ABSTRACT

Climate change remains one of the most severe challenges to Africa in the 21st century. Climate change is a great threat to food security and livelihood, with possible increase in climate sensitive diseases in the sub-region. Adverse effects of climate change include extreme events such as flood, drought, storms and heat waves, which are threats to water, food and energy security. Climate Change challenges affect women and children more than men. This situation demands a critical need to develop effective and pro-active measures to reduce the negative impacts of climate change.

From a baseline of about 30 Climate Scientists in West Africa in 2011, WASCAL graduate studies program has intervened by increase the stock of Climate Scientists by more than 500 percent. WASCAL has directly trained and transformed 258 young scientists through the masters and doctoral research programs into Climate Scientists in the thematic areas of West African Climate System, Climate Change and Agriculture, Land Use and Adapted land Use, Biodiversity, Energy, Education, Human Security, Water resources and Economics. The In-service training handle has also trained 35 government officials. Many of the graduates are actively working in the West African region providing solutions to the adverse effects of Climate Change.

One-third of the scientists trained by WASCAL are women. About 86 percent of the female trainee were not married at the time of the postgraduate program. There is a positive correlation between late marriage, postgraduate training and women empowerment.

Gender equality and women training will lead to women empowerment and environmental sustainability in the long run. Women empowerment will facilitate reduction in global carbon footprint. There is need for increase in public expenditure on postgraduate training in climate change thematic areas for women.

Keywords: Climate change, climate education, women empowerment, gender equality, extreme events.
1. Introduction

Climate change remains one of the most severe challenges to Africa in the 21st century. Climate change is a great threat to food security and livelihood, with possible increase in climate sensitive diseases in the sub-region. Adverse effects of climate change include extreme events such as flood, drought, storms and heat waves, which are threats to water, food and energy security. Climate Change challenges affect women and children more than men. Women and children especially girls suffer more from the effect of flood such as displacement, loss of school days, loss of lives and economic loss which could lead to reallocation of family income to train boys and early marriage. This situation demands a critical need to develop effective and pro-active measures to reduce the negative impacts of climate change.

The Sustainable development goal (SDG) 2030 underscore the need to take urgent to combat climate change and its impact (SDG 13), achieve gender equality and empower women (SDG 5) and ensure inclusive and quality education (SDG 4). The AFDB High 5 and AU AGENDA 2063 are also in line with the need for sustainable development and combating the adverse effect of climate change.

The overall aim of the study is to examine the level of female participation in climate change education programs at the graduate level in West Africa as well analyse the relationship between early marriage and female postgraduate training in climate change thematic areas.

The paper is structured as follows. Section 2 presents the literature review, while section 3 presents the methodology. The penultimate section presents analyses of findings and the final section presents the summary, conclusions and policy recommendations.

2. Literature Review

2. 1 Women and Sustainable development

Sustainable human development will lead to reduction in poverty and inequality. UNDP frames the concept of sustainable human development based on the main objective of creating the conditions for every person to have a life free of hunger and want, to be educated, have decent shelter and work, access to health services, and the genuine freedom to choose to live lives which they value. Implicit in all of these factors is the element of environmental sustainability – appreciating the relationship between human development and the ecosystem in which it occurs. At the core of this approach is the belief that environmental unsustainability prevents the reduction of
poverty and inequality; that the persistence of inequality at high levels in many developing countries has made it more difficult to reduce poverty.

**Women are the strategic gatekeepers at the core of environmental sustainability.** Women and girls are the home makers, therefore decisions influencing environmental sustainability at the micro level is determined by women. Gender equality and women empowerment will lead into environmental sustainability in the long run. About 40 percent of global emission come from buildings and 20 percent are from residential building. Women take critical decisions about the use of appliances at home. For example switching off appliances at the power point instead of leaving them on standby or switching off the fridge for a few hours each day, choice of curtains or blinds will save a lot of energy (Hughes, 2016, Adelegan, 2017). Where girls and boys have equal access to education, these decisions will be a lot easier to make.

### 2.2 Women, Climate Change and Education

**Women in rural communities are more confronted with the adverse effect of climate change and variability than men.** A social vulnerability assessment of the impact of climate change on coastal erosion revealed that women in the Gambia Gunjur Village are more vulnerable than men. Coastal erosion affects their livelihood and wellbeing (Gomez, 2015). Government should mainstream gender in its efforts to reduce vulnerability to coastal erosion.

