

Cultural Perspective on Climate Change: Engagement and Sentiment Analysis on Nigeria's Social Media Space

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ABSTRACT

The increasing significance of the effects of climate change in Nigeria necessitates research on how stakeholders can respond. With climate change being a major focus of global action, and social media emerging as a key tool for social mobilization, this research focuses on understanding how Nigeria's social media space can be leveraged to improve climate change mobilization among Nigerian users. To understand the current interactions with climate change topics, this study examined Nigeria's Twitter space, analyzing the level of engagement and sentiments about climate change. Furthermore, the research involved a climate change knowledge survey targeting social media users and key informant interviews with communication stakeholders. An engagement and sentiment analysis revealed that while there is comparatively lower engagement on the subject of climate change in Nigeria's social media space, the engagements documented are significantly more positive when compared to those in western English-speaking countries such as the USA, Canada, the United Kingdom, and Australia. Analysis of the climate change knowledge survey supported these findings, with a sample of 175 social media users returning a climate change knowledge score of over 86%. Despite the high awareness of climate change and the comparatively positive sentiments of Nigerian social media users on the subject, Nigerians considered other elements of development to be more important than climate change. However, the significant variation in the perception of climate change between female and male participants provided a potential entry point for promoting climate change discussions in communities. Since female community members exhibited statistically significantly higher awareness of the importance of climate change compared to their male counterparts, it is recommended that women in the community be utilized as entry points for both virtual and physical community-level climate change advocacy.

DECLARATION OF AUTHENTICITY

I declare that the material contained in this project is the end result of my own work and that due acknowledgement has been given in the bibliography and references to **ALL** sources be they printed, electronic or personal.

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TABLE OF CONTENTS

ABSTRACT	1172
DECLARATION OF AUTHENTICITY.....	1173
TABLE OF CONTENTS.....	1174
LIST OF FIGURES	1176
LIST OF TABLES	1177
CHAPTER ONE INTRODUCTION.....	1178
A. Background.....	1178
➤ Climate Change as a problem in Nigeria.....	1178
➤ The Role of Stakeholders in Climate Change Adaptation.....	1178
➤ Adaptive Capacity	1179
➤ Social Media as an Opportunity	1179
B. Research Problem.....	1180
C. Research Objectives and Questions.....	1180
➤ Research Objective 1 (RO1).....	1180
➤ Research Objective 2 (RO2).....	1180
➤ Research Objective 3 (RO3).....	1180
D. Research Scope and Justification.....	1180
CHAPTER TWO LITERATURE REVIEW	1181
A. Background.....	1181
➤ Climate Change Denial.....	1181
➤ Gender and Climate Change.....	1181
➤ Climate Change Importance in Nigeria.....	1182
B. Communicating Climate-Change	1182
C. Communicating Climate Change to Youths through Social-Media.....	1182
➤ The role of Stakeholders in Climate Change Adaptation	1184
➤ Adaptive Capacity	1184
➤ Social Media as an Opportunity	1185
➤ Social Media Engagement Analysis	1185
➤ Sentiment Analysis.....	1185
CHAPTER THREE METHODOLOGY.....	1186
A. Overview.....	1186
B. Research Approach.....	1186
C. Social Media Engagement and Sentiment Analysis.....	1188
➤ Twitter Sample Data.....	1188
➤ Ethical Issues with Twitter Data for Academic Research	1190
D. Climate Change Knowledge Quantitative Survey	1191
➤ Climate Change Knowledge Survey sample	1191
➤ Data collection.....	1191
➤ Ethical Issues.....	1191
➤ Data Analysis.....	1191
E. Key Informants Interviews.....	1191
➤ Key Informants Sample	1192
➤ Key Informant Interview Questions.....	1192
➤ Data Analysis	1192
➤ Ethical Issues.....	1192
CHAPTER FOUR RESULTS AND DISCUSSION	1193
A. Overview.....	1193
B. Twitter Engagement Analysis	1193
➤ Number of Tweets	1193
➤ Retweets.....	1194
➤ Followers	1195
C. Twitter Sentiment Analysis	1196
➤ Textblob Analysis.....	1196
➤ VADER Analysis	1198
D. Climate Change Knowledge Survey	1201
➤ Demographics	1201
➤ Climate Change Knowledge Analysis	1204
➤ Statistical Analysis of Climate Change Knowledge	1207
E. Informant Interviews	1209

➤ Notions on climate change 1210

➤ Motivation for engagement 1210

➤ Relevance of Climate Change Discourse 1210

➤ Summary of Key Informants’ Interviews 1211

F. Results Summary 1211

CHAPTER FIVE CONCLUSIONS AND RECOMMENDATIONS 1212

A. Overview 1212

B. Research Hypothesis and Findings 1212

C. Recommendations 1212

REFERENCES 1213

APPENDIX 1 1214

Appendix 2 1218

Appendix 3 1226

APPENDIX 4: Invitation Letter – Key Informants 1231

Appendix 5: List of Analysis Files 1239

LIST OF TABLES

Figure 1. Nigeria's Active Social Media Trends – 2017 to 2022	1183
Figure 2. Most Popular Social Media Platforms in Nigeria - 2021	1183
Figure 3.: Deductive reasoning process	1186
Figure 4: The Influence Ecosystem	1187
Figure 5.: Influence Ecosystem for Climate Change Communication in Nigeria	1187
Figure 6.: #climatechange, the most used hashtag for Climate Change	1188
Figure 7. Code to extract twitter data	1189
Figure 8.: Textblob Python Library Function for Sentiment and Subjectivity Analysis	1190
Figure 9: VADER Python Library Function for Sentiment Analysis	1190
Figure 10. Number of Tweets containing 'Climate Change' per Country	1193
Figure 11. Overall Distribution of Textblob Sentiments	1196
Figure 12.: Nigeria vs. Western Countries Textblob Sentiments	1196
Figure 13.: Comparative Distribution of Western Countries' Textblob Sentiments	1197
Figure 14.: Statistical Test: Nigerian vs. Western Countries' Climate Change Sentiments	1198
Figure 15. Overall Distribution of VADER Sentiments	1198
Figure 16.: Nigeria vs western countries VADER Sentiment Analysis	1199
Figure 17.: Comparative Distribution of Western Countries' VADER Sentiments	1199
Figure 18.: Statistical Test: Nigerian vs. Western Countries' VADER Climate Change Sentiments	1200
Figure 19.: Participants' Location Distribution	1201
Figure 20. Excel Analysis of Participants' Location	1201
Figure 21: Participants Gender	1202
Figure 22a: Distribution of Respondents by Age	1202
Figure 22b: Percentage Distribution of Respondents by Age	1202
Figure 23: Distribution of Participants by Education	1203
Figure 24.: Distribution of Participants by Employment Status	1203
Figure 25a.: Number Distribution of Participants by Monthly	1203
Figure 25b.: Proportion Distribution of Participants by Monthly	1203
Figure 26: Proportion of Participants Using Different Social-Media	1204
Figure 27: Data wrangling scripts for Climate Change Scores	1204
Figure 28: Distribution of Climate Knowledge Scores by Participants' Sex	1205
Figure 29.: Statistical Test: Gender vs perceived climate change knowledge	1207
Figure 30.: Statistical Test: Gender vs exhibited climate change knowledge	1208
Figure 31.: Statistical Test: Gender vs Climate Change Experience	1208
Figure 32. Gender vs Perceived Importance of Climate Change	1209

LIST OF TABLES

Table 1. Engagement Factors of Adjustment per Country_____	1189
Table 2. Summary of Key Informants' Interview Guideline_____	1192
Table 3.: Nigeria vs. USA_____	1194
Table 4.: Nigeria vs. Canada_____	1194
Table 5.: Nigeria vs. UK_____	1194
Table 6.: Nigeria vs. Australia_____	1194
Table 7. Descriptive Statistics of Number of Tweets Per Country_____	1195
Table 8. Descriptive Statistics of Number of Followers Per Country_____	1195
Table 9.: Countries' respective Textblob Sentiment Polarity Scores_____	1197
Table 10.: VADER Sentiments Polarity Distribution_____	1200
Table 11; Distribution of Climate Knowledge Scores by Participants' Sex_____	1205
Table 12. Climate Change Knowledge by Age Distribution_____	1205
Table 13. Climate Change Knowledge by Education Distribution_____	1206
Table 14. Climate Change Knowledge by Employment Distribution_____	1206
Table 15. Climate Change Knowledge by Income Distribution_____	1206
Table 16. Development Issue Prioritization by Gender_____	1207
Table 17.: Final Coding Framework for Twitter Influencers_____	1209

CHAPTER ONE INTRODUCTION

A. Background

Climate change is considered one of the most important issues currently faced in the world, with its impact noted in all parts of the globe (IPCC, 2007). Rise in sea level is an important impact of climate change, which occurs as a result excess inflow of water from melting ice and the oceans' thermal expansion (von Schuckman, Cheng, Palmer, and Hansen, 2020). It is projected that the total melting of Greenland and Antarctica will cause an excess of 120 meters increase in the sea levels (Beniston, 2010). Thermal expansion of ocean waters will lead to an increase of about 100cm in the sea-level by the year 2100 (von Schuckman, et al., 2020). The impact of growing sea-levels will be felt significantly by coastal communities such as Indonesia, Marshall Islands, Maldives, etc. Climate-change factors including temperature variation, change in precipitation patterns and complex human migration, will put more pressure on water resources and have an impact on water supply, demand, and quality (Holding, Allen, Foster, and Hsieh, 2016). Communities located in arid locations experience environmental, social, and economic implications due to any slight reduction in water supply. With increasing migration to coastal cities around the globe, and rural to urban migration at the lowest level, it is only that there will be an increase in demand for water for industrial and domestic use (Berry, Brown, Chen, and Kontogianni, 2015). Notable impacts of climate change experienced in the world include rising sea levels, increasing frequency and severity of weather events, and variations in ecology and wildlife (IPCC, 2021). It is projected that these effects will only become more severe in the future, with the continuous increase in greenhouse gas emissions (UNEP, 2018). Although to a varying extent, the impact of climate change is experienced across all countries requiring them to implement different levels of climate sensitive activities to minimize these negative impacts.

➤ *Climate Change as a problem in Nigeria*

There has been a notable change in Nigeria's climate as can be seen in temperature variation, change in rainfall levels, increase in sea levels and annual flooding, land degradation (Elisha and Udeh, 2017), significant desertification and drought (Ebele and Emodi, 2016), more recurring life-threatening weather events, and impacted biodiversity and freshwater habitat (Olaniyi, Ojekunle, and Amujo, 2013). Annual increase in rainfall intensity and duration has been observed in most parts of Nigeria (Enete, 2014) resulting in more runoffs and frequent flooding in various parts of the country (Enete, 2014). It is expected that the variation in frequency and intensity of rainfall will continue to climb upwards (Akande, Costa, Mateu, and Henriques, 2017), which will result in higher sea levels in Southern Nigeria and higher recurrence and intensity of floods across the country (Ebele and Emodi, 2016). Despite the increase in frequency of precipitation in most parts of Nigeria, there has been a continuous reduction in precipitation in Northern Nigeria and this, coupled with the annual increase in average temperatures, has resulted in droughts becoming a constant occurrence in these parts of the country (Amanchukwu, Amadi-Ali, and Ololube, 2015). The effects of climate change on water bodies in Nigeria is also evident as is seen in the shrinking of the surface area covered by Lake Chad and other water bodies (Dioha and Emodi, 2018). Experts expect that the continuous increase in temperature levels, which has significantly been documented from the 1980s will continue for next decades to come (Enete, 2014; Akande, Costa, Mateu, and Henriques, 2017).

➤ *The Role of Stakeholders in Climate Change Adaptation*

The collaborative effort between various stakeholders, including government, communities, private sector and international organizations, is important for the successful implementation of climate change action (Biagini and Miller, 2013). For instance, it is the responsibility of the government to create a conducive environment and incentives for the private sector to manage climate change associated risks by operating efficiently (Mees, Uittenbroek, Hegger, and Driessen, 2019). The government is also responsible for implementing activities that promote the adaptive capacity of citizens, communities, and businesses (Persson, Eriksson, and Knaggard, 2021). The active implementation of climate efficient activities by the government will be evident by the types of climate and environment policies established, implemented, and enforced across private and public sector (Han and Sang, 2020). The policies set up by government may be derived by contextualizing soft laws and implementing hard laws set by international climate bodies such as the UNFCCC (Khan and Mishra, 2022).

While the role of the government is important with respect to creating a conducive environment for the promotion of climate adaptation, it also the responsibility of private sectors and business to design and implement activities in an efficient way. The environmental effect of oil prospecting in the Southern region of Nigeria has been repeatedly attributed to poor climate adaptive approaches by private players (Ibaba, 2015). While the primary objective of most private sector players is to make profit by minimizing cost and maximizing revenue (Holloway and Parmigiani, 2014), the consideration of cost is no longer limited to financial terms but has expanded to the cost on other development factors including climate, human rights, and ethical costs (Palmer and Flanagan, 2016). Private actors are therefore saddled with the responsibility of adhering to global ethical climate standards and seeking avenues for climate and community centric corporate social responsibility (Burritt, 2012). Another important stakeholder concerned in the quest for successful climate adaptation is the community (Pisor, Basurto, Douglass et al., 2022). While the government and private sectors may be willing to endorse and implement climate adaptive policies and practices respectively, the sustainability of these decisions will be driven by the inclusion of communities. The fact that climate change impacts are location specific and affect local communities (Adger, 2003) makes it necessary for bottom-up climate change actions that enhance communities' resilience to climate change impacts through expanded, community-level interactions and linkages

(Tompkins and Adger, 2004). Community level information access has been identified as one of the elements necessary for effective community based adaptation to climate change (Bryan and Behrman, 2013). Based on the understanding of the roles of the different stakeholders in climate change action, the research objectives of this focus on the current position of different variables that influence appropriate climate change information dissemination amongst stakeholders, for the improvement of climate change action in the Nigerian context. The importance of youths in communities for successful climate change action has been specifically highlighted by several studies (Vogel, Nkrumah, Kosciulek, et al., 2022). The approach this study is hinged on this concept of collaboration between the different stakeholders responsible for successful climate change action.

➤ *Adaptive Capacity*

With the inevitable worsening of climate change in Nigeria, it is important to consider the adaptive capacity of country to negative effects associated with climate change. Adaptive capacity refers to communities' abilities to adjust their behaviours to minimize the possible changes associated with climate change, and to harness the potentials or manage the negative impacts (BNRCC Project, 2011). The adaptive capacity of communities is influenced by the sufficient assets, education, income and information (Madu, 2016).

One of the more important factors influencing the adaptive capacity of communities in their exposure to skills and information. To successfully incorporate climate change adaptation to every area of existence and the national culture, Nigerians must possess the information and knowledge of the impact of climate change on their environment and the ways they can modify their behaviours to respond to these potential impacts (BNRCC Project, 2011). It will also be required that Nigerians possess the special abilities to enable them to address the risks associated with climate change and actively engage in adaptation practices and behaviours. To achieve this, knowledge and Information must be efficiently disseminated to an array of individuals using media avenues that have proven effective in communicating change (Anabaraonye, Okafor, Ikuelogbon, 2019; BNRCC Project, 2011).

Research has suggested that the knowledge and information about climate is low amongst the Nigerian public (BNRCC Project, 2011) and the Nigerian media space has yet to give adequate focus on issues about climate change (Ajaero and Anorue, 2018). The scale of climate change information affects the level of climate change knowledge (Duru and Emetumah, 2016) and the way Nigerians can adopt coping mechanism that are effective against the impact of climate change (Otitoju and Enete, 2016).

➤ *Social Media as an Opportunity*

The lack of dissemination of information about climate change through conventional mass media in Nigeria may result in the need to explore other forms of information dissemination to improve information and knowledge on the subject amongst Nigerian audience and one opportunity may be seen in the increasing popularity of social media. The growth in popularity of social media in Nigeria has significantly changed the manner information is formed and spread (Jacob, 2021). With the continuous understanding that knowledge is power (Lee, 2005), a variation in opinion may contribute to better solution driven behaviours in communities. The role of social media in influencing change in Nigeria has been investigated, for example Dunu and Uzochukwu's (2015) study of how social media promotes social mobilization for effective achievement of the sustainable development goals in Nigeria suggests the element of new engagement made possible through social media can serve as a motivation for social change. The authors suggest that through social media, Nigerians can be inspired to act on issues of development and social concern specifically because it may be perceived as the fairest form of media by the Nigerian audience (Dunu and Uzochukwu, 2015).

The power of social media in Nigeria is seen in the way it allows for rapid dissemination of media for action especially amongst youth, who make up 70% of the country's population (Eromosele, 2022). The availability of social media platforms allows youths to mobilize online without any formal support (Dunu and Uzochukwu, 2015). What influences the success of any mobilization effort is its ability to inspire people to leave their houses and participate in development activities (Earl and Kimport, 2011). The presence of social media makes it possible to engage in mobilization development of change activities by simply joining groups on Facebook or engaging in feeds on Twitter (Wang, Madnick, Li, Alstott, and Velu, 2015). It is important to note that youth mobilization results from social mobilization geared towards organizing individuals into groups to encourage their participation and engagement in development programmes. The objective of social mobilization is to offer a variety of actions in a wide strategic agenda to enable change (Dunu and Uzochukwu, 2015). Social mobilization, therefore, involves the discussion and collaboration with a variety of social factors with a result to achieve individual's active participation in the procedure beginning with recognizing a need to actualizing the development objective (Chinaemerem, 2022).

B. Research Problem

Despite evident indicators of the increasing climate change in Nigeria and their emerging impacts on the environment and Nigerians (Akande, Costa, Mateu, and Henriques, 2017; Elisha and Udeh, 2017; Ebele and Emodi, 2016; Enete, 2014; Olaniyi, Ojekunle, and Amujo, 2013), there appears to be insufficient creation and dissemination of information and knowledge about climate change, its impact and potential adaptive capacity and possible coping mechanisms to identify climate change and curb its impact (Tolppanen, Kang and Riuttanen, 2022; Kalafatis, Carmen, Lo and Frank, 2015). Furthermore, although social media has become a significant tool for social mobilization (Chinaemerem, 2022), there may be need for more discussion on the topic of climate change for active participation of Nigeria's social media users around climate change to influence adaptive behaviours. Therefore, this study will investigate the extent to which climate change is discussed on Nigeria's social media space and identify potential solutions to promote engagement of Nigerian social media users on the topic of climate change.

C. Research Objectives and Questions

➤ Research Objective 1 (RO1)

To critically evaluate the level of Nigeria's Twitter users' engagement on climate change issues.

• Research Question 1 (RQ1):

According to available Twitter data on topics about climate change, how does Nigerian Twitter users' interest compare to interest of users in other English-speaking countries?

➤ Research Objective 2 (RO2)

To critically evaluate the level of awareness amongst Nigerian social media users on climate change.

• Research Question 2 (RQ2):

How aware are Nigerian social media users about climate change?

• Research Question 3 (RQ3):

What is the relationship between gender and climate change awareness levels amongst social media users?

➤ Research Objective 3 (RO3)

To provide recommendations to the government and private sector on possible ways of encouraging Nigeria's youthful social media users' engagement in topics about climate change.

• Research Question 4 (RQ4):

Do Nigerians consider climate change an important aspect of development?

• Research Question 5 (RQ5):

What, if any, is the difference in perception of climate change importance between Nigeria's public and private sector?

• Research Question 6 (RQ6):

What possible factors will motivate Nigerian social media users to engage more in discussions about climate change?

D. Research Scope and Justification

The current study focused critically evaluating Nigerian social media users' climate change awareness, engagement and factors that will encourage discussion on climate change in Nigeria. Youths make up majority of the community element of Nigeria's climate change stakeholders, with 70% percent of the population below 30 years, and 28% of Nigeria's population aged between 15 and 30 years (Akinyemi and Mobolaji, 2022). With the increasing use of social media amongst Nigerian youths (Erhiegeke, Esimone and Ugoo-Onkonkwo, 2022) and its emergence as a platform of change advocacy in Nigeria (Asemah and Nwaoboli, 2022), it is important to critically evaluate the level of engagement on climate change related topics on Nigeria's social media space. Responding to the research objectives will provide evidence for climate change adaptation stakeholders such as private sector and the Nigerian government institutions. Nigeria's National Orientation Agency is the government institute responsible for informing the public about government policies and staying aware of public opinion, while encouraging patriotism, unity, and overall societal development (NOA, 2023), and evidence from this study can contribute to the design of their strategic relationship with private sector for increased youth engagement on the topic of climate change. With an increasing influence on the use of social media as a pressure tool in Nigeria, and due to the researcher's access to stakeholders such as Nigerian social media influencers and concerned government agency workers, it was important to keep the study within the geographical scope of Nigeria.

CHAPTER TWO LITERATURE REVIEW

A. Background

The research of related literature will support the understanding of theoretical frameworks that are related to the contribution of social media for social mobilization as related to the premise of the proposed study. There is an array of literature on social media, climate change, and mobilization of youths for social change, and this section of the study will review important issues related to climate change with focus on the communication of climate change and the related approaches implemented to minimize its impact. A review of how youthful populations are applying social media to advocate for climate sensitive behaviour will also be conducted in the part of the study.

Several studies have revealed the increasing impact of climate change on global communities irrespective of their level of development of demographic disposition (Masih, I., Maskey, Mussa, and Trambauer, 2014; WHO 2018). The atmospheric buildup of Greenhouse Gases (GHGs) is the major cause of global warming, which result in increased temperature (IPCC, 2021). The variation in climate due to human activity that interrupts the structure of the global atmosphere and contributes to the natural climate changes seen over comparable periods is known as climate change, and the actions of people over the last century have been proven to warm the earth (IPCC, 2014). Therefore, the implementation of long-term adaptation actions ought to be applied to minimize the impact of climate change majorly resulting from human actions.

Adaptation of people's behaviours to climate change can lead to a significance reduction in the negative effects of climate change and improve the positive effects (Smit, Pilifosova, Burton, Challenger, Huq, Klein, Yohe, Adger, Downing, Harvey, Kane, Parry, and Skinner, 2001). Many countries are becoming more deliberate in their efforts to adapt to climate change, with African populations showing a strong aptitude to adapt to the changes associated with climate change commonly applying evolving approaches and actions, not only to react to the risks associated with climate change, but to harness the opportunities that come with it (Brown, Hammill and McLeman, 2007).

