheick Anta Diop University



### 3.7 Relationship between the number of conducted studies by the graduates/students and host higher education institutions

Table 7 presents the relationship between the number of conducted studies by the graduates/students and their higher education institutions. Accordingly, the results of the Pearson chi-square test on the relative frequencies there was a significant correlation between the respondents' number of conducted studies and Host high education institutions ( $P = 0.001$ ). In addition, table 6 showed most the graduates/students (31.15%) have conducted two studies and most of them (9.84%) are graduated from the UAMN University.

**Table 6.** Relationship between the respondents' number of conducted studies and host high education institutions

Number of studies conducted	Training universities															TOTAL
	UAMN	KNUST	Bayero	Ouagadougou	Zinder	Tiajin	Jos	Gambia	Lund	Ghana	Lomé	ISAV	CAD	FUTA Akure	FHB	
0	4	5	0	2	0	0	1	2	1	0	0	0	0	0	0	15
	6.56	8.20	0.00	3.28	0.00	0.00	1.64	3.28	1.64	0.00	0.00	0.00	0.00	0.00	0.00	24.59
1	2	8	3	0	0	0	0	0	0	0	0	0	0	1	1	15
	3.28	13.11	4.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	1.64	1.64	24.59
2	6	3	1	0	5	2	0	1	0	0	0	1	0	0	00.00	19
	9.84	4.92	1.64	0.00	8.20	3.28	0.00	1.64	0.00	0.00	0.00	1.64	0.00	0.00		31.15
3	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	4
	1.64	1.64	1.64	0.00	1.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.56
4	1	0	0	0	0	0	0	0	0	0	1	0	1	0	0	3
	1.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.74	0.00	1.64	0.00	0.00	4.92

5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.28
6	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	0.00	0.00	0.00	1.64
8	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	1.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64
10	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	1.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64
TOTAL	17	17	6	2	6	2	1	3	1	1	1	1	1	1	1	61
	27.87	27.87	9.84	3.28	9.84	3.28	1.64	4.92	1.64	1.64	1.64	1.64	1.64	1.64	1.64	100.00

Pearson  $\chi^2(112) = 164.7808$   $P = 0.001$ . The symbols UAMN, KNUST, ISAV, FUTA, FHB and CAD refer respectively to the Abdou Moumouni University of Niamey in the Niger Republic, Kwame Nkrumah University of Science and Technology, Higher agronomic and veterinary institute, the Federal University of Technology, Akure, the Felix Houphouet Boigny University and the Cheick Anta Diop University.

### 3.8 Relationship between the fitness of the current works of the graduates and high education institution's back grounds

Table 7 presents the relationship between the fitness of the current works of the graduates and high education institution's back grounds. Pearson chi-square test showed there is no relationship between the current working place of the graduates and their academic backgrounds ( $P = 0.116$ ). In addition, most of the graduates work currently at the place suitable with their academic background (22.95%) were graduated from the KNUST University whilst most of them (11.48%) are currently working at the place that does not fit with their academic backgrounds were graduated from the Abdou Moumouni University.

**Table 7.** Relationship between the fitness of the current works of the graduates and high education institution's back grounds

fitness of the current works of the graduates	host higher education institutions															
	UAMN	KNUST	Bayero	Ouagadougou	Zinder	Tiajin	Jos	Gambia College	Lund	Ghana	Lomé	ISAV /Guinea	CAD	FUTA Akure	FHB	TOTAL
Yes	10	14	3	1	6	2	1	3	1	1	1	0	0	1	1	45
	16.39	22.95	4.92	1.64	9.84	3.28	1.64	4.92	1.64	1.64	1.64	0.00	0.00	1.64	1.64	73.77
N0	7	1	1	1	0	0	0	0	0	0	0	0	1	0	0	11
	11.48	1.64	1.64	1.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	18.03
Jobless	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	5
	0.00	3.28	3.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.64	0.00	0.00	0.00	8.20
TOTAL	17	17	6	2	6	2	1	3	1	1	1	1	1	1	1	61
	27.87	27.87	9.84	3.28	9.84	3.28	1.64	4.92	1.64	1.64	1.64	1.64	1.64	1.64	1.64	100.00

Pearsonchi2(28) = 37.1147P = 0.11. The symbols UAMN, KNUST, ISAV, FUTA, FHB and CAD refer respectively to the Abdou Moumouni University of Niamey in the Niger Republic, Kwame Nkrumah University of Science and Technology, Higher agronomic and veterinary institute, the Federal University of Technology, Akure, the Felix Houphouet Boigny University and the Cheick Anta Diop University.