**Women empowerment will facilitate reduction in global carbon footprint.** Educate a girl and educate a community is a popular slogan. Decisions such as using broom instead of vacuum cleaner, washing clothes in cold water and drying them in the sun instead of using dryers; limiting showers to few minutes; cooking with gas instead of hotplates and electric oven; using fluorescent and energy saving bulbs; recycling plastics used in the home, switching off appliances at the point instead of leaving them on standby will reduce global carbon footprint all over the world (Hughes, 2016). These decisions are gender based and mainly made and implemented by women and girls in sub-Saharan Africa. In sub-Saharan Africa, many women and girls use the local brooms for cleaning, wash clothes in cold water and dry them in the sun, shower with water in a bucket (or rain water harvested during the rainy season), and cook with charcoal, biomass and kerosene stoves. These decision have ability to reduce carbon footprint at the individual household levels, and if aggregated will reduce the carbon footprint in the African continent and facilitate sustainable human development (Adelegan, 2018).

**Women in their kitchens and shops can do a lot to save carbon emission daily if empowered.** We all need to eat. Although a lot of Africans live in the rural areas and they mainly consume locally grown foods, imported processed foods and beverages are increasingly gaining entry even into the local markets with increased globalization and trade and dumping. However, producing and transporting food produces
greenhouse gas emission. Decisions to buy and consume foods produced locally will minimize food miles and contribute towards decarbonizing the world and sustainable development. The food miles is determined by how much each food item has come from point of production to point of sale. Even if the price of exported food is cheaper, it is still more expensive than the local available alternatives, because there is significant global reduction of carbon emission by buying locally made food and reducing food miles (Hughes, 2016). Educated and well informed women even in the rural areas in Africa will make wise choices (Adelegan, 2017).

**Women empowerment will also reduce biomass consumption and deforestation, and improve the ecological systems and household health.**

Around 3 billion people cook using polluting open fire or simple stove and traditional biomass for cooking (WHO, 2018). An empirical study in Republic of Benin West Africa revealed that almost 100 percent of the 137 households across 17 villages in Dassani catchment use firewood to cook, while 76 percent also use non timber forest products (NTFP) for cooking. The average firewood consumption was 1.026kg per capita during the rainy season and 0.814kg per capita during the dry season, with tree branching being the most used firewood collection method (Issoufou, 2014). This has negative implications on the sustainability of the ecosystems and economic growth.

**Women empowerment will lead to improved household health and reduce government expenditure on public and primary health care and stimulate economic growth.**

The intense use of biomass for cooking has negative impacts on human health especially women and children. About 3.8 million premature deaths result from in-door air pollution yearly and 85 percent of these deaths are caused by biomass use (WHO, 2018). Incomplete combustion of biomass results in the emission of air pollutants such as carbon monoxide (CO), nitrogen oxide (NO\textsubscript{x}) and fine particle matter such as PM\textsubscript{2.5} and PM\textsubscript{10}. This has caused acute respiratory infections in children. (Shi and Zhou, 2016; Yanosky, 2012). Women exposed to indoor smoke are three times more likely to suffer from chronic obstructive pulmonary disease than those who cook with electricity, while a child exposed to indoor air pollution is two or three times more likely to suffer from pneumonia infection (WHO, 2018). The burden of gathering biomass and firewood collection also rest on women and children, who trek kilometers to gather firewood. Production of charcoal from firewood burning also worsen land degradation in sub-Saharan Africa (IEA, 2006). Furthermore, when firewood and charcoal are not sufficient, women also use animal dung and agricultural remains for fuel and this result in a reduction in soil fertility (Shi and Zhou, 2016). Women that are empowered and educated will use gas energy to cook instead of the traditional methods. This will ultimately enhance soil fertility, productivity and stimulate economic growth (Adelegan, 2017).
Urbanisation and globalization has great influence on food choices and has aggravated carbon emission problems in sub-Saharan Africa. There is a lot of food import "dumping" in the urban areas. This is a situation where the prices of imported food products are cheaper than the one produced locally. Since consumers are rational and will want to maximize their utility function, subject to the constraint of income and prices, they will choose the cheaper alternative. Critical decisions on environmental sustainability and prices and choice of food are made by women in the urban cities in sub-Saharan Africa. Women and girls can reduce household carbon footprints by making good choices about the food that they buy for consumption at the household level.

A woman who is educated and well informed about the adverse effect of climate change will make a different and better decision (Adelegan, 2017). Environment sustainability will ultimately result in healthy living and reduction in poverty. This study documents the level of female participation in post graduate programs in climate change in Universities in West Africa.