The need for the implementation of coping actions to minimize the impact of climate change, especially amongst vulnerable communities, cannot be overemphasized (Moser and Boykoff, 2013). These coping mechanisms require reduction of emissions of and stabilization of heat-trapping atmospheric GHGs, and climate change mitigation is defined as human actions aimed at reducing the sources of GHGs or enhancing the GHGs sinks (IPCC, 2021). Majority of GHGs emissions result from the burning of fossil fuels and possible ways of mitigating this include conservation of energy, use of renewable energy, trapping and storing of carbon and nuclear and replacing fossil fuels with other options of energy (IPCC 2011).

➤ Climate Change Denial

Despite the increasing suggested evidence of climate change, there is continuous growth in the popularity of climate denial theories (Boulianne and Belland, 2022). Climate denial theories seek to provide evidence that climate change may either not exist (Antilla, 2005) or may have insignificant effects. Climate denial theories, which increasingly becomes popular in western countries like USA, Canada, and UK (Boulianne and Belland, 2022), are categorized into three parts namely 'outright denial', which refutes all evidence of climate change, or logical denial, which refutes the effects of climate change (Almiron, 2021). Thirdly, some climate change denial advocates insist that there is no multidimensional effect of climate change (Almiron, 2021). However, there is limited research on the emergence of climate change denial in Nigeria therefore, the first hypothesis will test the relationship between participants' location (Nigeria vs. western countries) and their sentiments about climate change.

• Hypothesis 1

There is a significant difference between the sentiments of Twitter users from Nigeria and Western English-speaking countries.

➤ Gender and Climate Change

Although the evidence of climate change Nigeria has been highlighted by various researchers (Swinbank, 2021), it is important to consider premise of the role of gender on climate change impact as argued by various studies. For example, research, Kabeer (2005), conclude that even though the impact of climate change is felt at community level, climate change impact in the sub-Saharan African context is felt more by women (Sharif, Nasir, Khanum, and Khan, 2016)). This is supported by Sultana (2022), who conclude that women bear the burden of climate change especially in developing countries due to other underlying gender issues.

• Hypothesis 2

Therefore, the second hypothesis posits that there is a significant difference between the way Nigerian men and women perceive the importance of climate change.

➤ *Climate Change Importance in Nigeria*

In spite the evidence of how climate change impacts Nigeria, the other associated developmental issues characteristic to the country means climate change seizes to be a priority (Ajala, 2023). Security, poverty, and lack of facilities are some developmental elements that may be considered more important than climate change (Lawal and Oluwatoyin, 2017). Since there is limited research to test this, it is important to develop the next hypothesis.

• *Hypothesis 3*

There is a significant difference between the Nigerian social media users' perceived importance of climate change and other aspects of development.

B. Communicating Climate-Change

Apart from identifying potential ways of mitigating and adapting to climate change, it is important to communicate these methods through media that are assessable and acceptable by the target audience. Effective communication of climate change evaluates an array of variables that influence or are influenced by the way climate change is communicated (Chadwick 2019). Different studies (Masih 2014; Blakeney and Mengistie 2011; Smit et al. 2001) have examined the way climate change communication experts try to design, examine, and apply scientific methods, and determine methods of communication that are effective for addressing the important issue of climate change. An example of communicating climate change is the responsibility of media in promoting the understanding of climate change amongst the public. The news media play an important role in defining what climate change means and, even though there may be a disconnected between scientific and media definitions of climate change, the media ultimately informs what society considers as climate change (Russill and Nyssa, 2009). To ensure harmony between scientific and media definitions of climate change, there need to be a deliberate strategic approach to transferring the clear and definitive statements between scientists and journalists (Falkheimer and Heide, 2018; Schafer, 2012).

C. Communicating Climate Change to Youths through Social-Media

As mentioned in the previous section of the literature review, the importance of deliberate climate change communication in mitigating the impacts of climate change cannot be overemphasized. However, the poor economic conditions of African countries (and other developing countries) have influenced the extent to which climate change issues are covered by traditional media (Blakeney and Mengistie, 2011). Nevertheless, the availability of social media in developing countries offer an opportunity for individuals to participate in discussions about different issues, climate change inclusive. The opportunity of social media in these developing countries is due to the unique feature of autonomy it provides to individuals therefore, minimizing the possibility that information will be influenced by corrupt elements (Taprial and Kanwar, 2012); social media is also less expensive and more accessible to individuals when compared to conventional media such as radio, TV, and newspapers (Lee, VanDyke and Cummins, 2018). The use of social media is popular among young people with web application such as Facebook, Twitter, YouTube, Snapchat, TikTok and Instagram being popular platforms. These platforms provide almost all that is required to satisfy the curious nature of young people, including chatting, multi-media sharing, and gaming (Ephraim, 2013).

The advantage of social media as a tool for mass media has been harnessed by some climate change agents especially by interventions that seek to promote youth online engagement on topics about climate change (Katz-Kimchi and Manosevitch, 2015). It is important to target youths in climate change discussions because, compared to other generations, theirs is the generation that will be most affected by the impacts of climate change if not managed (Corner, Roberts, Chiari, Voller, Mayrhuber, Mandl, Monson, 2015; Ojala, 2012). This understanding has led to design and implementation of climate change social media movements such as the Fridays for Future, initiated by Greta Thunberg, a climate change activist, with the objective of advocating for the establishment of climate change policies that are effective, whose contents have gone viral of various social media fora (Kalla, 2019).

Alexandria Villasenor is another young activist using social media to propagate knowledge and information on climate change through her “Earth Uprising” movement (Kaplan, 2019). Aditya Mukarji and Vic Barrett from India and USA respectively, sued their governments and started campaigns to make discourage the use of plastic straws (Perera, 2021). Other significant youth-based instances of the online campaigns for the propagation of climate change information and knowledge, include Fossil Free, Connect4Cimate, World Wildlife Fund (WWF), and International Youth Climate Movement (IYCM). These activists and campaigns give a picture of the landscape of the role of social media as a potential tool for effective and impactful climate change discourse.

While climate activism is increasing in popularity globally, there may be lower mention of the Nigerian youth in climate change activism, despite the increasing presence of Nigerian internet users. Figure 1 below shows the growth in social media amongst Nigerians over the 6 years.

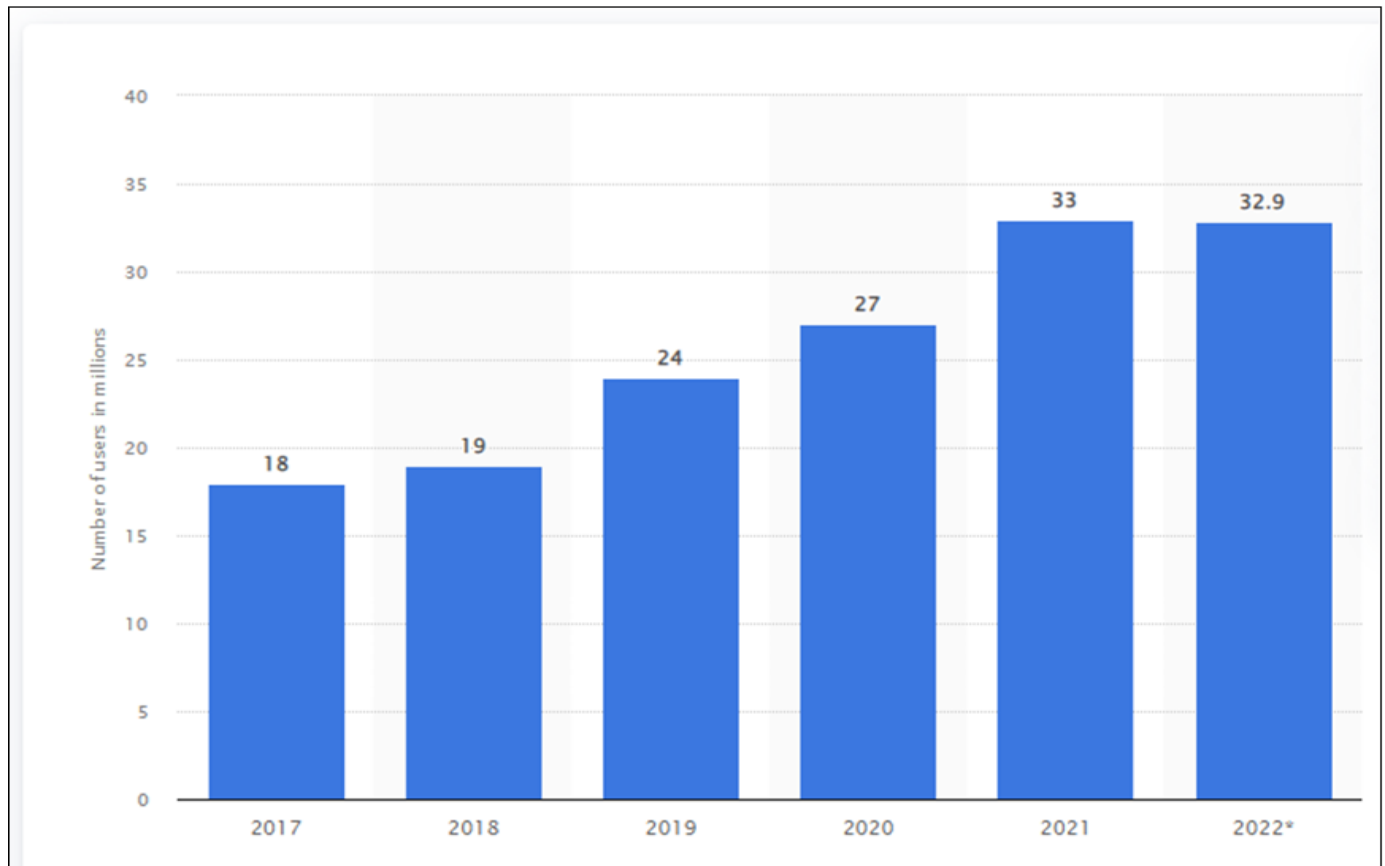


Fig 1 Nigeria’s Active Social Media Trends – 2017 to 2022

Source: Statista.com (2022)

Nigerian social media users are actively sharing text and media on all popular social media platforms (Statista.com, 2022). Figure 2 below shows the availability of different social media platforms in Nigeria by popularity.

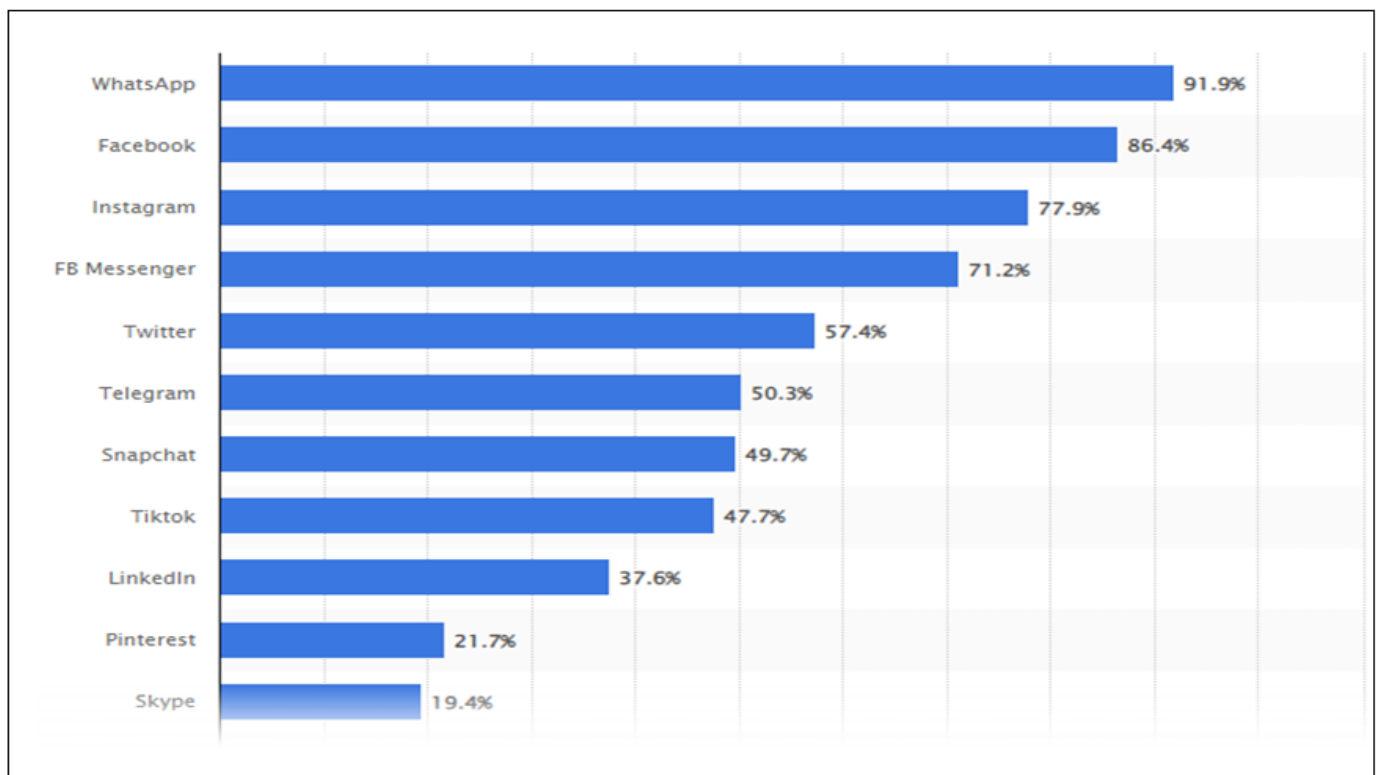


Fig 2 Most Popular Social Media Platforms in Nigeria - 2021

Source: Statista.com (2021).

Even though there are climate change activists in Nigeria, who have been engaged in activism for years, they are yet to be brought to the limelight by mainstream media (Unigwe, 2019). Issues about marginalization of African youth activists by mainstream media has also been noted, for instance, The Associated Press's cropping of Vanessa Nakate out of a published photo (Woodyatt, 2020). Being the only black individual in the picture taken alongside four other young activists, this action led to backlash especially on social media, where users criticized and condemned the action of AP (BBC, 2020). While marginalization is evident, it is important to consider the level of engagement and interest of Nigerian youths in social media discussions. While there is limited study on this, the findings from this study will contribute to literature on youthful activism amongst Nigerian social media users with respect to climate change issues.

➤ *The Role of Stakeholders in Climate Change Adaptation*

The collaborative effort between various stakeholders, including government, communities, private sector and international organizations, is important for the successful implementation of climate change action (Biagini and Miller, 2013). For instance, it is the responsibility of the government to create a conducive environment and incentives for the private sector to manage climate change associated risks by operating efficiently (Mees, Uittenbroek, Hegger, and Driessen, 2019). The government is also responsible for implementing activities that promote the adaptive capacity of citizens, communities, and businesses (Persson, Eriksson, and Knaggard, 2021). The active implementation of climate efficient activities by the government will be evident by the types of climate and environment policies established, implemented, and enforced across private and public (Han and Sang, 2020). The policies set up by government may be derived by contextualizing soft laws and implementing hard laws set by international climate bodies such as the UNFCCC (Khan and Mishra, 2022).

While the role of the government is important with respect to creating a conducive environment for the promotion of climate adaptation, it also the responsibility of private sectors and business to design and implement activities in an efficient way. The environmental effect of oil prospecting in the Southern region of Nigeria has been repeatedly attributed to poor climate adaptive approaches by private players (Ibaba, 2015). While the primary objective of most private sector players is to make by minimizing cost and maximizing revenue (Holloway and Parmigiani, 2014), the consideration of cost is no longer limited to financial terms but has expanded to the cost on other development factors including climate, human rights, and ethical costs (Palmer and Flanagan, 2016). Private actors are therefore saddled with the responsibility of adhering to global ethical climate standards and seeking avenues for climate and community centric corporate social responsibility (Burritt, 2012). Another important stakeholder concerned in the quest for successful climate adaptation is the community (Pisor, Basurto, Douglass et al., 2022). While the government and private sectors may be willing to endorse and implement climate adaptive policies and practices respectively, the sustainability of these decisions will be driven by the inclusion of communities. The fact that climate change impacts are location specific and affect local communities (Adger, 2003) makes it necessary for bottom-up climate change actions that enhance communities' resiliency to climate change impacts through expanded, community-level interactions and linkages (Tompkins and Adger, 2004). Community level information access has been identified as one of the elements necessary for effective community-based adaptation to climate change (Bryan and Behrman, 2013). Based on the understanding of the roles of the different stakeholders in climate change action, the research objectives of this focus on the current position of different variables that influence appropriate climate change information dissemination amongst stakeholders, for the improvement of climate change action in the Nigerian context. The importance of youths in communities for successful climate change action has been specifically highlighted by several studies (Vogel, Nkrumah, Kosciulek, et al., 2022). The approach this study is hinged on this concept of collaboration between the different stakeholders responsible for successful climate change action.

➤ *Adaptive Capacity*

With the inevitable worsening of climate change in Nigeria, it is important to consider the adaptive capacity of country to negative effects associated with climate change. Adaptive capacity refers to communities' abilities to adjust their behaviours to minimize the possible changes associated with climate change, and to harness the potentials or manage the negative impacts (BNRCC Project, 2011). The adaptive capacity of communities is influenced by the sufficient assets, education, income and information (Madu, 2016).

One of the more important factors influencing the adaptive capacity of communities in their exposure to skills and information. To successfully incorporate climate change adaptation to every area of existence and the national culture, Nigerians must possess the information and knowledge of the impact of climate change on their environment and the ways they can modify their behaviours to respond to these potential impacts (BNRCC Project, 2011). It will also be required that Nigerians possess the special abilities to enable them to address the risks associated with climate change and actively engage in adaptation practices and behaviours. To achieve this, knowledge and Information must be efficiently disseminated to an array of individuals using media avenues that have proven effective in communicating change (Anabaraonye, Okafor, Ikuelogbon, 2019; BNRCC Project, 2011).

Research has suggested that the knowledge and information about climate is low amongst the Nigerian public (BNRCC Project, 2011) and the Nigerian media space has yet to give adequate focus on issues about climate change (Ajaero and Anorue, 2018). The scale of climate change information affects the level of climate change knowledge (Duru and Emetumah, 2016) and the way Nigerians can adopt coping mechanism that are effective against the impact of climate change (Otioju and Enete, 2016).

- *Hypothesis 4*

In spite the clarity of stakeholder role, the lack of implementation of climate change discourse on social media may be evidence of lack of cohesion between the identified stakeholders. To test this, it is hypothesized that *there is a significant gap in the interest of climate change between Nigeria's public and private sector and community stakeholders.*

- *Social Media as an Opportunity*

The lack of dissemination of information about climate change through conventional mass media in Nigeria may result in the need to explore other forms of information dissemination to improve information and knowledge on the subject amongst Nigerian audience and one opportunity may be seen in the increasing popularity of social media (Ashwani and Pandey, 2020). The growth in popularity of social media in Nigeria has significantly changed the manner information is formed and spread (Jacob, 2021). With the continuous understanding that knowledge is power (Lee, 2005), a variation in opinion may contribute to better solution driven behaviours in communities. The role of social media in influencing change in Nigeria has been investigated, for example Dunu and Uzochukwu's (2015) study of how social media promotes social mobilization for effective achievement of the sustainable development goals in Nigeria suggests the element of new engagement made possible through social media can serve as a motivation for social change. The authors suggest that through social media, Nigerians can be inspired to act on issues of development and social concern specifically because it may be perceived as the fairest form of media by the Nigerian audience (Dunu and Uzochukwu, 2015).

The power of social media in Nigeria is seen in the way it allows for rapid dissemination of media for action especially amongst youth, who make up 70% of the country's population (Eromosele, 2022). The availability of social media platforms allows youths to mobilize online without any formal support (Dunu and Uzochukwu, 2015). What influences the success of any mobilization effort is its ability to inspire people to leave their houses and participate in development activities (Earl and Kimport, 2011). The presence of social media makes it possible to engage in mobilization development of change activities by simply joining groups on Facebook or engaging in feeds on Twitter (Wang, Madnick, Li, Alstott, and Velu, 2015). It is important to note that youth mobilization results from social mobilization geared towards organizing individuals into groups to encourage their participation and engagement in development programmes (Ashwani and Pandey, 2020). The objective of social mobilization is to offer a variety of actions in a wide strategic agenda to enable change (Dunu and Uzochukwu, 2015). Social mobilization, therefore, involves the discussion and collaboration with a variety of social factors with a result to achieve individual's active participation in the procedure beginning with recognizing a need to actualizing the development objective (Chinaemerem, 2022).

- *Social Media Engagement Analysis*

Social media users usually engage in topics that are of interest to them (Jibril and Targema, 2017). An engagement analysis reviews the statistics of social media users' interest in specific topics or themes including retweets, likes, comments, reactions, views, etc. (Bhattacharya, Srinivasan and Polgreen, 2017). The level of engagement in a topic by different demographics can be used to understand the role people's profiles play in what they are interested in. Common tools used for Twitter engagement analysis comprise the monitoring of number of tweets (Almgren and Lee, 2016), frequency of retweets (Lee, Mahmud, Chen, Zhou and Nichols, 2014), and number of users' followers (Chen and Pirolli 2012).

For the proposed study, understanding the role of geographic demographics, by way of social media users' locations, and the level of engagement in topics and themes around climate change is important to understand how Nigeria compares to other countries in social media advocacy and discussions around climate change. An engagement analysis will be conducted to compare the engagement levels of climate change themes on social media between Nigeria and other countries. A comparison between the level of engagement between climate change themes and other areas of advocacy, such as police brutality, politics, and corruption, amongst Nigerian social media users can provide an understanding of the popularity of climate change themed discussions compared to other themes.

- *Sentiment Analysis*

Sentiment analysis refer to the investigations of people's qualitative inclinations towards certain topics or subjects of discussion (Mehmood and Balakrishnan, 2020). The sentiment of a person is typically classified as being positive, negative, or neutral. Using a lexicon of words and their denotations, sentiment analysis categorizes qualitative statements as being positive negative or neutral (Ribeiro and Araujo, 2010). For example, in a sentiment analysis to classify people's perception of 'beans', the text 'I love beans', will be classified as a positive sentiment because a typical sentiment lexicon attributes the word 'love' as a positive inclination. Therefore, a sentiment analysis of Nigerian Twitter posts related to climate change in Nigeria, will reveal how people perceive certain subjects around contribute to climate change.

CHAPTER THREE METHODOLOGY

A. Overview

The study uses a mixed method, which integrates the collection and analysis of both qualitative and quantitative data (Bryman, 2013). Quantitative data refers to numerical data that can be analyzed by way of measures of central tendencies and advanced statistical analysis (Goertzen, 2017), while qualitative data refers to textual data that may be analyzed based on context analysis of the meanings of textual information (Baskarada, 2014). Both primary and secondary quantitative and qualitative data are sourced, analyzed, and applied to respond to the research questions and draw conclusions.