## Discussion

The study explored climate change curriculum development in some West African higher education institutions. The study findings showed most of the graduates from West African higher education institutions were male. The fact that female is not encouraged to follow the climate change curriculum in these higher education institutions could affect negatively the efforts of the regions to respond properly to the adverse impacts of climate change because the women could easily spread climate change behavior in society. These results are consistent with Lambrou and Piana, (2006) who highlighted that gender is of key importance in responding to climate change. Also, Monroe et al. (2019) mentioned that climate change education is a solution to cope with the negative impacts of climate change, particularly women education in the region most affected by climate change due to that most of women livelihoods come from agriculture activities and natural resources.

On the other hand, the study findings showed that most of the respondents were originated from French-speaking and followed their climate change education in West Africa higher education with French as an education language. The preference of higher education institutions with the same language as the native country of the respondents could be due to they would like to avoid language barriers during their education cycle. This could contribute to them to better understand their fields of study. Previously, Flottum (2017) indicates that language has a key role in the climate change debate in the world, and Conway (2008) and Epule et al. (2017) highlighted that it has great implications for the countries to report their executed climate change actions.

On the other hand, the study revealed that the graduates'/students' performance of practical internships and mastery of statistical and econometric tools depends to the host higher education institutions. Most of them mastered only one statistical and econometric tool which could be a weakness in their future professional careers. This could reduce the ability of the graduates to perform good research in the climate change field. These results are aligned with Peter (2017) who noted that the mastery of statistics is of a key important role in conducting climate change researches. In addition, most of them conducted climate change studies as mandatory practical internships that took less than one year within their host institutions for the education graduation purpose. Hence, most respondents have conducted one or two studies related to climate change so that they lacked sufficient training to tackle the challenges posed by climate change in the region. Similarly, Oliver (2013) and Molthan-hill et al. (2019) highlighted that climate change training at higher education institutions affects the country's sustainable vision and social response to climate change and the skill of climate change future leaders. Also, Anderson (2012) indicated that any social systems with adequate climate change curriculum might cope with the adverse impacts of climate change on its socio-economic assets and

Cordero et al. (2020) noted that climate change education leads to environmentally friendly behaviors of the individuals.

The study findings showed that most of the respondents work currently at a place that fits with their education curriculum. This could contribute significantly to the region's efforts in responding to climate change such as implementing climate change mitigation and adaptation strategies. Correspondingly, Wynes and Nicholas (2017) mentioned that educated individuals in climate change might easily accept climate change taxes as well as support the community to develop climate change adaptation and mitigation action.

### **Conclusion**

This study examines the climate change curriculum development in West Africa higher education institutions. Most of the participants in this study were either graduated or students from 15 West African higher education institutions. Although most West African higher education institutions had climate change curriculum, their features changed from one higher education institution to another. Most of the graduates/students preferred to study in the higher institution whose education language is the same as their native countries' official languages. especially French-speaking higher education institutions. In addition, the study findings showed that the graduates lacked of sufficient mastery of statistics and econometric tools and conducted research only as mandatory for their graduation. This could reduce the efforts of this region in implementing climate action and report properly the challenges they faced due to climate during national and international debates amongst climate leaders. Consequently, West African higher education institutions should review their current climate change curriculum by for instance including statistical and econometric training to provide sufficient research skills for future professional graduates and climate change leaders. This could significantly reinforce the climate change adaptive strategies of the regions. This study is a call for action for a more sustainable climate change action through climate change education in West African higher education institutions.

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### **6. References**

Adesina, F., & Odekunle, T. O. (2011). Climate Change and Adaptation in Nigeria: Some Background to Nigeria's Climate Change and Adaptation in Nigeria: Some Background to Nigeria ' s Response - III. In International Conference on Environmental and Agriculture Engineering (Vol. 15, pp. 2–10).

Singapore: AICSIT Press.