3. Methodology

The study used both primary and secondary data. Secondary data was obtained from the database of 13 Universities from 10 West African Countries and database of West African Science Service Center on Climate Change and Adapted (WASCAL) Capacity Building Department and data base of Universities affiliated with WASCAL and this was complemented with interviews of some WASCAL Graduate studies program (GRP) Directors and Scientists in the universities and countries for additional information or clarifications where necessary. The data obtained include enrolment in science based programs by male and female students at post graduate levels in 2016 and 2017 in the selected Universities and WASCAL based graduate programs as well as data on marital status of WASCAL graduate students

Table 1 presents the list of Universities and countries included in the study sample. Ten (10) of the 13 Universities in the study sample have WASCAL graduate studies programs (GRP) in different thematic areas which include West African Climate Systems, Climate change and Economics, Water Resources, Agriculture, Land use, Climate Change and Human Security, Adapted land Use, Biodiversity and Education at the masters and doctoral levels. The Universities included that are non-WASCAL affiliated are Universities in Nangui, Abrogoua and Bingerville in Cote D’Ivoire and University of Ouagadougou 1 in Burkina Faso. All the Universities in the study sample are based in West African Countries namely: Nigeria, Mali, Benin, Niger, Cote D’Ivoire, The Gambia, Ghana, Togo, Burkina-Faso and Senegal. One university from each of the countries listed above are in the study sample, with the exception of Cote D’Ivoire which has 3 universities in study sample (Université Felix Houphouët Boigny, Cocody, Nangui Abrogoua and Bingerville) and Nigeria with 2 Universities in the study sample (Federal
Universities of Technology in Akure and Minna). Sample was selected based on availability of graduate programs on Climate change and affiliation with WASCAL and data availability.
### Table 1: West Africa Countries and Universities in the Study Sample

<table>
<thead>
<tr>
<th>Countries &amp; Universities &amp; WASCAL GRP/MPR</th>
<th>Number of Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nigeria: 1. Federal University of Technology, Akure. 2. Federal University of Technology, Minna, Nigeria</td>
<td>2</td>
</tr>
<tr>
<td>3. Togo, Université de Lomé, Togo</td>
<td>1</td>
</tr>
<tr>
<td>4. Niger, Université Abdou Moumouni de Niamey, B.P. 10662 Niamey, Niger</td>
<td>1</td>
</tr>
<tr>
<td>5. The Gambia, University of the Gambia, Serrekunda.</td>
<td>1</td>
</tr>
<tr>
<td>6. Mali, Institut Polytechnique Rural de Formation et de Recherche Appliquée, (IPR-IFRA) de Katibougou, Mali</td>
<td>1</td>
</tr>
<tr>
<td>7. Senegal, Université Cheikh Anta Diop de Dakar, B. P. 5683 Faseg/Dakar Senegal</td>
<td>1</td>
</tr>
<tr>
<td>8. Benin, Université d'Abomey-Calavi, 01 B.P. 526, Cotonou, Benin</td>
<td>1</td>
</tr>
<tr>
<td>9. Ghana, Kwame Nkrumah University of Science and Technology (KNUST), Kumasi, Ghana</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

Source: Author’s compilation from WASCAL database.

Data was analysed using descriptive statistics, ratios, charts and tables.

Analysis of findings are grouped into 2 categories, namely: Gender and postgraduate education in West Africa and Female participation in Climate change education.

4.1 Gender and Postgraduate Education in West Africa

Table 2 presents the gender analysis of graduate students in Science based programs in 13 West African Universities from ten West African Countries namely: Nigeria, Mali, Benin, Niger, Cote D’Ivoire, The Gambia, Ghana, Togo, Burkina Faso, Niger and Senegal.

About 75 percent of the 17,926 post graduate students in the sample are male while, 25 percent are female. Figure 1 presents female enrolment in postgraduate programs. In total 4,565 female postgraduate students were enrolled in all the 13 Universities in 2016/2017 and 2,721 representing about 60 percent were enrolled in in science based courses. Majority of the postgraduate female students are in science based courses, with the exception of Niger (21%), Ghana (18%) and The Gambia (41%).
Table 2. Gender of Postgraduate Students in Universities in 10 West African Countries 2016/2017

<table>
<thead>
<tr>
<th>Country</th>
<th>Total</th>
<th>Female</th>
<th>Female in Science</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benin-UAC</td>
<td>6108</td>
<td>1408</td>
<td>1102</td>
<td>78</td>
</tr>
<tr>
<td>Burkina Faso-UOG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niger -UAM</td>
<td>709</td>
<td>153</td>
<td>32</td>
<td>21</td>
</tr>
<tr>
<td>Ghana-KNUST</td>
<td>5499</td>
<td>1670</td>
<td>307</td>
<td>18</td>
</tr>
<tr>
<td>Gambia-UTG</td>
<td>112</td>
<td>34</td>
<td>14</td>
<td>41</td>
</tr>
<tr>
<td>Togo-UL</td>
<td>1748</td>
<td>283</td>
<td>249</td>
<td>88</td>
</tr>
<tr>
<td>Mali/IPR-IFRA</td>
<td>95</td>
<td>34</td>
<td>34</td>
<td>100</td>
</tr>
<tr>
<td>Senegal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigeria-FUTA</td>
<td>2722</td>
<td>756</td>
<td>756</td>
<td>100</td>
</tr>
<tr>
<td>FUT Minna</td>
<td>818</td>
<td>153</td>
<td>153</td>
<td>100</td>
</tr>
<tr>
<td>Cote D'Ivoire</td>
<td>115</td>
<td>74</td>
<td>74</td>
<td>100</td>
</tr>
<tr>
<td>Total (average)</td>
<td>17926</td>
<td>4565</td>
<td>2721</td>
<td>(60)</td>
</tr>
</tbody>
</table>

Note: 3 Universities in Cote D'Ivoire (UFHB, Nangui Abrogoua and Bingerville), 2 Universities in Nigeria

Source: Author’s compilation from WASCAL database.