B. Research Approach

Research approach refers to the general plan and process for conducting research (Andiappan and Wan, 2020), and has been grouped into three categories namely inductive, deductive, and abductive (Dogan, 2005). The major difference between the two most popular approaches, deductive and inductive, is the importance of the research hypotheses to the research (Folde, 2016). In the deductive (positivist) approach, the validity of the hypotheses is tested, while in the inductive approach, new theories are developed because of the research (Andiappan and Wan, 2020). The current research applied a deductive (positivist) approach by defining a problem, identifying potential theories, and responding to these based on collected information.



Fig 3 Deductive Reasoning Process
Source: Diffen (2022)

Figure 3 above is an illustration of the steps in deductive research approach. Using the deductive research approach, this study takes the steps illustrated in figure 3 above, by commencing with the social network theory, followed by an analysis of evidence related to this theory. Therefore, like scientific studies (Stevenson and Witschge, 2020), the study goes from a generic to a specific lens. The research approach commences with a review of the social network theory, and then applies available and new evidence to test the hypotheses that result from the social network theory.

➤ *Theoretical Framework: The Social Network Theory and the Emerging Communication Ecosystem*

The social network theory highlights the influence of social connections in the information transmission (Heckathorn and Cameron, 2017), utilization of media and personality influence (Park, Grosser, Roebuck, and Mathieu, 2020), and contribution to behavioral change (Hendrikx, Bubendorfer and Chard, 2015). Social networks emerge when relationships are formed among social actors, like people and corporations (Zhang, Dong, and Herrera-Viedma, 2018). Before the emergence of Web 2.0, social networks were driven predominantly by corporations leading in media and mass communication, however, the emergence of Web 2.0 and social media changed the communication ecosystem and increased the speed with which the elements in the social networks interact, exchange information, react to new information, and influence others to react to new information (Gruzd, Wellman and Takhteyev, 2011). Through social media technologies (Facebook, Twitter, Instagram, etc.), people connect with each other by sharing texts, multi-media, and other digital contents (Kind, Patel, Lie, and Chretien, 2014). From the social network theory lens, these connections are not seen from the perspective of users' personalities but from the perspective of the connections between the social entities (Del Fresno, 2022). An archive of these interactions accumulates to form evolving models or network themes (Del Fresno, 2022). Social networking platforms enable users to create networks by interconnecting with others and sharing information with them (Del Fresno, 2022). For instance, Twitter's social networks are created by users and the interactions they create with others when they retweet, like, mention, or tag them (Del Fresno, 2022).

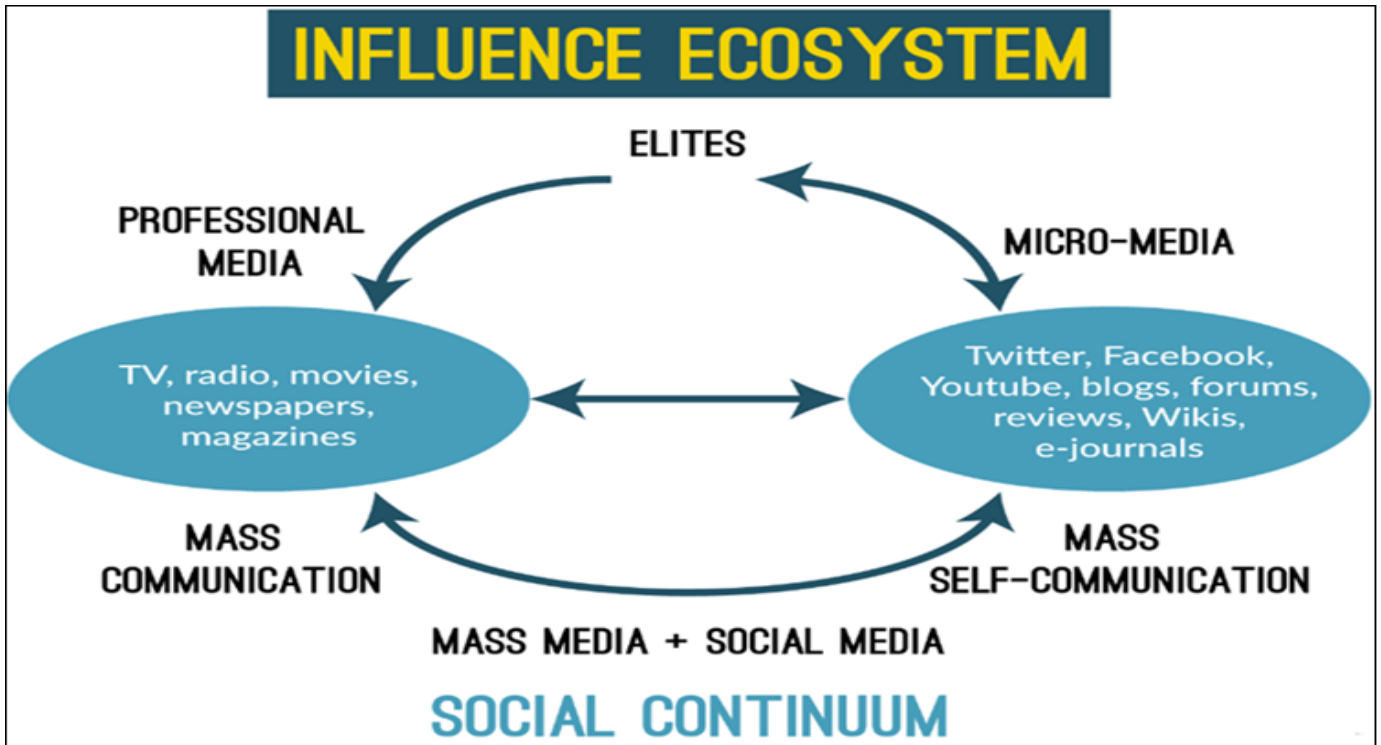


Fig 4 The Influence Ecosystem
Source: Del Fresno, M. (2022)

The ecosystem that holds conventional media (or old media including TV, newspapers, etc.) and new media (driven by Web 2.0) and highlights their role in the creation of social networks has been referred to as the “influence ecosystem” (Del Fresno, 2022). Illustrated in figure 4 above, this hybrid system shows the existence of conventional and social media integrated into one system, and both functioning in one “social continuum” (Del Fresno, 2022).

The stakeholders identified to contribute to Nigeria’s social continuum, with respect to climate change adaptation communication are government institutions, private sector, and the youthful social media users (Jibril and Targema, 2017). A modification of the social media continuum illustrated below shows the position of each of these stakeholders in the influence ecosystem. By understanding the roles of these stakeholders, effective recommendations can be provided for improving climate change information dissemination.

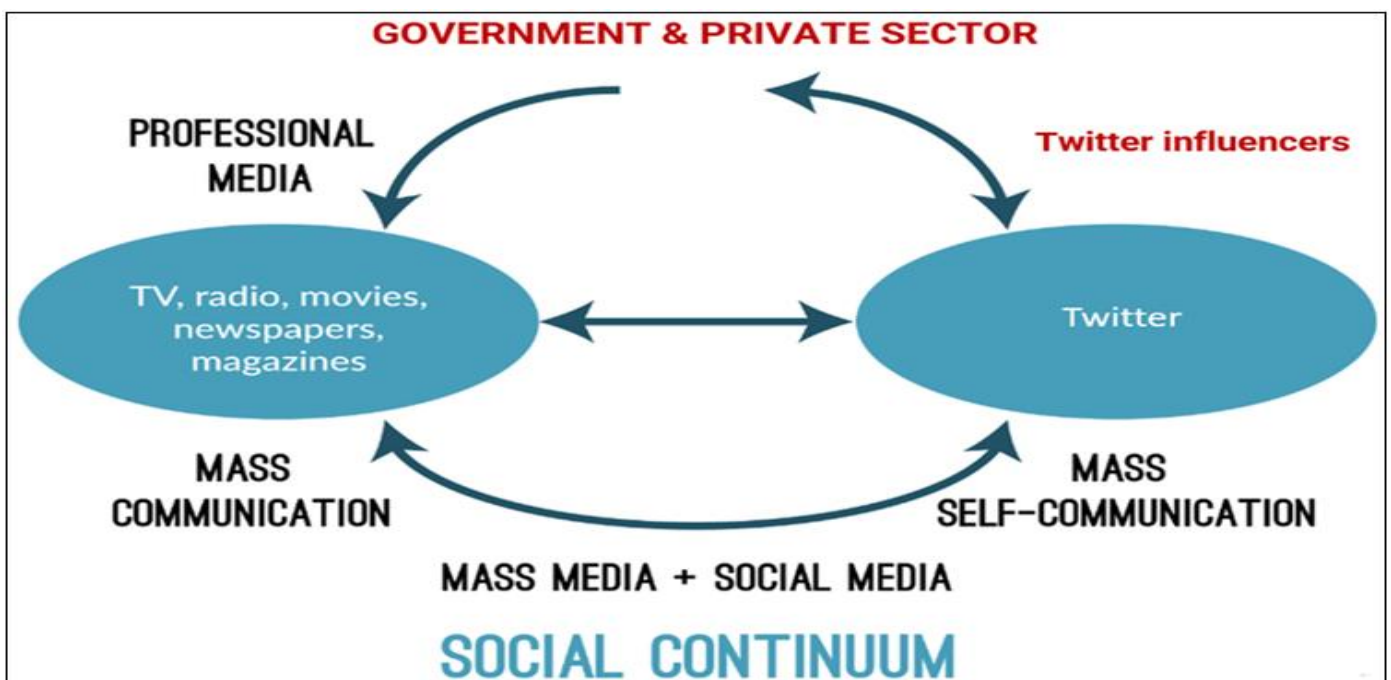


Fig 5 Influence Ecosystem for Climate Change Communication in Nigeria

As seen in the figure 5 above, the stakeholders contributing to Nigeria’s influence ecosystem are social media users (influencers and mass communication), while government institutions and private sector represent the elites that promote information through professional media and Twitter. Therefore, based on the deductive approach, the research will collect and analyze evidence on social media users (with a focus on Twitter influencers and users), government key influencers, private stakeholder stakeholders, and the general population influenced by the influence ecosystem.

C. Social Media Engagement and Sentiment Analysis

The first phase of evidence used for the research is Nigeria’s Twitter data related to climate change. The engagement analysis and sentiment analysis for the proposed study will be based on the interactions of Nigerian social media users with hashtags and keywords that represent climate change discussions. Hashtags and words or phrases used on social media to denote specific topics of discussions and social media users usually include hashtags when they speak about the subject (Koppel and Schler, 2006). There are popular hashtags that are related to climate change and understanding the level of engagement and the sentiments of Nigerians towards selected hashtags will help in the understanding of their interests in the discussion of climate change. According to best-hashtags.com (2022) The hashtag, #climatechange, will be used to test the level of engagement of social media users in Nigeria and the way they believe, or do not believe, in the impacts of climate change. The hashtag ‘#climatechange’ is the most used popular in discussions around climate change accounting for 46% of all related discussions as shown in Figure 6 below.

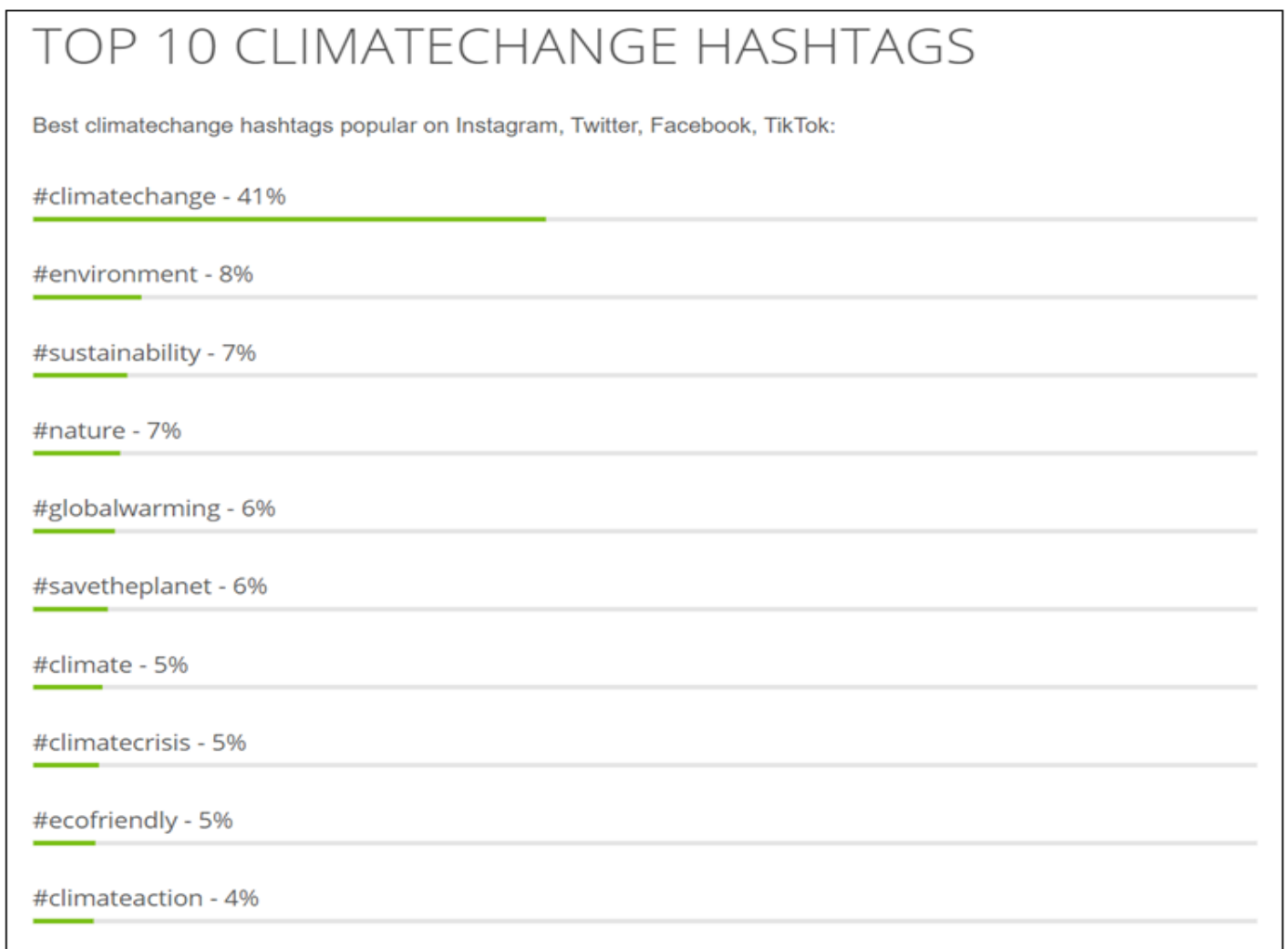


Fig 6 #Climatechange, the Most used Hashtag for Climate Change
 Source: <http://best-hashtags.com/hashtag/climatechange/>

➤ *Twitter Sample Data*

As part of Twitter user privacy policy, users are provided the options of making their content private or public (Twitter Inc., 2020a)). The sample of ‘participants’ in the twitter sentiment analysis comprises registered Twitter users who have made their content publicly accessible. 5,600 tweets from Nigeria, United States of America, United Kingdom, Canada and Australia were used for the engagement and sentiment analysis. These comprise tweets related to climate change discussions posted by users from 24st to 27th April 2023. Additionally, 500 tweets on hashtags related to poverty in Nigeria were streamed to enhance the engagement analysis.

• *Data Collection*

The Tweepy Python Library will be used to mine tweets related to the climate change hashtags and sentiment analysis will be conducted using Python's Natural Language Processing Tool Kit (NLTK). One technology that has been used for mining data from twitter is the Tweepy Library (Shelar and Huang, 2018). Python's Tweepy library is an open-source library, that makes it possible for python to interact with Twitter's Application Programming Interface (API) for the purpose of capturing current and historical Twitter data (Sourav, Arijit, Varma and Tiwari, 2018). The Tweepy library allows developers to specify the parameters of a tweet to include in the dataset, including username, location, account creation date, tweet, number of followers, number of tweets, and verification status (Shelar and Huang, 2018).

```
In [3]: import pandas as pd

In [7]: import tweepy

In [3]: auth = tweepy.OAuth1UserHandler(
        [REDACTED],
        [REDACTED])

In [4]: api = tweepy.API(auth)

In [5]: stream = tweepy.Stream(
        [REDACTED])

In [55]: text_query = "Climate Change Nigeria"
        today = date.today()
        #begin = today - timedelta(days = today.weekday())
        startDate = today - timedelta(days = 8)
        result_type = 'recent'
        numTweets = 20

In [ ]:

In [59]: tweets = tweepy.Cursor(api.search_tweets, q = text_query, until = "2023-04-10").items(numTweets)

In [60]: tweet_list = [[tweet.id, tweet.user.name, tweet.user.screen_name,
                        tweet.user.verified, tweet.user.geo_enabled, tweet.user.lang,
                        tweet.user.followers_count, tweet.coordinates, tweet.text, tweet.created_at,
                        tweet.user.location, tweet.retweet_count, tweet.source] for tweet in tweets]
```

Fig 7 Code to Extract Twitter Data

• *Data Analysis*

✓ *Engagement Analysis*

The engagement analysis compared the popularity of climate change related discussions in between Nigeria's social media ecosystem and other social media ecosystems (England and USA). A time series analysis, representing the number of tweets per day within each of the selected locations was performed. Various weights were applied to tweet counts from each location to factor for the variation in population size of each location as well as the popularity of social media in the locations. For example, Nigeria has approximately 4 million Twitter users (Kemp, 2023), while USA has over 90 million Twitter users therefore, each Tweet from Nigeria was assigned a weight of 1 while those from USA were assigned a weight of 4/90. The table below shows the factor of adjustment for each considered country.

Table 1 Engagement Factors of Adjustment Per Country

Country	Adjusting Factor
USA	19.27
Australia	1.17
UK	3.85
Canada	1.62

Using descriptive statistics and time series analysis, climate change data from Nigeria will be compared with data from other locations, using variables like number of daily engagements (number of tweets per day), popularity of users (number of followers), status of user accounts (company or personal) and number of retweets.

✓ *Sentiment Analysis*

Sentiment analysis can be conducted using either the lexicon-based approach or the machine learning approach (Taboada and Brooke, 2011). Notwithstanding the approach applied for twitter sentiment analysis, the first step is to mine the textual data (or “tweets”) (Dey and Mirajul, 2008). After the tweets are mined and archived, the algorithms are applied to the dataset to assign the sentiments associated with each tweet (Cambria, Schuller, Xia and Havasi, 2013). Existing Python libraries like TextBlob and VADER have been created and developed to include the classifiers and parameters described above specifically for lexicon-based analysis (Oyewola, Oladimeji, and Sowore, 2023; Mansoor, Gurumurthy and Prasad, 2020; Bonta, Kumaresh, and Janardhan, 2019). While VADER has been reported to be more effective for analyzing contents from social media and movie reviews (Mansoor, Gurumurthy and Prasad, 2020; Bonta, Kumaresh, and Janardhan, 2019), the strength of TextBlob is its ability to provide analysis on how subjective textual content is, which provides room for analysis to rank the sentiments of content according to how subjective they are (Oyewola, Oladimeji, and Sowore, 2023).

```
In [38]: from textblob import TextBlob

In [39]: def sentiment_polarity(text):
    try:
        return TextBlob(text).sentiment.polarity
    except:
        return None

    def sentiment_subjectivity(text):
    try:
        return TextBlob(text).sentiment.subjectivity
    except:
        return None

In [40]: tweet_df ['TextBlobPolarity'] = tweet_df['Text'].apply(sentiment_polarity)

In [41]: tweet_df ['TextBlobSubjectivity'] = tweet_df['Text'].apply(sentiment_subjectivity)
```

Fig 8 Textblob Python Library Function for Sentiment and Subjectivity Analysis

The screenshot in Figure 8 above shows the code for a function created for the application of the TextBlob sentiment analysis to the twitter datasets. Line 38 is the code to import the textblob library, while line 39 holds the code for the functions for computing sentiment polarity and sentiment subjectivity. The code in lines 40 and 41 are applied to create new fields in the data frame that assigns sentiment polarity and sentiment subjectivity scores for each record streamed.

The VADER function is illustrated in Figure 9 below and is created to iterate through the dataset and assign the sentiment polarity scores for each record. Line 42 is the code to import the VADER python library, while line 42 is the function for iterating the VADER analyzer to each record. In line 44, the code adds a new field, with the VADER polarity scores to the data frame.

```
In [42]: from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
    vd_sentiment = SentimentIntensityAnalyzer()

In [43]: def vdsentiment_score(text):
    try:
        return vd_sentiment.polarity_scores(text)
    except:
        return None

In [44]: tweet_df ['VaderPolarity'] = tweet_df['Text'].apply(vdsentiment_score)
```

Fig 9 VADER Python Library Function for Sentiment Analysis

➤ *Ethical Issues with Twitter Data for Academic Research*

Twitter data contains personal identifiable information of users, such as username, and locations (Gold, 2020), and such information raises ethical issues. In response to this ethical concern, all twitter data used for the study will exclude username and handle names, which are the identifiable parameters in any twitter dataset. Data related to handle names will be codified as handle_ref and data on usernames will codified as user_ref. Another ethical concern emerges due to the inability of the researcher to share an informed consent form to each user whose tweet was streamed. However, this ethical issue is overcome considering that Twitter discloses that all content posted on the platform may be used for research and marketing purposes and allows users to set their tweets as either private or public mode (Twitter Inc., 2020a).

D. Climate Change Knowledge Quantitative Survey

The second phase of the research seeks to understand Nigerians' knowledge of climate change. A quantitative survey will be conducted to generate quantitative data for an analysis of Nigerians' climate change awareness. The survey comprises closed-ended questions related to the topic of climate change that allow participants to evaluate their perceived knowledge of climate change. Closed ended questions are restricted in nature and offer a range of options for participants to choose from (Howell, 2012).

➤ *Climate Change Knowledge Survey Sample*

A sampling frame aged 18 and above years residing in different cities across Nigeria will be included in the study and a random sample of 150 respondents will be targeted for the study selected from different places of worship, government offices and academic institutes in the Federal Capital Territory of Nigeria.

➤ *Data Collection*

A questionnaire was designed to understand the awareness levels of the participants about climate change. This questionnaire, coined the Climate Change Awareness Tool (CCAT), is coined from the UNICEF Climate Change Knowledge Survey (Armenia) contextualized to Nigeria (for example, snow is switched for harmattan) (UNICEF, 2022). The CCAT also includes questions on participants' choice and frequency in social media use. The data emanating from the implementation of the CCAT is quantitative in nature and can be analyzed using descriptive and inferential statistics.