Ado, A. M., Savadogo, P., & Abdoul-Azize, H. T. (2019). Livelihood strategies and household resilience to food insecurity: insight from a farming community in Aguié district of Niger. *Agriculture and Human Values*, 36(4), 747–761. <https://doi.org/10.1007/s10460-019-09951-0>

Aksa, F. I., & Samudra, U. (2019). An analysis climate change of the curriculum in Indonesia, (November). <https://doi.org/10.1088/1742-6596/1321/2/022121>

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development*, 6(2), 191–206. <https://doi.org/10.1177/0973408212475199>

Bidoli, T. ., Isa, A. G., Shehu, B., Kezi, D. M., & Adbullahi, M. Y. (2012). Assessment of the Effects of Climate Change on Livestock Husbandry and Practices in Jigawa State , Nigeria. *Journal of Agricultural Extension*, 16(1), 20–30. <https://doi.org/http://dx.doi.org/10.4314/jae.v16i1.3>

Conway, G. (2008). *The Science of Climate Change in Africa : Impacts and Adaptation*, (February), 1–43.

Cordero, E. C., Centeno, D., & Todd, A. M. (2020). The role of climate change education on individual lifetime carbon emissions. *Plos One*, 15(2), e0206266. <https://doi.org/10.1371/journal.pone.0206266>

Epule, E. T., Peng, C., Lepage, L., & Chen, Z. (2014). The causes, effects and challenges of Sahelian droughts: A critical review. *Regional Environmental Change*, 14(1), 145–156. <https://doi.org/10.1007/s10113-013-0473-z>

Epule, T. E., Ford, J. D., Lwasa, S., & Lepage, L. (2017). Climate change adaptation in the Sahel.

*Environmental Science and Policy*, 75(May), 121–137. <https://doi.org/10.1016/j.envsci.2017.05.018>

Flottum, K. (2017). The role of language in the climate change debate. *Language in Society* (Vol. 47). Francis., Taylor &. <https://doi.org/10.1017/S0047404518000994>

Lambrou, Y., & Piana, G. (2006). GENDER: THE MISSING COMPONENT OF THE RESPONSE TO CLIMATE CHANGE.

Mamadou, I., Gautier, E., Descroix, L., Noma, I., Bouzou Moussa, I., Faran Maiga, O., ... Vandervaere, J. P. (2015). Exorheism growth as an explanation of increasing flooding in the Sahel. *Catena*, 131, 130–139. <https://doi.org/10.1016/j.catena.2015.03.017>

Mochizuki, Y., & Bryan, A. (2015). Climate Change Education in the Context Rationale and Principles. *Research*, 9(1). <https://doi.org/10.1177/0973408215569109>

Molthan-hill, P., Worsfold, N., Nagy, G. J., Leal, W., & Mifsud, M. (2019). Climate change education for universities : A conceptual framework from an international study. *Journal of Cleaner Production*, 226, 1092–1101. <https://doi.org/10.1016/j.jclepro.2019.04.053>

Offorrna, G. C. (2015). 9 . Climate Change and the Need for New Curriculum Development in Nigerian Universities, (January 2014).

- Oliver, J. (2013). Climate Change Education: Knowing, doing and being. *Journal of Chemical Information and Modeling* (Vol. 53). London and New York: Rotledge Taylor & Francis Group. <https://doi.org/10.1017/CBO9781107415324.004>
- Padgham, J., Virji, H., & Seipt, C. (2013). Promoting climate change curricula development in African universities. *Environmental Development*, 5, 169–171. <https://doi.org/10.1016/j.envdev.2012.08.001>
- Roudier, P., Sultan, B., Quirion, P., & Berg, A. (2011). The impact of future climate change on West African crop yields: What does the recent literature say? *Global Environmental Change*, 21(3), 1073–1083. <https://doi.org/10.1016/j.gloenvcha.2011.04.007>
- Watts, N., Adger, W. N., & Agnolucci, P. (2015). Health and climate change: Policy responses to protect public health. *Environnement, Risques et Sante*, 14(6), 466–468. [https://doi.org/10.1016/S0140-6736\(15\)60854-6](https://doi.org/10.1016/S0140-6736(15)60854-6)
- Wynes, S., & Nicholas, K. A. (2017). The climate mitigation gap : education and government recommendations miss the most effective individual actions The climate mitigation gap : education and government recommendations miss the most effective individual actions. *Environmental Research Letters*, 12.