Figure 1. Female Enrolment in Masters and Doctoral Students from 10 West African Countries (Science and Non-Science) 2016-2017

Source: Author’s compilation from WASCAL database.
4.2 Gender and Climate Education in West African Universities

Figure 2 presents the Climate change thematic areas of study of a pool of Masters and doctoral students from ten West African Countries namely: Nigeria, Mali, Benin, Niger, Cote D'Ivoire, The Gambia, Ghana, Togo, Burkina Faso, Niger and Senegal enrolled on the West African Science Service Center on Climate Change and Adapted Land Use (WASCAL) program.

Figure 2. Climate Change Graduate Education Thematic Areas in West African Universities

Source: Author’s compilation from WASCAL database.
The graduate students in the 10 West African Universities are enrolled in various Climate change thematic areas including agriculture, biodiversity, adapted land use, economics, education, water resources, renewable energy and human security graduate studies programs (GSP).

Figure 3 presents the gender analysis of the graduate students enrolled on the WASCAL GSP.

Figure 3. Gender Analysis of WASCAL Graduate Students 2012-2018

Source: Author’s compilation from WASCAL database.

Total number of enrolment of graduate students is 258 from 2012 to 2018, out of which 80 are female students. Female students accounts for one-third of the total enrolment.

Women education and empowerment is closely linked with gender equality. Harmful traditional practices such as child marriage also limit women from being empowered and reaching their full potentials in life. Child marriage truncates educational attainment of the child mother, early exposure to pregnancy complications and high maternal mortality rate. Measures should be put in place to discourage child marriage. Delayed marriage are associated with greater educational achievement, lower fertility and increase in life expectancy.

Figure 4 below presents the marital status of a pool of Masters and doctoral students from ten West African Countries namely: Nigeria, Mali, Benin, Niger, Cote D’Ivoire, The Gambia, Ghana, Togo, Burkina Faso, Niger and Senegal that are within the age bracket 20 to 30 years old enrolled on the West African Science Service Center on Climate
Change and Adapted Land Use (WASCAL) program. Out of 28 students within the age bracket of 20 to 30 years, 24 are single, representing 86 percent of the graduate students. About 86 percent of the female trainee were not married at the time of the postgraduate program.

Figure 4 Marital Status of Masters and Doctoral Students from 10 West African Countries (Age bracket 20-30 years)

Source: Author’s Computation from WASCAL data base, 2018

Figure 5 presents the marital status of all the graduate students between age 20 to 45 years from 2016 to 2018. Out of a total of 31 graduate students, 24 are single. The percentage of single students represents 77 percent of the total female students.

There is a positive correlation between late marriage, postgraduate training and women empowerment.
This further buttress the point that there is a positive correlation between greater educational achievement in Climate Change and delayed marriage. Early marriage is a barrier to pursuing graduate studies.

5. Conclusion and Policy Recommendations

Gender equality and female training in climate change thematic areas will lead to women empowerment and environmental sustainability in the long run. Women empowerment will facilitate reduction in global carbon footprint. There is need for increase in public expenditure on postgraduate training in climate change thematic areas for women.

Policy handles should focus on climate change education at graduate levels. Coordinated effort by the household and informal institutions should be targeted at eliminating social norms limiting women’s mobility and economic power such as early marriages.

Government should focus policy handle on mainstreaming gender in intervention policy to combat the adverse effect of Climate Change. Government policy aimed at balancing
interests of Female that constitute 49.6% of world population should ensure that no child is left behind, both girls and boys. Education of Female Climate Scientists should be promoted at postgraduate levels at all tiers of government. Universities should have gender mainstreaming in their admission processes especially at graduate levels, and Association of African Universities should take the lead in providing a benchmark for gender mainstreaming in climate change education in higher institutions.

References


Hughes, L (2016): Climate Change (ClimChan), open2study.com, Open Universities, Australia.


Yanosky, J (2012): An overview of Health Impacts from Biomass Combustion: Bioenergy Emissions and Health Impacts, short course delivered at Department of Public Health Sciences, Penn State College of Medicine, USA on 22 March.