The CCAT tool (see Appendix 1) was hosted electronically using the Enketo form technology, which allows participants access surveys anywhere and archives their responses on a dedicated database (Enketo, 2022). The link to the CCAT is: <https://enketo.ona.io/x/6zX4feQ1>, and participants were invited to participate by positing this link on various social media spaces with Nigerian users including Facebook, Twitter, Instagram, and WhatsApp. Participants responses were anonymous and aggregated in real time on an ONA server. The ONA server allows easy access to archived, aggregated data and allows the researcher to download the dataset as Excel or csv formats (ONA.io, 2023). ONA also provides an API for instantly retrieving survey responses using Python; this enabled the researcher to collect, clean, transform, and analyze the data easily. The script below extracts, cleans, and transforms CCAT survey dataset from the ONA Server.

➤ *Ethical Issues*

The introductory part of the CCAT is an informed consent form that allows participants to confirm if they are willing to participate in the study. The informed consent discloses the purpose of the survey including the fact that participants records will remain anonymous thus ensuring the data collection process via the CCAT remains ethical and all participants' rights are protected (Creswell, 2008). Through the informed consent, the procedure of data collection is disclosed and participants and informed that they can opt out of the survey at any time they want to (Howell, 2012). As a means of safeguarding the participants, the "demographic" section of the survey is placed at the end of the tool and participants are informed prior to this section that the data will help the research classify their answers (Creswell, 2008). In line with the university's research ethics requirements, the completed forms are attached in appendix 2 and appendix 3.

➤ *Data Analysis*

Both descriptive and inferential statistics were applied to understand the overall responses to the participants and to test the role of demographic variables on participants' perception of climate change knowledge. Descriptive statistics involve the summarizing of a group of observations for simple communication of information through several aggregations, such as average, maximum, minimum, sum, median, and mode (Babbie, (2009). Since the data generated from the CCAT is quantitative in nature, data was validated from the source since participants were provided closed ended questions to respond to.

Further statistical analysis was conducted to infer the relationship between participants' demographic characteristics and their level of climate knowledge. Inferential statistics are used to test the relationship between one or more variables (Stapor, 2020). The Welch t-test was used as the primary inferential test for this study, due to its efficiency for testing variables with different sample sizes (Derrick, Toher, and White, 2016).

E. Key Informants Interviews

The third phase of the research explores other 'elite' stakeholders' motivations for climate change information dissemination. Key informant interviews refer to qualitative detailed consultations with participants who are familiar with the subject matter (Bjornholt and Farstad, 2012) or are key stakeholders that have some level of influence on the ecosystem under study (Owens, 2022). Key informant interviews are conducted to gather information from different participants who are directly involved in the elements that drive the ecosystem under study (Bjornholt and Farstad, 2012). Due to their conversance with the topic, key informants can offer insight to the extent to which factors influence the problem being studied and proffer potential solutions and approaches to influence change (Teachman and Gibson, 2013).

➤ *Key Informants Sample*

The choice of key informants for the study is based on the different influences and possible interests they have in relation to climate change advocacy through social media. Emails were sent to the key informant inviting them to participate in the study; direct messages were sent to some of the key informants who could easily be reached through their social media platforms. Appendix 4 is a sample of the email sent, informing key informants of the research and inviting them to consent by responding. The following groups of people were selected as key informant for this study:

- *Twitter Influencers*

Research on the role of Nigeria social media influencers on their followers showed that through informative communication strategy, twitter influencers attracted significant (over 40%) of their followers (Obono, 2016). The strength of Twitter influencers on Nigeria social media users, is also highlighted by Uji (2015) who highlights the speed with which contents and information is disseminated via social media space driven by influencers' strategic communication approaches.

- *Strategic Government Official from the National Orientation Agency*

Owing to the mandate of this government institution to promote government policies and enhance community participation through strategic communication (NOA, 2023), the research selects a key informant to understand if there are programmes directed towards climate change communication.

- *Private Sector Communications Representative*

With the continuous engagement of private sector actors in different Corporate Social Responsibility (CSR) activities (Mamudu, Mamudu, Elehinafe, and Akinneye, 2021), a representative of the private sector is interviewed to understand the approaches, if any, engaged by their organization to promote climate change communication through social media. The key informant under this stakeholder category is selected from an energy generation and distribution company located in the Northern region of Nigeria.

➤ *Key Informant Interview Questions*

Three categories of key informants representing the stakeholder groups in Nigeria’s social media continuum for climate change are interviewed for the study. As suggested by Bjornholt, and Farstad (2012), the interviews are delivered in a way to instigate open ended interactions between the researcher and the key informant. Therefore, the interview questions will seek to understand the stakeholders’ level of social media communication in the topic of climate change.

Table 2 Summary of Key Informants’ Interview Guideline

Key Informant	Broad Questions
Twitter Influencer	What influences what you post? Have you posted any information on climate change?
Government Agency Management Level Staff	What are the current programmes related to climate change? Does the agency use social media for promoting these programmes and how?
Private Sector Communications Personnel	What is your CSR for climate change? Does the agency use social media for promoting these programmes and how?

➤ *Data Analysis*

Data collected through the key informant interviews were transcribed and grouped in thematic areas as advised by Creswell (2008). After the grouping into thematic areas, the texts were summarized and review in the context of the critical analysis conducted in the literature review related to effective communication strategies for social media advocacy. The findings for each thematic area are presented in the subsequent chapter; recommendations on how the different stakeholder groups can promote climate change adaptation through social media communication are highlighted.

➤ *Ethical Issues*

Key informants were informed of the purpose of the study and asked to confirm and provide consent their willingness to participate in the interview by responding to the email and direct message. On the day of the interview, before commencing the main questions of the interview, all key informants were again informed of the purpose of the interview and asked to consent that they were willing to continue. The researcher also informed these participants that could decline to respond to any question or even opt out of the interview at any point.

CHAPTER FOUR RESULTS AND DISCUSSION

A. Overview

This chapter presents the results and analysis of the data collected for the purpose of the research. This chapter presents descriptive and inferential statistical summaries and analysis designed to respond to the research questions and test the hypothesis. While descriptive statistics presented summary analysis presented in tables and charts providing an overview of the results of different variables considered (Andiappan and, Yoke, 2020), the statistical tests are relevant to test the hypothesis by statistically comparing the results of the variables (Andiappan and, Yoke, 2020). This chapter is broadly divided into four sections covering twitter engagement analysis; twitter sentiment analysis; climate change knowledge survey analysis; and stakeholder practice analysis.

B. Twitter Engagement Analysis

As earlier mentioned, a social media engagement analysis identifies the level of engagement and the level of discourse about a theme on social media platforms. The Twitter data mined for this research was subjected to an engagement analysis to understand the level of discourse on the topic of climate change amongst Nigerian social media users compared to their counterparts in Western English-speaking countries. 5,600 tweets containing the phrase ‘climate change’ were mined with no restrictions to location; the analysis was conducted to identify the proportion of tweets emerging from Nigeria compared to Australia, Canada Europe, UK, and USA. Figure 4.1 below illustrates the contribution of tweets from each country.

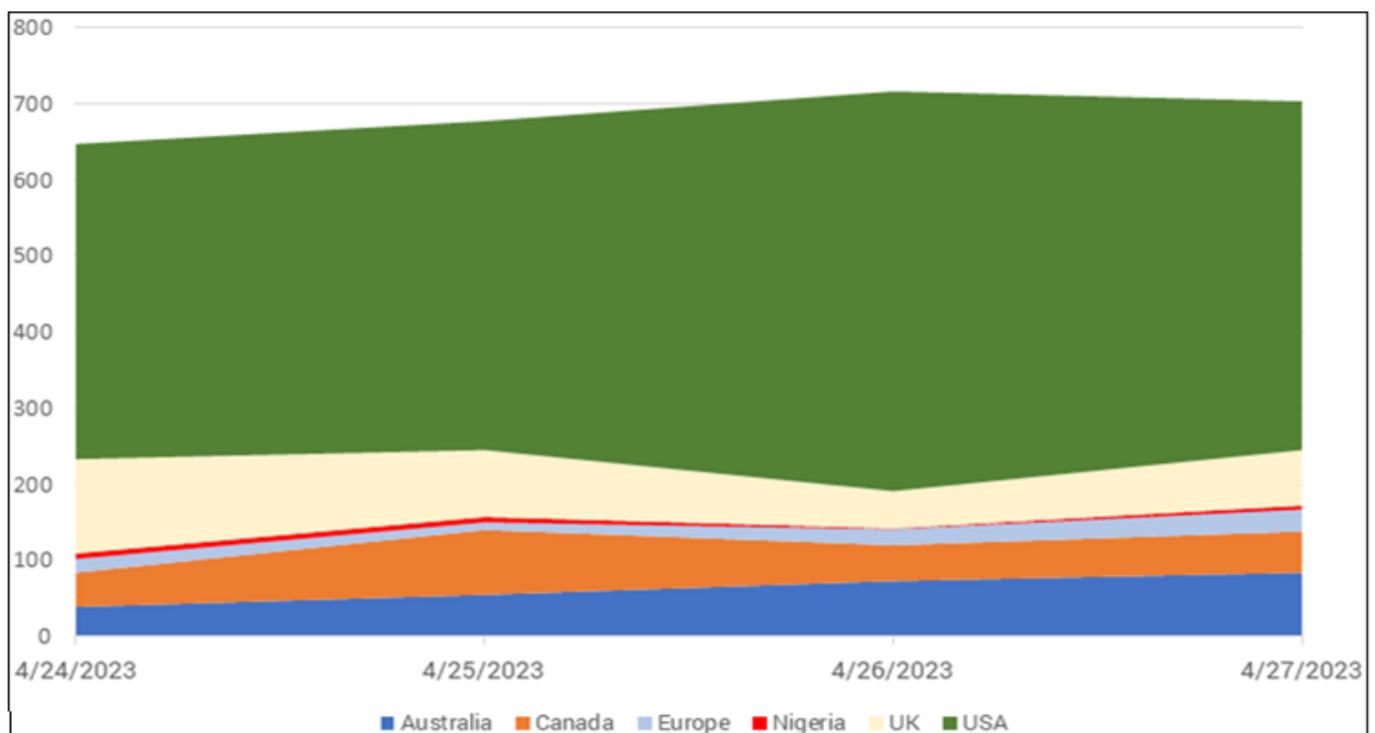


Fig 10 Number of Tweets containing ‘Climate Change’ per Country

From figure 10 above, Nigerian tweets (highlighted in the deep red area) represented the least number of tweets, showing that, between the countries considered for the analysis, Nigeria presented the least amount of engagement on the topic of ‘climate change’.

➤ Number of Tweets

Although figure 3 showed Nigeria had the least level of engagement, considering that the number of twitter users vary from country to country, it was necessary to apply a weight that adjusts the number of tweets from Nigeria correct for the difference in twitter users. For example, there are 95.4 million and 4.95 million active users twitter users in USA (Oberlo, 2022) and Nigeria (Kemp, 2023), respectively. Therefore, it is logical to apply a factor of 95.4/4.95 to each Nigerian tweet before comparing the tweets from the two countries. The table 3.1. in the methodology provided a summary the factor applied for each country.

Table 3 presents a summary of the number of tweets emerging from Nigeria compared to those from USA. The adjusted number of tweets was derived by applying a weight of 19.3 to each Nigerian tweet. Comparing the adjusted number of tweets from Nigeria to USA, shows that the between the period of 24 – 27 April 2023, a minimum of 200% more tweets came from USA than Nigeria, with over 2,500% more tweets generated from USA than Nigeria on April 26.

Table 3 Nigeria vs. USA

# Twitter Users (millions)		4.95		95.4	
Date	Nigeria Tweets	Nigeria Tweets*	USA Tweets	% Difference	
4/24/2023	7	135	414	207%	
4/25/2023	7	135	432	220%	
4/26/2023	1	19	525	2624%	
4/27/2023	5	96	458	375%	

Tables 4, 5 and 6 summarize the results of the same engagement analysis based on the number of tweets between Nigeria and Canada, UK and Australia, respectively. The adjusted number of tweets was derived by applying weights of 4, 5, and 6 for Canada, UK, and Australia respectively. Comparing the adjusted number of tweets from Nigeria to Canada, UK, and Australia respectively, shows that between the period of 24 – 27 April 2023, a minimum of 207%, 298% and 360% more tweets, respectively, were generated. Excesses of 2800%, 1100%, and 6000%, compared to tweets from Nigeria, were reported for Canada, UK, and Australia respectively on April 26.

Table 4 Nigeria vs. Canada

# Twitter Users (millions)		4.95		8	
Date	Nigeria Tweets	Nigeria Tweets*	Canada Tweets	% Difference	
4/24/2023	7	11	45	298%	
4/25/2023	7	11	85	651%	
4/26/2023	1	2	47	2808%	
4/27/2023	5	8	54	568%	

Table 5 Nigeria vs. UK

# Twitter Users (millions)		4.95		19.05	
Date	Nigeria Tweets	Nigeria Tweets*	UK Tweets	% Difference	
4/24/2023	7	27	124	360%	
4/25/2023	7	27	88	227%	
4/26/2023	1	4	49	1173%	
4/27/2023	5	19	73	279%	

Table 6 Nigeria vs. Australia

# Twitter Users (millions)		4.95		5.8	
Date	Nigeria Tweets	Nigeria Tweets*	Australia Tweets	% Difference	
4/24/2023	7	8	39	375%	
4/25/2023	7	8	55	571%	
4/26/2023	1	1	73	6130%	
4/27/2023	5	6	84	1334%	

The results of the engagement analysis shown in the tables above, highlight the significant difference in twitter engagement on climate change subjects between the social media space of Nigeria and Western English-speaking countries of USA, Canada, UK, and Australia, when number of tweets is considered as the variable for engagement. This significance is still observed when the number of tweets from Nigeria is adjusted to account for the difference in number of active users between Nigeria and the considered countries.

➤ *Retweets*

Another variable that represents the level of engagement on a topic on twitter is the number of retweets generated by the tweet (Lee, Mahmud, Chen, Zhou, Nichols, 2014). Although not all users who engage with a tweet will retweet it, the number of retweets is an indication of the engagement received by each tweet (Lee, Mahmud, Chen, Zhou, Nichols, 2014). Table 7 below is a descriptive summary of the number retweets, showing the minimum, maximum, mean, and total number of retweets.

Table 7 Descriptive Statistics of Number of Tweets Per Country

Country	Minimum	Maximum	Mean	Sum
Australia	-	41	1.4	349
Canada	-	56	1.8	419
Nigeria	-	2	0.4	7
UK	-	14	0.4	130
USA	-	1,051	2.2	3,975
Grand Total	-	1,051	2	4,880

The tweet with the phrase ‘climate change’ that had the highest number of retweets was from USA, with 1,051 retweets, while every country reported tweets that had 0 retweets as the minimum retweet count. Canada, Australia, and UK reported 56, 41 and 14 the maximum number of retweets for any tweets with the phrase ‘climate change’ from 24 to 27 April 2023. However, the maximum number of retweets for any tweet with the phrase ‘climate change’ from Nigeria between the same period was 2. The average number of retweets per tweet coming from Nigeria with the ‘climate change’ phrase from 24 to 27 April 2023 was 0.4. Although this mean retweet count was the same with average retweets per tweet returned by UK during the same period, it was the lowest as USA, Canada, and Australia returned 2.2, 1.8 and 1.4 respectively, as the average number of retweets per tweet.

Considering the number of retweets as an indication of the level of engagement with the subject of a tweet (Lee, Mahmud, Chen, Zhou, Nichols, 2014), the retweet score exhibited by ‘climate change’ tweets from Nigeria shows low engagement compared to western English-speaking countries considered in this research.

➤ *Followers*

The number of followers a twitter user has is directly related to the width of the tweets they post on the platform (Arrabal-Sanchez and De-Aguilera-Moyano, 2016). This is especially necessary for twitter users who have personal accounts and not corporate accounts (Tutaj and Van Reijmersdal, 2012). Corporate twitter accounts, such as news outlets, usually post messages for the purpose of information sharing (Arrabal-Sanchez, and De-Aguilera-Moyano, 2016), compared to personal accounts where subjective messages are posted to usually inspire opinion sharing (Tutaj and Van Reijmersdal, 2012). Therefore, while more users may ‘see’ tweets emanating from twitter accounts with many followers, they may not necessarily engage with these tweets.

Table 8 Descriptive Statistics of Number of Followers Per Country

Country	Minimum	Maximum	Mean	Sum
Australia	1	2,195,963	29,767	7,471,425
Canada	4	2,008,488	18,523	4,278,699
Nigeria	13	1,669,089	85,560	1,711,195
UK	2	3,385,655	16,488	5,506,993
USA	-	20,047,875	60,529	110,707,236
Grand Total	-	20,047,875	48,659	129,675,548

The role of analyzing the number of followers per tweet on the topic of ‘climate change’ is to understand the level of personality involved in each tweet. The lower the number of followers associated with the username of a tweet, the more personal the tweet is (Tutaj and Van Reijmersdal, 2012), because personal accounts usually have fewer followers. Table 8 above shows that the maximum number of followers for users who posted tweets about ‘climate change’ from 24 to 27 April 2023 was over 20 million. Australia, UK, and Canada returned 1, 2, and 4 respectively, as the lowest number of followers of users. Amongst tweets emanating from Nigeria with the phrase ‘climate change’, users had at least 13 followers. This is a representation of high likelihood that most tweets coming from Nigeria on this topic are from corporate users. Although the maximum number of followers for any account tweeting from USA was over 20 million, average number of followers per user for USA was still lower than the average followers from Nigeria by over 25,000, showing that compared to USA, where most of the tweets were from personal accounts, most Nigerian tweets about the subject of ‘climate change’ may have been from corporate accounts, or agencies promoting ‘climate change’.

C. Twitter Sentiment Analysis

Using Textblob and VADER python libraries, sentiment analysis were conducted to understand the polarity of tweets related to climate change, emanating from Nigeria and the Western English-speaking countries of Australia, Canada, UK, and USA. The same data used for the engagement analysis was exposed to a sentiment analysis however, due to the lower engagement levels recorded from Nigerian twitter space, the dataset for climate change related tweets from Nigeria was expanded by mining more data between 24 and 27 April 2023, containing other phrases related to climate change. To improve the availability of data from Nigeria for the sentiment analysis, tweets containing the following words were mined: “clean energy Nigeria”; “#climatechange”; ‘ecofriendly’; ‘global warming’; ‘greenhouse’; ‘#climate’; ‘solar’; ‘sustainability’; ‘temperature’. ‘Nigeria’ was parsed along each of the mine commands to ensure that the location of the context of the tweet was related to Nigeria. Afterwards, the resulting dataset was to include tweets emanating from Nigeria. The resulting dataset contained 659 tweets emanating from Nigeria on subjects related to climate change against 2,645 tweets from Western countries.

➤ Textblob Analysis

The Textblob Polarity Analysis categorizes texts on a polarity scale of -1 to 1, with a polarity score <0 representing negative sentiments and scores >0 representing positive sentiments; all scores of 0 represent the neutrality. Figure 11 below represents the distribution of sentiments for the overall dataset, showing 49%, 28% and 23% of positive, neutral and negative sentiments respectively.

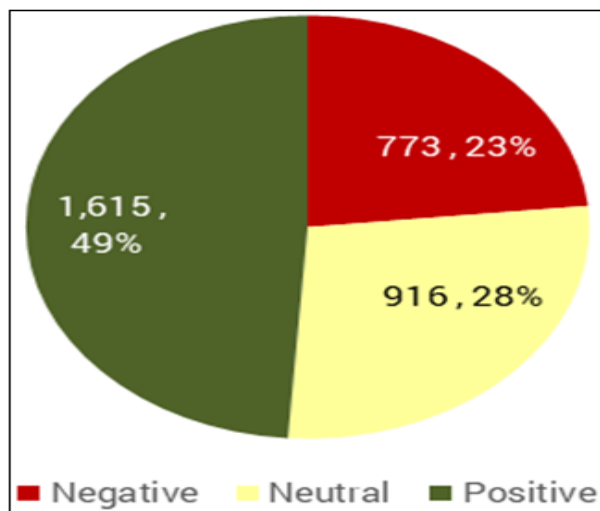


Fig 11 Overall Distribution of Textblob Sentiments

When considered separately, as shown in figure 12 below, tweets from Nigeria returns 60% positive sentiment compared to tweets from Western countries, which returned 46% positive sentiments. Nigerian tweets also returned 16% less negative sentiments towards climate change compared to 25% negative sentiments returned by tweets from the considered western countries. The neutral tweets were 24% and 29% from Nigeria and Western countries respectively.

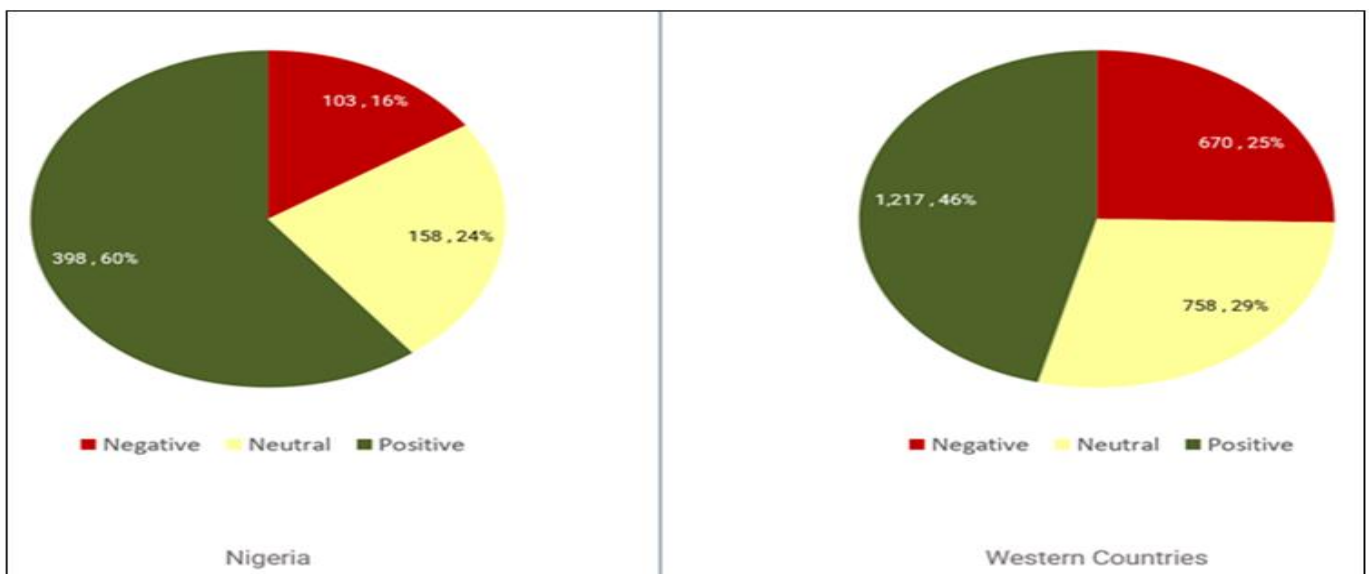


Fig 12 Nigeria vs. Western Countries Textblob Sentiments

The results of the comparative analysis in figure 12 above indicates the possibility of more climate change deniers in western countries compared to Nigeria. To further understand if the climate change deniers were skewed towards a particular western country under consideration, figure 13 below shows a comparison of sentiment polarity distribution between the western countries considered.

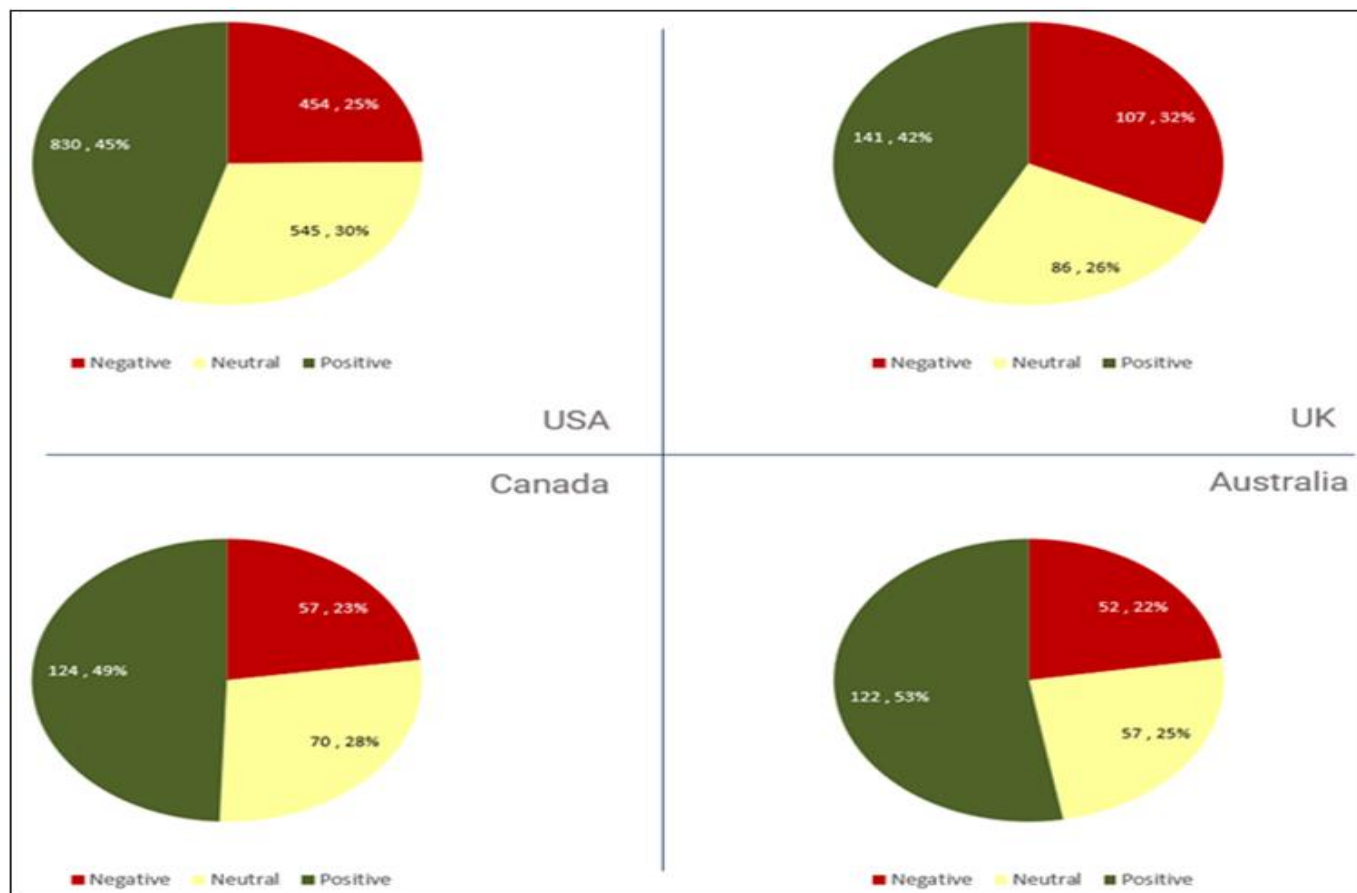


Fig 13 Comparative Distribution of Western Countries' Textblob Sentiments

From the sentiments polarity charts, it can be seen that the distribution of sentiments across the western states were comparatively similar to each other. The table below summarizes the polarity of all the countries considered in the dataset.

Table 9 Countries' Respective Textblob Sentiment Polarity Scores

Country	TextBlob Category	# of Tweets	% of Tweets
Australia	Negative	57	22.71%
	Neutral	70	27.89%
	Positive	124	49.40%
Canada	Negative	52	22.51%
	Neutral	57	24.68%
	Positive	122	52.81%
Nigeria	Negative	103	15.63%
	Neutral	158	23.98%
	Positive	398	60.39%
UK	Negative	107	32.04%
	Neutral	86	25.75%
	Positive	141	42.22%
USA	Negative	454	24.82%
	Neutral	545	29.80%
	Positive	830	45.38%

At 60.4%, Nigeria returned the highest proportion of positive sentiments towards climate change, while UK returned the lowest proportion of positive tweets at 42.2%. USA, Australia, and Canada, returned 45.4%, 49.4% and 52.8% positive tweets respectively, all lower than Nigeria.

Despite the variation observed in the polarity of sentiments between Nigeria and Western countries through the summary analysis, an analysis was conducted to test the statistical significance of this difference. Figure 14, below is a summary of the results of Welch’s t-test to compare the means of polarity between Nigeria’s and the considered western countries’ tweets on climate change.

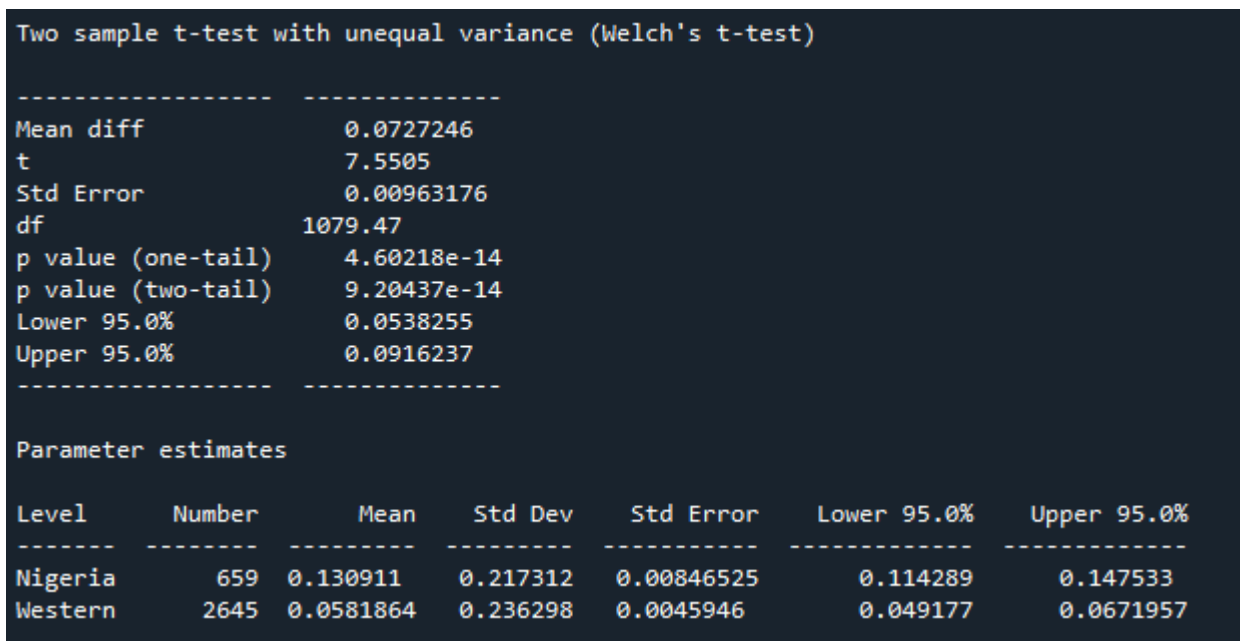


Fig 14 Statistical Test: Nigerian vs. Western Countries’ Climate Change Sentiments

With a p-value <0.05, the difference between the polarity of tweets from Nigeria’s social media space and western countries’ social media space is statistically significant.

➤ *VADER Analysis*

The VADER polarity analysis was also used to conduct similar comparisons described in the previous section. As shown in figure 15 below, the overall results of the VADER polarity analysis showed a distribution of 9%, 82% and 9%, positive, neutral and negative sentiments respectively for the overall data considered for the sentiment analysis.

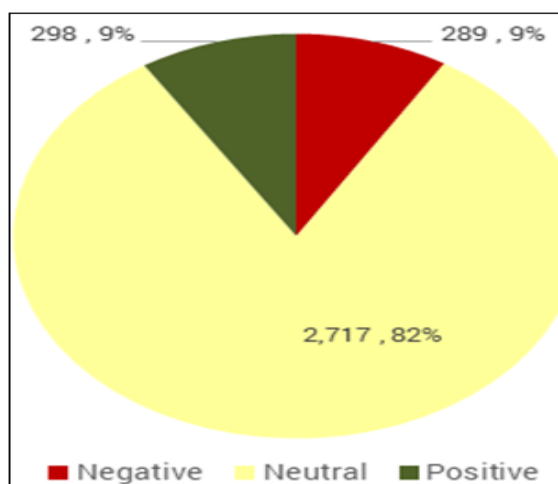


Fig 15 Overall Distribution of VADER Sentiments

Figure 16 below further analyzes the difference in sentiments’ polarity distribution between Nigeria and western English-speaking countries. The results show that while climate change related tweets from Nigeria returned 11%, 84%, and 5% positive, neutral, and negative sentiments respectively, tweets from the considered western countries returned 8%, 82% and 10% positive, neutral and negative sentiments respectively.

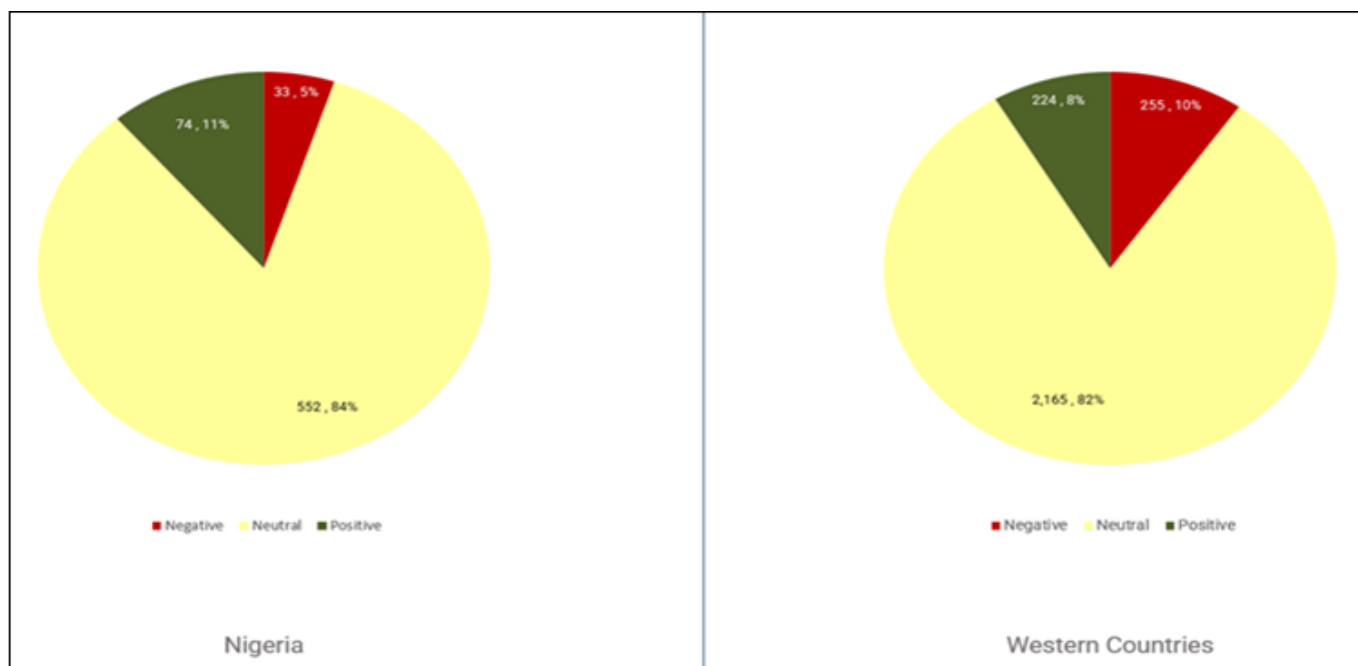


Fig 16 Nigeria vs western countries VADER Sentiment Analysis

A further disaggregation of sentiments by western country, as shown below, reveal similar results as with the Textblob analysis, with all western countries returning comparative distribution of sentiments.

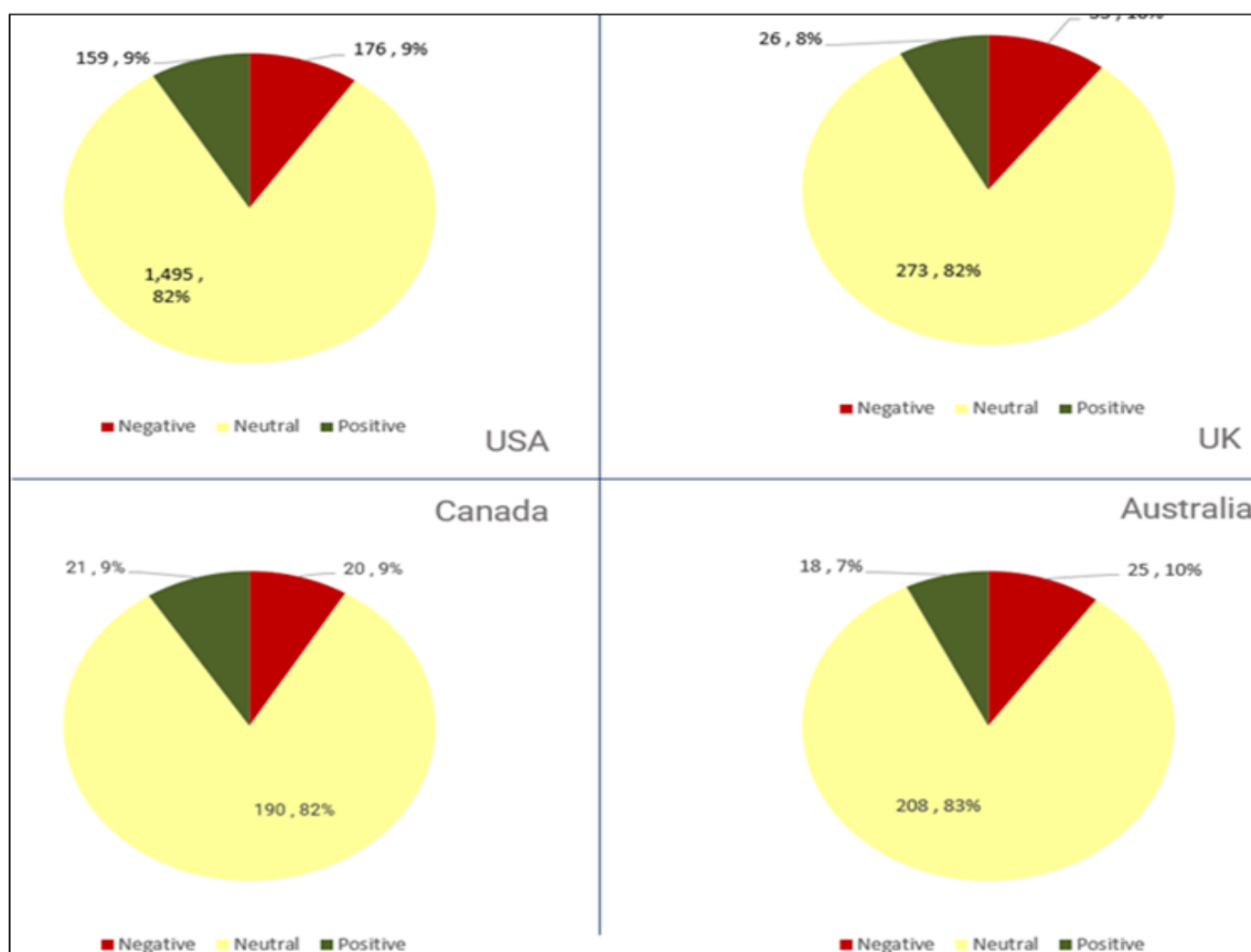


Fig 17 Comparative Distribution of Western Countries' VADER Sentiments

Table 10 below presents the VADER polarity scores of all countries considered in the analysis to enable a comparison between Nigeria and each western English-speaking country.

Table 10 VADER Sentiments Polarity Distribution

Country	Category		
Australia	Negative	25	9.9%
	Nutral	208	82.9%
	Positive	18	0
Canada	Negative	20	8.6%
	Nutral	190	82.3%
	Positive	21	9.1%
Nigeria	Negative	33	5.1%
	Nutral	552	83.7%
	Positive	74	11.2%
UK	Negative	35	10.5%
	Nutral	273	81.7%
	Positive	26	7.9%
USA	Negative	176	9.6%
	Nutral	1,495	81.7%
	Positive	159	8.7%

At 11.2%, Nigeria returned the highest proportion of positive sentiments towards climate change according VADER polarity distribution, while Australia returned the lowest proportion of positive tweets at 0%. UK, USA, and Canada, returned 7.9%, 8.7% and 9.1 positive tweets respectively, all lower than Nigeria. The VADER polarity score for all countries returned more than 80% neutral sentiments.

Fig 18, below is a summary of the results of Welch’s t-test to compare the means of VADER polarity between Nigeria’s and the considered western countries’ tweets on climate change.

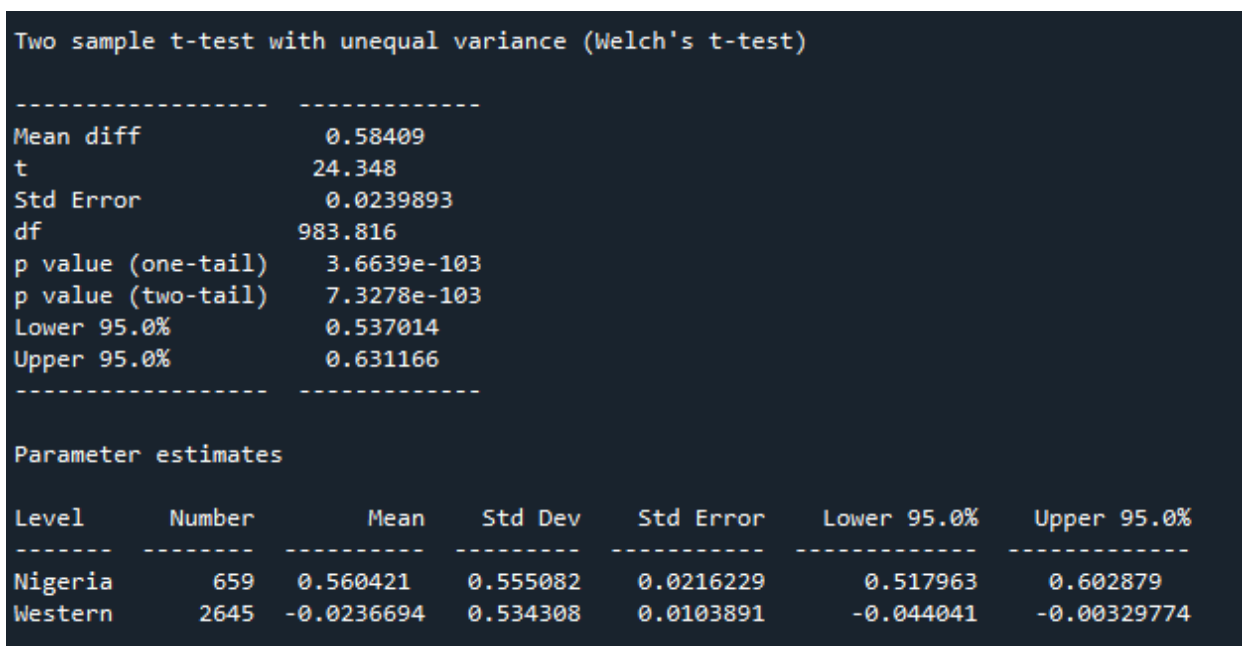


Fig 18 Statistical Test: Nigerian vs. Western Countries’ VADER Climate Change Sentiments

A p-value <0.05, shows that the difference between the polarity of tweets from Nigeria’s social media space and western countries’ social media space is statistically significant.

The descriptive summary analysis and statistical test, for both Textblob and VADER sentiment analysis results, all support the premise that tweets from Nigeria’s social media space on climate change vary in sentiments from tweets from western countries’ social media space, which supports Hypothesis 1. Therefore, the hypothesis that there is a significant difference between the sentiments of Twitter users from Nigeria and Western English-speaking countries, is valid.

D. Climate Change Knowledge Survey

The climate change survey, distributed through a web-based questionnaire, yielded results that contributed to understanding the perceived and experiential knowledge of Nigerian social media users on the topic of climate change. This section of the chapter presents the results of the climate change knowledge survey, commencing with the demographic overview of the participants, to a descriptive summary of participants’ climate change knowledge viz-a-viz their demographic characteristics, and concluding with statistical tests to understand the significance of participants demographics and their knowledge.

➤ *Demographics*

Hosted on an online web platform from April 18 to 30 2023, the climate change knowledge survey yielded responses from 208 participants. Figure 19 below shows that 84% (74) responses were from Nigerian social media users, while 16% (33) responses were from participants across other parts of the world.

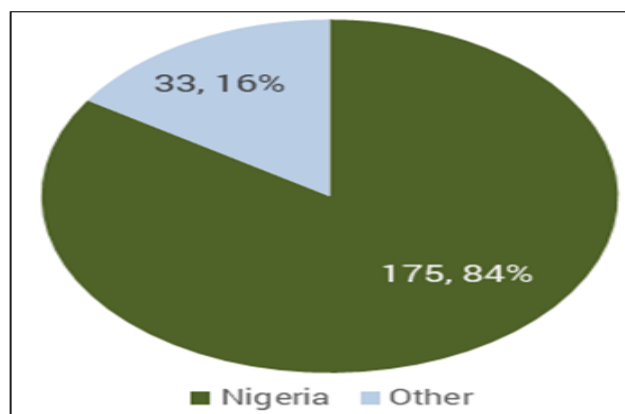


Fig 19 Participants’ Location Distribution

While the survey was hosted online and targeted Nigerian participants, it was possible to receive responses from participants all over the world. However, considering the scope of this study, only responses of participants from Nigeria were considered. However, for possibility of future research, the excel analysis workbook was designed in a way that responses of participants from other countries can be generated using the slicer tool shown in the screenshot below included in the Excel Analysis file (see Appendix 5).

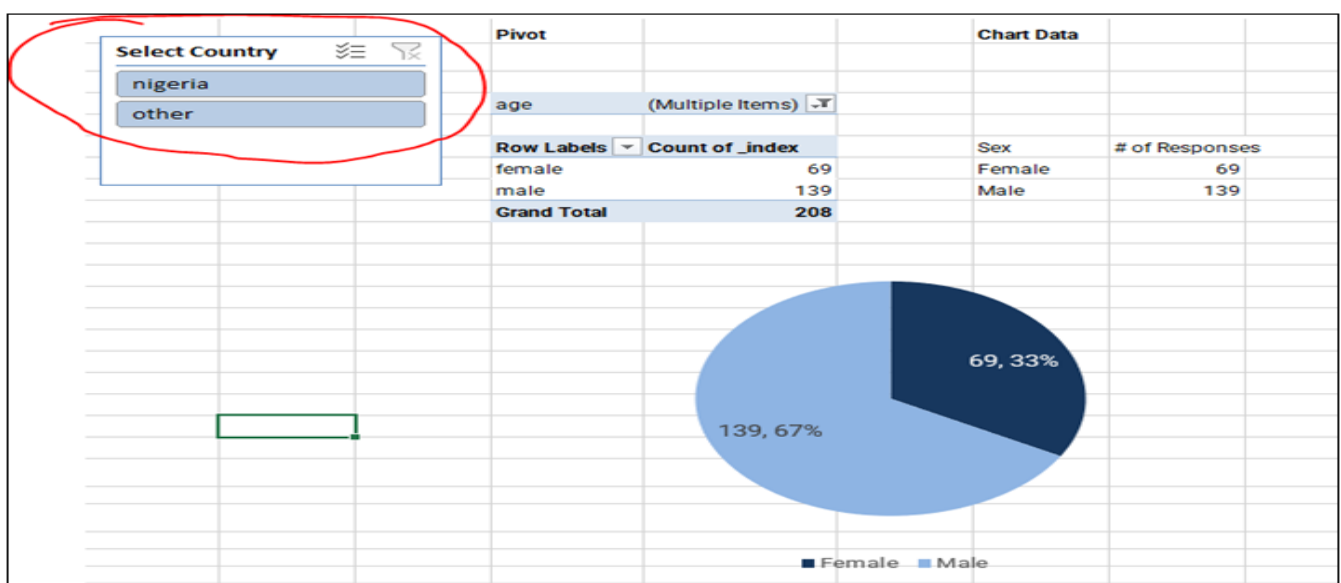


Fig 20 Excel Analysis of Participants’ Location

The Nigerian slicer button was used to generate analysis for Nigerian participants presented in the rest of the climate change knowledge survey analysis section.

Figure 21 below summarizes the distribution of participants by gender for all responses received from participants who indicated they were responding from Nigeria. 69% of the participants were male while 31% of them were female.

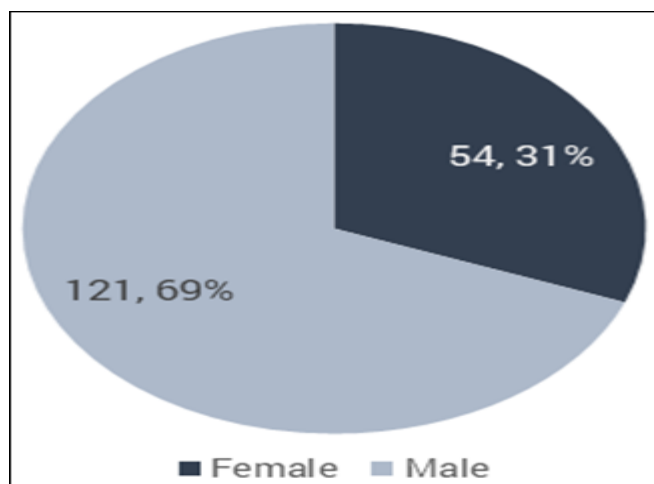


Fig 21 Participants Gender

The age distribution of participants is summarized in figure 22a and 22b below. Most participants were 18 to 45 years old, which is representative of the social media users in Nigeria (Khatua, Khatua and Cambria, 2019).

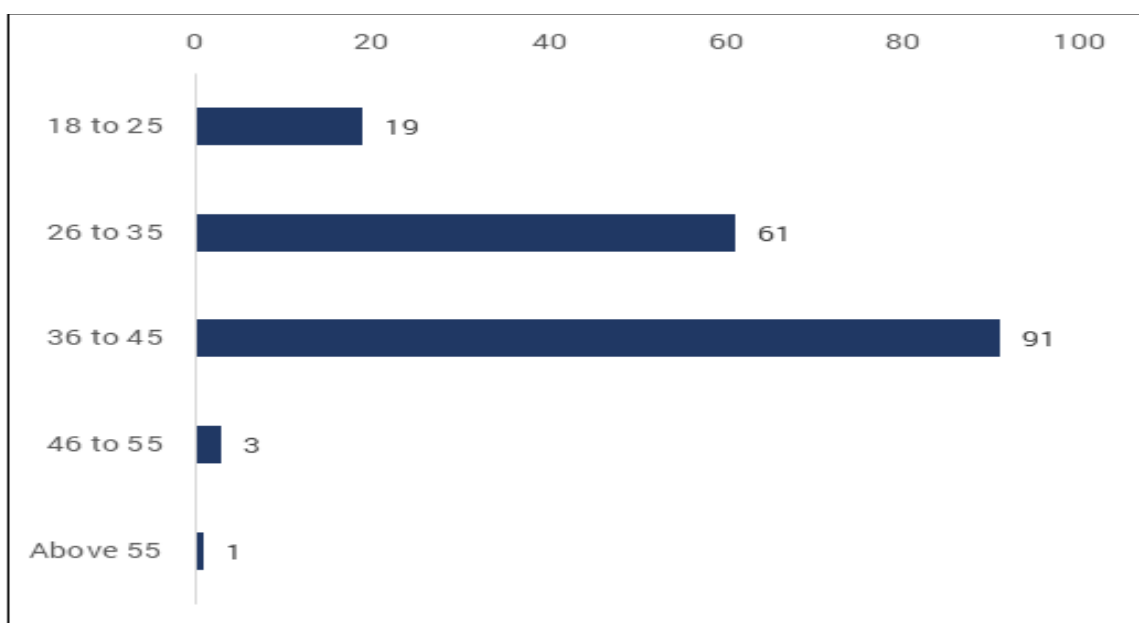


Fig 22a Distribution of Respondents by Age

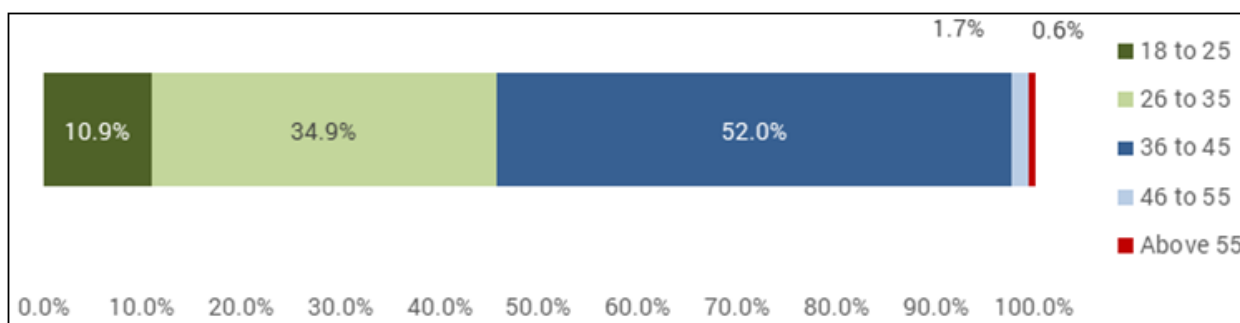


Fig 22b Percentage Distribution of Respondents by Age

The roles of education, employment and economic status on climate change knowledge have been highlighted in various studies (Ayanlade and Jegede, 2016). Figures 23, 24, 25a. and 25b. illustrate the distribution of participants by highest educational qualification, employment status, and estimated monthly earning.

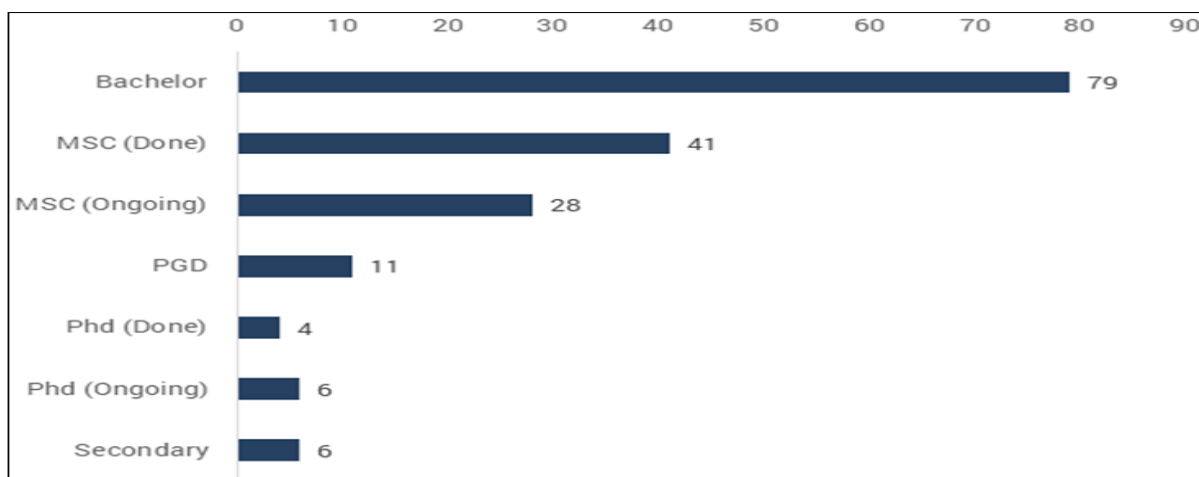


Fig 23 Distribution of Participants by Education

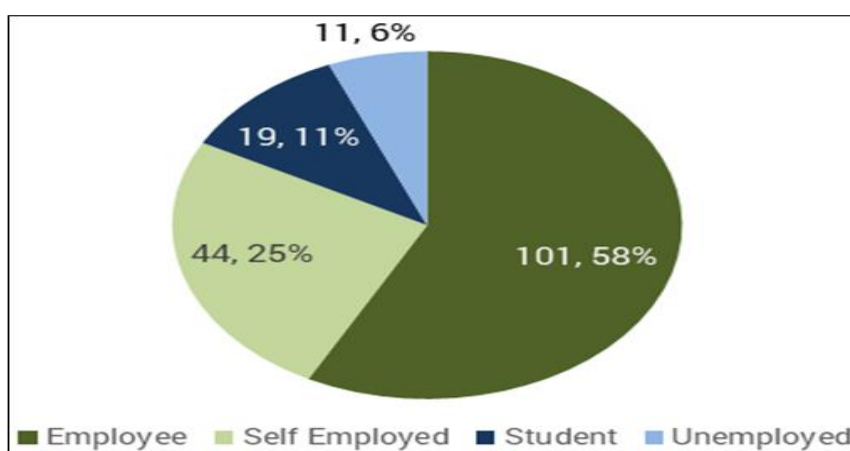


Fig 24 Distribution of Participants by Employment Status

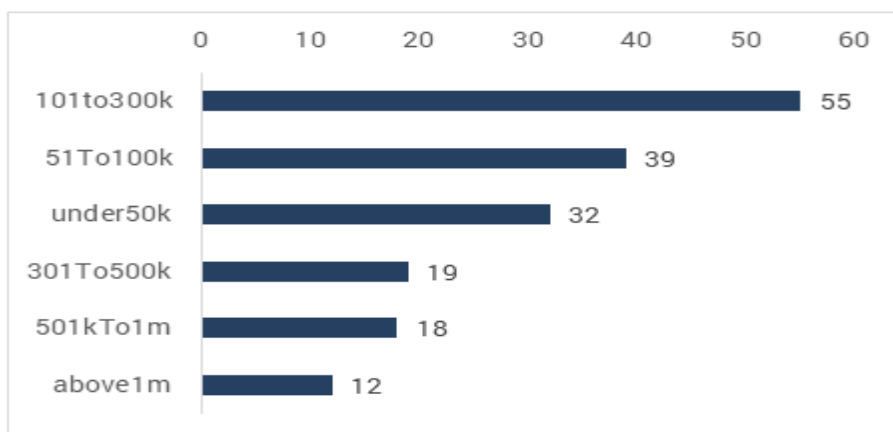


Fig 25a Number Distribution of Participants by Monthly

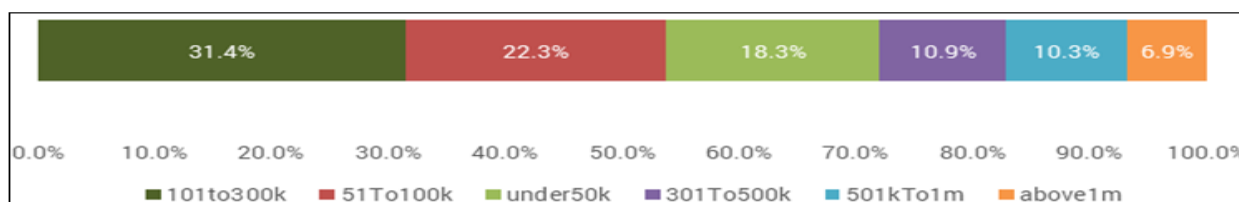


Fig 25b Proportion Distribution of Participants by Monthly

The most popular social media app amongst the respondents is Whatsapp, with 87% of them reporting that they used Whatsapp frequently. This was followed by Facebook (64%), Instagram (46%) and Twitter (45%), as highlighted in Figure 26 below.

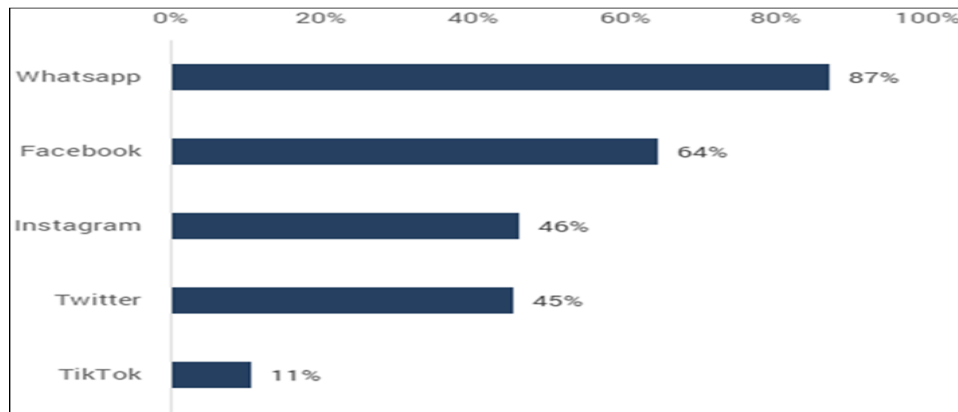


Fig 26 Proportion of Participants Using Different Social-Media

➤ *Climate Change Knowledge Analysis*

Using the python script shown in Figure 27 below, climate knowledge scores were assigned to each category of the survey tool. The script converts the responses of participants to scores for categories of: climate change information access; climate change experience; climate change perceived importance; climate change perceived knowledge; climate change exhibited knowledge.

```
##-----DATA WRANGLING - Transform Data for analysis-----
#assign scores to climate change information access question
climate_df['info_acces_score'] = (np.where((climate_df.heard_cc == 'yes'), 1, 0) +
    np.where((climate_df.understand_cc == 'yes'), 1, 0))/2

#assign scores to climate change experience
climate_df['experience_score'] = (np.where((climate_df.rain == 'true_'), 1, 0) +
    np.where((climate_df.heat == 'true_'), 1, 0) +
    np.where((climate_df.wind == 'true_'), 1, 0) +
    np.where((climate_df.dust == 'true_'), 1, 0))/4

#assign scores to climate change experience
climate_df['perceived_knowledge_score'] = (
    (np.where((climate_df.informed_cc_cause == 'very'), 1, (np.where((climate_df.informed_cc_cause == 'kinda'),0.5, 0)))) +
    (np.where((climate_df.informed_cc_effects == 'very'), 1, (np.where((climate_df.informed_cc_effects == 'kinda'),0.5, 0)))) +
    (np.where((climate_df.informed_cc_protect == 'very'), 1, (np.where((climate_df.informed_cc_protect == 'kinda'),0.5, 0)))) +
    (np.where((climate_df.informed_cc_reduce == 'very'), 1, (np.where((climate_df.informed_cc_reduce == 'kinda'),0.5, 0)))))/4

#assign scores to each climate change knowledge question
climate_df['exhibited_knowledge_score'] = (np.where((climate_df.cc_changes_temp == 'true_'), 1, 0) +
    np.where((climate_df.cc_affects_weather == 'true_'), 1, 0) +
    np.where((climate_df.cc_increases_airTemp == 'true_'), 1, 0) +
    np.where((climate_df.cc_melts_ice == 'true_'), 1, 0) +
    np.where((climate_df.cc_causes_drought == 'true_'), 1, 0) +
    np.where((climate_df.cc_causes_hurricanes == 'true_'), 1, 0) +
    np.where((climate_df.cc_by_nature == 'false_'), 1, 0) +
    np.where((climate_df.cc_by_god == 'false_'), 1, 0) +
    np.where((climate_df.cc_by_ppl == 'true_'), 1, 0) +
    np.where((climate_df.cc_by_deforestation == 'true_'), 1, 0)
    )/10

#assign scores to the climate change importance question
climate_df['importance_score'] = ((np.where((climate_df.cc_importance == 'very'), 1,
    (np.where((climate_df.cc_importance == 'important'),0.5,
    (np.where((climate_df.cc_importance == 'somewhat'),0.25,
    0)))))))

#save the file for tableau
climate_df.to_excel(r'C:\Users\cikyernum\Downloads\Cumbria\climate_knowledge_analysis\climate_tableau_data.xlsx')
```

Fig 27 Data Wrangling Scripts for Climate Change Scores

• *Descriptive Analysis of Climate Change Knowledge Survey*

Table 11 below summarizes the distribution of climate change knowledge scores per category by participants' sex. While it appears that the scores of participants were similar for both male and female participants, it seems that female participants had a higher perception of the importance of climate change compared to their male counterparts. Female participants had an overall higher climate knowledge score.

Table 11 Distribution of Climate Knowledge Scores by Participants' Sex

Indicator	Female	Male	Overall Average
Information Access	98.15%	99.17%	98.9%
Experience	74.54%	70.87%	72.0%
Importance	84.26%	75.62%	78.3%
Perceived Knowledge	64.12%	67%	66.4%
Exhibited Knowledge	82.41%	82.07%	82.24%
Overall	81%	79%	

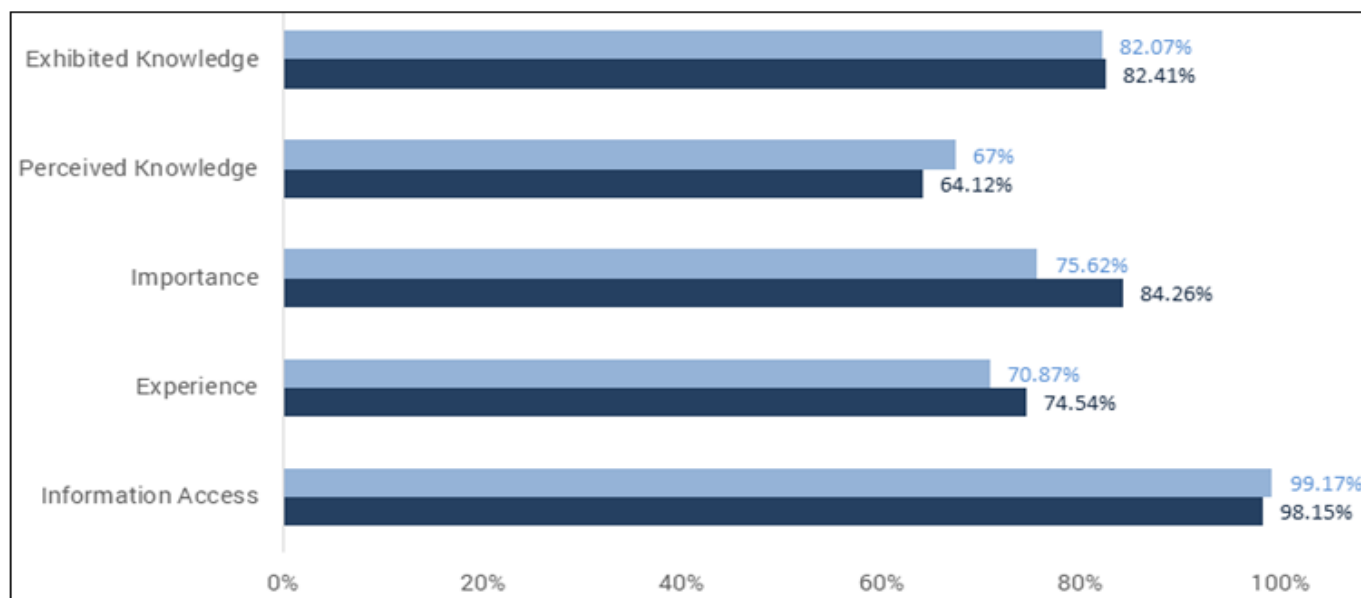


Fig 28 Distribution of Climate Knowledge Scores by Participants' Sex

Figure 28 above further illustrates the distribution of climate change knowledge scores between male and female participants, and it can be seen that while most of the bar charts had a similar length, the variation in importance scores are visible.

The role of participants' age on their climate change knowledge scores can be seen in table 12 below. It appears that participants below 25 years of age had lower scores compared to participants above 25 years. Also, only participants between 46 and 55 years scored more than 70% in the perceived knowledge score. Overall, participants between 26 to 35 years scored highest.

Table 12 Climate Change Knowledge by Age Distribution

Age	18 to 25	26 to 35	36 to 45	46 to 55	Above 55	Overall Average
Information Access	97.37%	99.18%	98.90%	100.00%	100.00%	98.9%
Experience	59.21%	75.82%	71.15%	100.00%	75.00%	72.0%
Importance	65.79%	82.79%	76.92%	100.00%	100.00%	78.3%
Perceived Knowledge	59.21%	67%	67%	88%	38%	66.4%
Exhibited Knowledge	72.11%	86.72%	81.10%	86.67%	80.00%	82.24%
Overall	71%	82%	79%	95%	79%	

In terms of exhibited knowledge however, participants across all age categories had comparative scores except those below 25 years.

Table 13 below is a summary of distribution of knowledge scores by education and it was not surprising that participants with the secondary qualification showed the lowest perceived knowledge of climate change, considering that they were likely below 25 years of age. Most scores were above 70% across the categories.

Table 13 Climate Change Knowledge by Education Distribution

Education								
Indicator	Secondary	Bachelor	PGD	MSc (Ongoing)	MSc (Done)	Phd (Ongoing)	Phd (Done)	Overall Average
Information Access	100%	99%	95%	100%	99%	100%	100%	98.9%
Experience	71%	70%	70%	70%	76%	79%	75%	72.0%
Importance	75%	78%	82%	76%	78%	88%	88%	78.3%
Perceived Knowledge	56%	64%	72%	69%	65%	81%	81%	66.4%
Exhibited Knowledge	83%	80%	80%	79%	88%	83%	95%	82.24%
Overall	77%	78%	80%	79%	81%	86%	88%	

It seems the more educated participants were, the higher they scored with those who had completed their PhDs scoring highest at 88%, followed by those currently undergoing their PhD scoring the second highest (86%) and MSc holders coming third (81%).

Students and self-employed respondents scored the least overall score (76%) while unemployed respondents and employees scored the 84% and 81% overall knowledge scores respectively. This may be related to the possibility that unemployed participants spend more time exposed to sources of climate change information (Khatua, Khatua and Cambria, 2019).

Table 14 Climate Change Knowledge by Employment Distribution

Employment					
Indicator	Employee	Self Employed	Student	Unemployed	Overall Average
Information Access	99%	99%	100%	100%	98.9%
Experience	74%	69%	68%	77%	72.0%
Importance	81%	70%	74%	95%	78.3%
Perceived Knowledge	68%	65%	64%	59%	66.4%
Exhibited Knowledge	84%	79%	76%	88%	82.24%
Overall	81%	76%	76%	84%	

There seems to be a relationship between income levels and participants' climate change knowledge score with those earning above 1 million Naira reporting a higher overall climate change knowledge score and those earning between 500,000 and 1 million scoring the second highest score.

Table 15 Climate Change Knowledge by Income Distribution

Income							
Indicator	Under 50k	51 to 100k	101 to 300k	301 to 500k	501 to 1m	Above 1m	Overall Average
Information Access	98%	100%	98%	100%	97%	100%	98.9%
Experience	70%	62%	75%	79%	74%	83%	72.0%
Importance	73%	79%	84%	67%	83%	77%	78.3%
Perceived Knowledge	61%	67%	66%	64%	76%	72%	66.4%
Exhibited Knowledge	79%	78%	87%	81%	79%	86%	82.24%
Overall	76%	77%	82%	78%	82%	84%	

The perceived importance of different factors of development was also explored. While respondents scored considerably high in the climate knowledge indicators, the willingness to engage in climate discourse will be influenced by how important they consider climate change to be (Lawal and Oluwatoyin, 2017). The multidimensional development issues characteristic to Nigeria (Lawal and Oluwatoyin, 2017) necessitated the exploration of participants' perception of how important climate change is when compared to other areas of development. Participants were asked to select the top three issues of development they considered most important and the results are summarized, by gender disaggregation in Table 16 below.

Table 16 Development Issue Prioritization by Gender

Most Important Issue	Male	Female
Covid	1.7%	0.0%
Demographic	5.7%	3.4%
Economic	32.0%	14.3%
Education	11.4%	4.0%
Environmental	20.6%	13.1%
Health	22.9%	8.6%
Political	13.7%	5.7%
Poverty	13.7%	5.7%
Facilities	20.6%	13.1%
Security	32.0%	16.6%
Unemployment	13.7%	8.0%
Political	13.7%	5.7%

From the table above, security and economic stability are considered the two most important factors of development by both male and female respondents. Whole health issues were reported as the third most important areas of development for male participants, female participants considered environmental and facilities equally important areas of development. Although there were no follow up questions asking participants to described why they considered these areas important, it is possible that the lower life expectancy of Nigerian men compared to Nigerian females accounted for this perception (Kress, Su, and Wang, 2016). The suggestion by different studies on how vulnerable women are to climate change (Sultana, 2022) is further highlighted by the female respondents' consideration of the importance of environmental issues for development. The descriptive summary of the top three elements of development validates the hypothesis that Nigerian social media users consider other elements of development to be more important than climate change. While climate change is in the top four elements of development considered important, security and economic stability are considered generally the most important areas of development. Therefore, the hypothesis that there is a significant difference between the Nigerian social media users' perceived importance of climate change and other aspects of development, is valid.

➤ *Statistical Analysis of Climate Change Knowledge*

Although the descriptive summaries of the climate change knowledge survey results provided some insight on the general knowledge of Nigerian social media users in the area of climate change, further analysis to understand the statistical significance of gender on different climate knowledge variables was necessary.

From the descriptive summaries, it was seen that perceived climate change knowledge was lower than exhibited climate change knowledge. It was important to test if this was a result of any variations between the perceived and exhibited knowledge of male and females respectively. Figure 29 below shows the results of the test of statistical significance in difference of perceived climate change knowledge between male and female respondents.

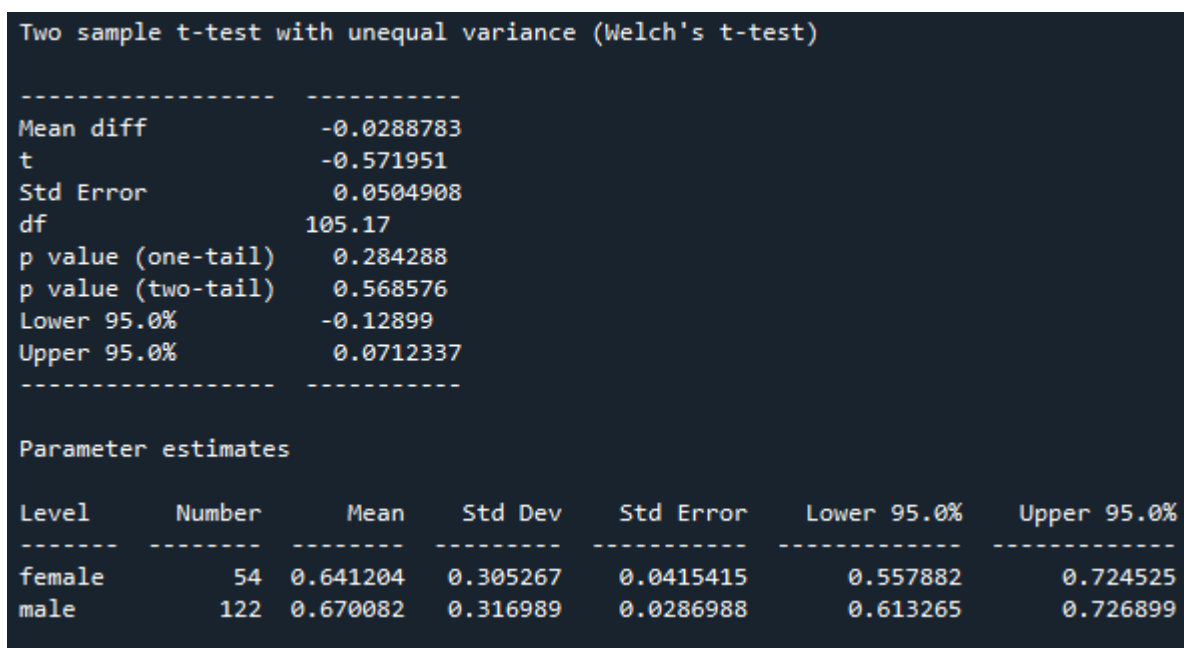


Fig 29 Statistical Test: Gender vs Perceived Climate Change Knowledge

The result of the Welch’s t-test returns a p-value >0.05 showing no statistical significance in the difference between male and female participants’ climate change perceived knowledge.

The Welch’s t-test was also conducted to test the relationship between respondents’ gender and their exhibited climate change score, with the results presented in figure 30 below.

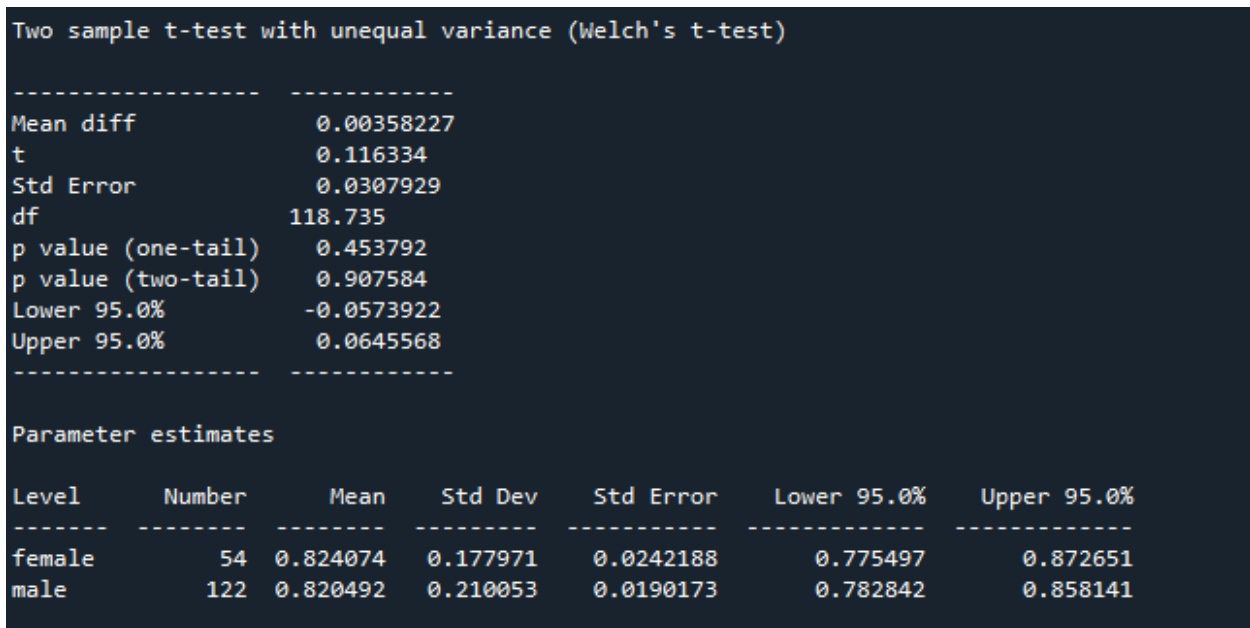


Fig 30 Statistical Test: Gender vs Exhibited Climate Change Knowledge

Like the results of the test of statistical significance in the different between gender and perceived climate knowledge, the result of the Welch’s t-test returns a p-value >0.05 showing no statistical significance in the difference between male and female participants’ climate change exhibited knowledge.

The average climate change experience score for female respondents was 75%, while that of male respondents was 71%. The Welch’s t-test was conducted to understand the statistical significance of this difference and the results are summarized in the figure 31 below.

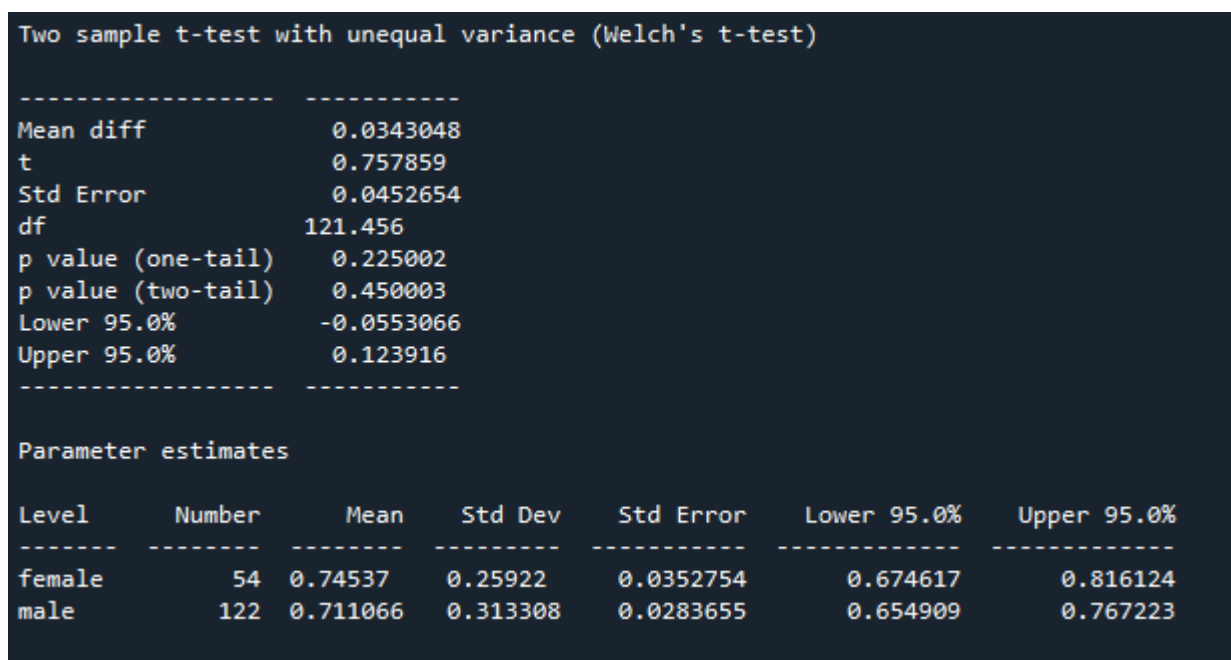


Fig 31 Statistical Test: Gender vs Climate Change Experience

With a p-value >0.05, there is no significant difference between gender and climate change experience.

While climate change perceived knowledge, exhibited knowledge and experience were statistically comparable between male and female participants, the consideration of the importance of climate change by male and female participants was. Figure 32 below shows the results of the statistical test using the Welch’s t-test.

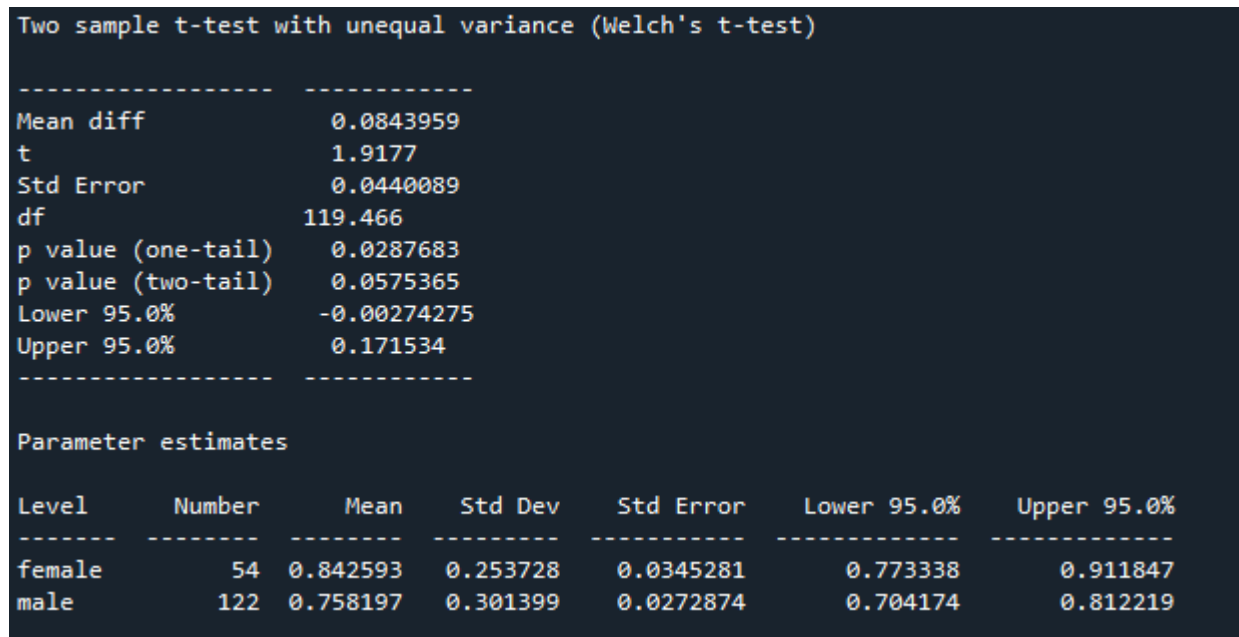


Fig 32 Gender vs Perceived Importance of Climate Change

With a p-value <0.05, the difference between male and female Nigerian social media users’ perception of the importance of climate change is statistically significant. This echoes the highlights in the literature review that suggest the impact of climate change on females (Swinbank, 2021; Sultana, 2022; Sharif, Nasir, Khanum, and Khan, 2016). The result of this statistical test validates the hypothesis that there is a significant difference between the way Nigerian men and women perceive the importance of climate change. Stakeholder Key.

E. Informant Interviews

The stakeholder key informants’ interviews yielded qualitative data, which are textual in nature and may be complex to analyze (Bjornholt and Farstad, 2012). In response to the complexity associated with analyzing qualitative data, a coding framework was used to categorize participants’ responses into different common thematic areas. Coding frameworks are recommended to ease the process of content analysis of qualitative data (Lister, Han, and Bellas, 2021). Based on the transcribed responses of the participants, four broad thematic areas were identified namely: climate change notions, motivations for engagement, contextual relevance, and potential. Tables 17 presents the final coding frameworks for twitter influencers, the public sector key informant, and the private sector key informant. The initial coding framework, which provides the basis for theme identification (Lister, Han, and Bellas, 2021), was based on the direct responses of the participants, and guided the development of the different themes in the final coding framework.

Table 17 Final Coding Framework for Twitter Influencers

Final Coding Framework	Initial Coding Framework
Notions	<ul style="list-style-type: none"> • Perceptions of climate change • Positive perceptions of climate change • Negative perceptions of climate change
Motivation for engagement	<ul style="list-style-type: none"> • Trend • Profitability • Reputation
Relevance	<ul style="list-style-type: none"> • Status quo • Prospects

The result of the final coding framework was a set of themes that guided the analysis of participants responses. The responses of key informants were analyzed along these themes.

➤ *Notions on Climate Change*

The thematic area of climate change notions of the key stakeholders highlights the way stakeholder perceive climate change with respect to their acknowledging the importance of having discussions about climate change. Since the focus of this study was on social media communication of climate change, this thematic area focuses on the notion of key stakeholders with respect to the whether climate change is an important topic of discussion on social media. One of the Twitter influencers, when asked about their general notion of climate change, as a potential subject of discussion stated that while climate change was an important topic, it was not a priority for them. According to this key informant, 'climate change is something that most of my audience acknowledge its existence; the question is 'do they consider it a priority?... I will rather discuss politics and get more engagement than discuss climate change. This negative perception was reflected by the second Twitter influencer interviewed for the study who mentioned that climate change discussions should be left for Non-Governmental Organization who were more knowledgeable and stood to gain more from talking about it since it falls within their mandate. According to this Twitter influencer, "climate change should be discussed by the United Nations and other agencies partnering with Nigeria's Emergency Management Agency" because, "my followers want to engage with more enticing topics".

It appears the stakeholder representing the public sector agreed with the perception of the twitter influencers as they mentioned that climate change discussions were a priority topic of discussion for the government. "We recently made a post on twitter about how we empowered farmers with machinery and skill acquisition for the implementation of sustainable agriculture". The government key informant went further to highlight the importance of promoting the need for community level climate change action on its social media channels.

The key informant from the private sector appeared to take a neutral perspective in expressing their notion about climate change. While they mentioned that the organization engages in corporate social responsibility (CSR), the key informant made effort to link these CSR activities to climate change, even though they were not. "We engage in CSR activities mainly in the area of education by renovating primary schools particularly in areas with high records of out of school children". When further probed if there were any climate change-related criteria informing the selection of schools to be renovated, such requiring schools to include climate-change knowledge as part their curriculum, the key informant explained that while they do not require such criteria, they believe that schools include climate change knowledge as part of their curriculum, therefore, they may indirectly be engaged in climate change action.

➤ *Motivation for Engagement*

Twitter influencers were straight to the point and mentioned that the motivations for them to make any posts, currently and in the future, will be the reward these posts will bring to them either financially, or how it will increase their popularity. "As a businessperson, my twitter account is my brand, and I consider the value each posts I make brings to that brand – either financially or increasing my popularity. Most of the posts I make are sponsored so if I am sponsored to make a post on climate change I will consider". This element of motivation was echoed by the second Twitter influencer who explained that 'money' and "potential for more followers" will make them engage in topics around climate change. "If [mentions the name of a popular Nigerian artiste] starts promoting climate change, then it will seem cool, and positing about it then will increase my popularity". The influencers are passive about engaging in the topic of climate-change and will need some form of incentive to engage in this discussion.

The perception of the government key informant on initiating discussions on climate change was directly opposite to that of the Twitter influencer, because the government agency makes, and will continue to make posts on Twitter about climate change because it "creates information public awareness especially on the SDG ["sustainability development goals"] strides achieved by the government".

The private sector key informant was quite passive in their response highlighting they are open to engage in climate change discussions if these discussions can influence the reputation of the organization. "We operate in a market where our reputation within the community is very important so if climate is considered important by the community, we will engage in climate change discussions through our communication channels.

➤ *Relevance of Climate Change Discourse*

The motivation for engagement on climate change, or any subject, on social media channels is influenced by the stakeholders' perception of the relevance of that subject. One of the Twitter influencers mentioned that "this is not the right time for discussing climate change from my point of view". This was echoed by the second Twitter influencer who explained that the Nigerian audience is more interested in issues of security, economic development, or entertainment. "These are the three trending areas on Twitter and most of my followers will engage in discussion around these topics".

On the contrary, the key informant from the government sector emphasized that the need for public discussion on the topic of climate was "long overdue" because "climate change is connected to all the other development issues we are having". The government key informant gave examples of the role of climate change in security, citing the increase in farmers herders' crisis due to diminishing grazing options for herders.

As with the previous themes, the private sector key informant considers that there is flexibility in their organization's communication strategy and the organization remained open for climate change communication partnerships. However, the organization's consideration of the importance of climate change discussions "will reflect what our communities of interest see as important to them.

➤ *Summary of Key Informants' Interviews*

The content analysis of stakeholders interviewed on the topic of climate change and their generation and engagement of related discussion on their social media outlets shows a notable gap in their notions, motivations, and perceived relevance on the issue. While Twitter influencers will engage in climate change related discussions if it results in financial rewards or more popularity, the government stakeholders engage more on the topics of climate change if it communicates development to the community. Therefore, while Twitter influencers exhibit a passive (or reactive) approach towards the generation and engagement of climate change related discussions on Twitter, the government agency takes an active approach towards climate change. On the other hand, the private sector appears indifferent on the discussion of climate change and will engage on social media posts about the topic if it improves the organization's reputation. A clear variation in the outlook of climate change between public (government), private (business organizations), and community (Twitter influencers) is established therefore, the hypothesis that there is a significant gap in the interest of climate change between Nigeria's public and private sector and community stakeholders, is valid.

F. Results Summary

This chapter presented the results of the quantitative and qualitative analysis performed to respond to test the hypothesis and respond to the research questions. The first section of the presented the findings from the twitter data engagement analysis which showed a significant difference of up to 2000% in the level of engagement between Nigeria's and western countries' twitter communities on climate change topics. While more engagement was observed from western countries' twitter communities, a sentiment analysis using two different methods, namely Textblob and VADER, showed that Nigeria's twitter community had significantly fewer climate change deniers compared to the twitter communities of western countries. Descriptive and statistical analysis of data emerging from a climate change knowledge survey further established that Nigerian social media users are knowledgeable and gave experienced climate change. However, the consideration of the importance of climate change between females and males significantly varied with women have a statistically significant higher level of perception of the importance of climate change. A qualitative analysis of key informants representing stakeholders of climate change communication on Nigeria's social media space shows significant variation in their interests, motivations, and perception of importance of climate change communication on social media.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

A. Overview

There is a growing concern on the impact of climate change in Nigeria, with notable related evidence observed including flooding, desertification, land degradation, expansion of sea level, change in rainfall patterns, and periodic life-threatening weather events, and these trends will only continue to rise (Elisha and Udeh, 2017; Ebele and Emodi, 2016; Olaniyi, Ojekunle, and Amujo, 2013; Enete, 2014; Akande, Costa, Mateu, and Henriques, 2017; Dioha and Emodi, 2018). One of ways to curb the effects of climate change is through an all-inclusive approach to climate action, which requires the contribution of key stakeholders namely public sector (government), private sector, and communities (Costa, Mateu, and Henriques, 2017). Climate change action will be more successful if climate-change communication is implemented (Kalafatis, Carmen, Lo, and Frank, 2015), and the increasing significance of social media as an environment for change-mobilization (Rani, Gill, and Gulia, 2021) necessitates an understanding of the dynamics of the stakeholders in this environment.

Despite evidence of increasing climate change issues in Nigeria and the growing position of Nigeria's social media space as a tool for change highlighted above, there appears to be insufficient creation and dissemination of information and knowledge about climate change through social media platforms in Nigeria. This study investigated the extent to which climate change is discussed on Nigeria's social media space and sought to identify potential solutions to promote engagement key stakeholders for the promotion of climate change communication on social media. Following a deductive approach and using Twitter as the social media platform of interest, the study sought to understand the level of Twitter users' engagement and sentiments on climate change issues.

The study also sought to understand the general level of awareness amongst Nigerian social media users on climate change through a climate change knowledge survey targeting all social media users. To identify a potential entry point for climate change discussion at the community level, the role of gender on climate change was investigated. The understanding of stakeholders' variation in knowledge and perceptions of the importance of climate provided evidence for potential recommendations on ways to improve climate change action through social media driven climate change discussion.

B. Research Hypothesis and Findings

To respond to the research questions and test the hypothesis, different forms of data were generated and analyzed. With the increasing popularity of climate changer deniers' and conspiracy theorist in Western countries like US and UK (Boulianne and Belland, 2022), it was first important to understand if the subject of climate change was considered true by Nigerian social media users. Therefore, the first research hypothesis sought to test the significant difference between the sentiments of Twitter users from Nigeria and Western English-speaking countries. Sentiment analysis of Twitter data from Nigeria and western English-speaking countries of Australia, Canada, UK, and US showed that there was a significant difference between the sentiments of Nigerian twitter users and their western counterpart. A p-value <0.05, shows that the difference between the polarity of tweets from Nigeria's social media space and western countries' social media space is statistically significant.

Although climate change is evidently important, it was necessary to understand the perception of stakeholders on the importance of climate change. Data generated through a climate knowledge survey provided evidence to test the hypothesis there is a significant difference between the Nigerian social media users' perceived importance of climate change and other aspects of development. Through descriptive statistics, it was seen that while Nigerian social media users were aware about the issues of climate change, with an average score of over 85% in exhibited knowledge of climate change, they considered security and economic stability as the most important areas of development, over environmental issues. This validated the hypothesis that despite their knowledge of climate change, it was not a priority are of development for Nigerians.

To understand potential entry points for community level climate change communication, it was important consider the profiles and perceptions of community members who considered climate change to be an important element of development. Previous research has argued the role of gender on the level of climate change-impact (Swinbank, 2021; Sultana, 2022; Sharif, Nasir, Khanum, and Khan, 2016), therefore, the second hypothesis postulated that there is a significant difference between the way Nigerian men and women perceive the importance of climate change.

To design effective social media driven climate change communication strategies that are all encompassing, the current practices of key stakeholders from public, private and community, were identified and owing to the different interests and responsibilities, it was hypothesized that there is a significant gap in the interest of climate change between Nigeria's public and private sector and community stakeholders. A qualitative analysis of key informants representing stakeholders of climate change communication on Nigeria's social media space shows that government, private sector, and community stakeholders held significantly different views of the need and relevance of climate change discussions on Twitter. However, the identified motivations for other discussions provided evidence for potential recommendations to improve climate change communication on Nigeria's social media space.

C. Recommendations

The significance in difference between Nigerian social media users' perception of the climate change identified through the sentiment analysis shows that compared to western country social media, Nigerian social media users have a more positive perception on the importance of climate change. However, they consider other elements of development, such as security and economic stability to be more important than climate change. With the government stakeholders actively willing to engage in the discussion of climate change and Twitter influencers ready to engage in any conversation provided they are incentivised, it is recommended that the government partners with Twitter influencers to create climate change contents that are "cool" and can attract the engagement of Nigeria social media users.

Furthermore, female social media users should be considered as the entry point for climate change interaction on social media space. The engagement of private sector actors on the topic of climate change is reactive and driven by what communities engage in therefore, an implementation of strategies that draw the participation of communities in the climate change discussion and improves their consideration of its importance, will contribute to improved climate change communication on Nigeria's social media space.

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APPENDICES

APPENDIX 1

Climate Change Survey

Welcome to this study on the climate change communication.

The aim of this study is to investigate the extent to which climate change is discussed on Nigeria's social media space and identify potential solutions to promote engagement of Nigerian social media users on the topic of climate change. You are invited to participate in this climate change knowledge survey because you are a social media user.

The data will be analyzed quantitatively and will contribute to knowledge in the field of climate change communication. Your participation and contribution to this study is highly appreciated.

Please note that there are no risks associated with your participation in this survey and it will take less than 15 minutes to complete.

Your confidentiality is ensured as all data collected during this survey remains anonymous and the researcher of the study, Caleb Terhemba Ikyernum, is a Master's student of Robert Kennedy College. The research advisor is Patrick Reid.

Your response to this survey is completely voluntary and you may withdraw at any point during the process, by closing the webpage.

Thank you very much.

CLICK NEXT TO PROCEED

CONSENT

WILL YOU BE WILLING TO PARTICIPATE IN THIS SURVEY?

Yes

No

CLIMATE CHANGE KNOWLEDGE

HAVE YOU EVER HEARD THE TERM "CLIMATE CHANGE"?

- Yes
- No

WOULD YOU SAY YOU UNDERSTAND WHAT "CLIMATE CHANGE" MEANS?

- Yes
- No

WHERE HAVE YOU EVER HEARD THAT THE EARTH'S CLIMATE OR ITS WEATHER PATTERNS ARE CHANGING?

- TV
- Internet
- At School
- Social Media
- Parents or Neighbors
- Movie
- Other Family
- Radio
- Workplace
- Newspapers
- From children or young people
- Other
- Difficult to Answer

Have you noticed changes in the following yearly weather patterns?

MORE RAIN OR LESS RAIN

- Yes
- No
- Difficult to Answer

HOTTER DAYS OR NIGHTS

- Yes
- No
- Difficult to Answer

STRONGER WINDS

- Yes
- No
- Difficult to Answer

MORE OR LESS DUST DURING HARMATTAN

- Yes
- No
- Difficult to Answer

How well informed are you about

<p>WHAT IS CAUSING THE CLIMATE TO CHANGE?</p> <p><input type="radio"/> Very well informed</p> <p><input type="radio"/> More or less informed</p> <p><input type="radio"/> Not really informed</p> <p><input type="radio"/> Difficult to Answer</p>	<p>POSSIBLE EFFECTS OF CLIMATE CHANGE?</p> <p><input type="radio"/> Very well informed</p> <p><input type="radio"/> More or less informed</p> <p><input type="radio"/> Not really informed</p> <p><input type="radio"/> Difficult to Answer</p>
<p>WHAT CAN BE DONE TO PROTECT YOURSELF AND YOUR FAMILY FROM CLIMATE CHANGE?</p> <p><input type="radio"/> Very well informed</p> <p><input type="radio"/> More or less informed</p> <p><input type="radio"/> Not really informed</p> <p><input type="radio"/> Difficult to Answer</p>	<p>WHAT CAN BE DONE TO REDUCE CLIMATE CHANGE?</p> <p><input type="radio"/> Very well informed</p> <p><input type="radio"/> More or less informed</p> <p><input type="radio"/> Not really informed</p> <p><input type="radio"/> Difficult to Answer</p>

Respond to these statements

<p>CLIMATE CHANGE WILL CHANGE TEMPERATURE AND RAINFALL NOW/IN THE FUTURE GLOBALLY</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>	<p>CLIMATE CHANGE AFFECTS WEATHER AND CLIMATE GLOBALLY</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>
<p>CLIMATE CHANGE CAUSES INCREASES IN AIR TEMPERATURE</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>	<p>CLIMATE CHANGE CAUSES MELTING OF ICE CAPS AT THE POLES</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>
<p>CLIMATE CHANGE CAUSES MORE DROUGHT OR FLOOD CONDITIONS</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>	<p>CLIMATE CHANGE IS RESPONSIBLE FOR MORE HURRICANES AND STORMS</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>
<p>CLIMATE CHANGE ARE JUST NATURAL CHANGES</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>	<p>CLIMATE CHANGES ARE ACTS OF GOD</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>
<p>CLIMATE CHANGES ARE CAUSED BY PEOPLE'S USE OF ELECTRICITY AND BURNING OF FUELS</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>	<p>CLIMATE CHANGES ARE CAUSED BY PEOPLE CUTTING DOWN TREES</p> <p><input type="radio"/> Yes</p> <p><input type="radio"/> No</p> <p><input type="radio"/> Difficult to Answer</p>

What's Important?

LET US SAY "CLIMATE CHANGE" REFERS TO "CHANGES IN WEATHER PATTERNS OVER TIME". BASED ON THIS MEANING AND YOUR OWN OBSERVATIONS, HOW IMPORTANT A PROBLEM DO YOU THINK CLIMATE CHANGE IS AT THIS MOMENT FOR YOUR CITY OR VILLAGE? (1 IS "NOT IMPORTANT AT ALL" AND 3 IS "EXTREMELY IMPORTANT")

- 0
- 1
- 2
- 3

WHAT DO YOU CONSIDER THE THREE MOST IMPORTANT ISSUES IN YOUR COMMUNITY?

- Coronavirus pandemic (incl, vaccination)
- Demographic issues (including migration, high birth rates, family separation)
- Economic issues (including inflation)
- Education
- Environmental issues and climate change (incl. floods, drought)
- Health care systems
- Political instability
- Poverty and social issues
- Public facilities (including water, road, electricity)
- Security issues (incl, Police brutality, banditry, religious extremism)
- Unemployment

LOCATION

COUNTRY

- Nigeria
- Other

CONTINENT

- Africa
- Asia
- Ausaralia and Oceania
- Europe
- Middle East
- North America
- South America

STATE

- | | | |
|--------------------------------|-------------------------------|-----------------------------------|
| <input type="radio"/> Abia | <input type="radio"/> Adamawa | <input type="radio"/> Akwa Ibom |
| <input type="radio"/> Anambra | <input type="radio"/> Bauchi | <input type="radio"/> Bayelsa |
| <input type="radio"/> Benue | <input type="radio"/> Borno | <input type="radio"/> Cross River |
| <input type="radio"/> Delta | <input type="radio"/> Ebonyi | <input type="radio"/> Edo |
| <input type="radio"/> Ekiti | <input type="radio"/> Enugu | <input type="radio"/> Gombe |
| <input type="radio"/> Imo | <input type="radio"/> Jigawa | <input type="radio"/> Kaduna |
| <input type="radio"/> Kano | <input type="radio"/> Katsina | <input type="radio"/> Kebbi |
| <input type="radio"/> Kogi | <input type="radio"/> Kwara | <input type="radio"/> Lagos |
| <input type="radio"/> Nasarawa | <input type="radio"/> Niger | <input type="radio"/> Ogun |
| <input type="radio"/> Ondo | <input type="radio"/> Osun | <input type="radio"/> Oyo |
| <input type="radio"/> Plateau | <input type="radio"/> Rivers | <input type="radio"/> Sokoto |
| <input type="radio"/> Taraba | <input type="radio"/> Yobe | <input type="radio"/> Zamfara |

CITY/TOWN/VILLAGE

Sex and Age

SEX

- Male
- Female

AGE

- Less than 18
- 18 to 25
- 26 to 35
- 36 to 45
- 46 to 55
- Above 55

WHICH OF THESE DO YOU USE AT LEAST ONCE A WEEK?

- Facebook
- Instagram
- Tik Tok
- Twitter
- WhatsApp

Education and Employment

WHAT IS YOUR HIGHEST EDUCATIONAL QUALIFICATION

- Secondary
- Bachelor or equivalent
- PGD
- Masters (ongoing)
- Masters (completed)
- PhD (ongoing)
- PhD (completed)

EMPLOYMENT STATUS

- Student
- Employee
- Self-Employed
- Unemployed

WHAT IS YOUR MONTHLY INCOME?

<input type="radio"/> Below 150k	<input type="radio"/> 151k to 500k	<input type="radio"/> 501k to 1 million
<input type="radio"/> 1.1 to 5 million	<input type="radio"/> 5.1 to 12 million	<input type="radio"/> Above 12 million

APPENDIX 2

Checklist of Ethical Principles for Research

Please tick

1. Accountability

- Are there clear potential benefits?

- Are there procedures for obtaining written informed consent? If not, please explain:

YES

NO

Comments.....

- a. Twitter data will be mined from the using the Twitter API. While there is no informed consent for each record (which represents a tweet/person’s opinion, all usernames will be kept anonymous.
- b. For the questionnaire survey, participants will be provided an informed consent form at the beginning of the survey and they can opt to continue by consenting to the informed consent however, if they do not consent to the survey, they can opt out.
- c. For the Key informants interview, participants will be informed of the purpose of the study and asked to confirm/consent their willingness to participate. On the day of the interview, before commencing the main questions of the interview, all key informant will still be informed of the purpose of the interview and asked to consent that they are willing to continue.

...

2. Confidentiality

- Are there arrangements for ensuring anonymity?
If not, please explain the nature of confidentiality
protection of participants and institutions

YES

NO

Comments...

- a. All twitter data used for the study will exclude username and handle names, which are the identifiable parameters in any twitter dataset. Data related to handle names will be codified as USER_REF
- b. For the questionnaire survey, participants’ personal identifiable information (PIIs) will not be collected during this assessment therefore ensuring that participants remain anonymous. Since the questionnaire is published online, and the link disseminated

through social media platforms, the researcher will also not be aware of the identity of the participants who participated.

- c. The Key Informants will be informed that their personal identities will be kept confidential and no information about their personal identity will be published in the study.

3. Anti-Discriminatory

YES

NO

- Does the project demonstrate sensitivity to differences reflecting legislative statements

Comments.....
.....

4. Reciprocal

YES

NO

- Is the research mutual in its benefit and value to participants and researchers

Comments.....The issue of climate change affects everybody, making everybody a stakeholder in climate adaptation. This research will be beneficial for Nigerian climate change communication stakeholders as it will highlight the extent to which climate change is communicated through social media, and the need, if any, for improvement.....
.....

5. Empowering – Human Rights

YES

NO

- Are participants given the freedom to express their needs including the right to refuse or withdraw participation?

Comments.....

- a. **Twitter Data:** Users consent that their tweets can be accessible to the public and anybody can view and interact with their tweets. <https://help.twitter.com/en/safety-and-security/public-and-protected-tweets>
- b. **Climate Change Knowledge Questionnaire Survey:** Users are allowed to decline to participate and are informed of their rights to opt out of the survey at anytime they feel like.
- c. **Key Informants Interview:** participants will be informed of their rights to continue with the interview and to opt out at any time they feel like.

6. Honouring Professional Values – peer review

YES NO

- Does a professional code of conduct apply? YES NO
- If so, is it explicit in the research methodology? YES NO
- Has the project already been peer-reviewed? If so, by whom, and what was the outcome? YES NO

Comments.....
.....

7. Accessible

YES NO

- Is there a plan to make the results available and disseminate them in the public domain, particularly to stakeholders? YES NO

Comments.....The objective of this study if for academic purposes and will be shared with University of Cumbria
.....

8. Challenging

YES NO

- Is the research seeking new knowledge and or insights? YES NO

- How is it doing this?

Comments.....The research is not just investigating the engagement and sentiments of social media users but is further trying to understand the knowledge level of social media users and question the possibility that engagement levels could be related to knowledge level, and not simply a result of lack (or presence) of interest in the topic

9. Appropriate use of Funding -

YES NO

- Could there be any conflict of interests?

Comments.....
.....

10. Responsible

YES NO

- Is there a plan for the conduct of the research which ensures responsible behaviour?
- Are issues of Health and Safety considered
- Is the proposed analysis appropriate to the data?

Comments.....
.....

Title of Project: Cultural Perspective on Climate Change: Engagement and Sentiment Analysis on Nigeria’s Social Media Space

Name of Researcher:...Caleb Terhmba Ikyernum.....

Name of Supervisor:.....Patrick Reid.....

Signature of Supervisor:..... *Prashant Nair*

Date:.....22nd April 2023.....

Tickbox Checklist Present Absent N/A

Tickbox Checklist	Present	Absent	N/A
Informed consent form	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Written information sheet	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Indemnity signed	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Data protection	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Child protection documentation	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Risk assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Consent confirmed in writing	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

APPENDIX 3



Research Ethics Application for Taught Degree (Bachelors & Masters) students

Application for study involving Human Participants

NB: This form should be approved by your supervisor. The form is designed as a discussion document as well as a record of ethical approval. Please ensure you have carried out a [Privacy Impact Assessment](#) if your project involves collection of personal data.

All fields will expand as required.

1. Title of Project: Cultural Perspective on Climate Change: Engagement and Sentiment Analysis on Nigeria's Social Media Space
2. As this a student project, please indicate type of course you are on by ticking/ highlighting the relevant box: <input type="checkbox"/> BSc <input type="checkbox"/> BA <input checked="" type="checkbox"/> MSc <input type="checkbox"/> MA <input type="checkbox"/> MBA <input type="checkbox"/> PgC <input type="checkbox"/> PgD
3. Type of study: please indicate type of study you are on by ticking/ highlighting the relevant box: <input type="checkbox"/> Involves direct involvement by human subjects <input checked="" type="checkbox"/> Involves existing documents/anonymised data only.

4. Name of applicant (the student): Caleb Terhembra Ikyemum
5. Your project supervisor(s) Name(s): Patrick Reid E-mail(s): patrick.reid@rkc.edu

6. Provide a concise summary of your research project in lay terms (maximum length 150 words). What are you planning to do? The project seeks to understand the level of climate change information dissemination and discussion on Nigeria's Twitter space and the knowledge of the average Nigerian in the topic of climate change. Understanding the importance of climate change knowledge on the level of interest and confidence of social media users to engage in the discussion, this research seeks to understand
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how much Nigerian's talk about climate change on social media, how knowledgeable they are about the topic and how government, private sector stakeholders, and social media influencers promote the discussion of climate change adaptation on Nigeria's Twitter space.

7. Describe the **sample of participants** (including for example, number, age, gender).

Twitter Data:

The sample of 'participants' in the twitter sentiment analysis comprises registered Twitter users who have made their contents publicly accessible. 30,000 tweets from Nigeria, United States of America and England were used for the engagement and sentiment analysis. These comprised tweets related to climate change discussions posted by users from 21 to 26 May 2023. Additionally, 10,000 tweets on hashtags related to poverty in Nigeria were streamed to enhance the engagement analysis.

Climate Change Knowledge Survey: 200 respondents

A sampling frame aged between 18 to 65 years residing in different cities across Nigeria will be included in the study and a random sample of **200** respondents will be targeted for the study selected from different places of worship, government offices and academic institutes in the Federal Capital Territory of Nigeria.

Stakeholders (Key informants) interview: - 4 (four) key informants

- Twitter Influencers: 2 (1 male and 1 female)
- Government Agency Management Level Staff: 1 (female)
- Private Sector Communications Personnel: 1 (male)

8. Explain concisely how you will **recruit the participants** (be specific).

Twitter Data:

The Tweepy Python Library will be used to mine tweets related to the climate change hashtags

Climate Change Knowledge Survey:

The survey will be hosted electronically using the Enketo form technology, which allows participants access surveys online from anywhere and archives their responses on a dedicated database. The link to the survey is: <https://enketo.ona.io/x/6zX4feQ1>, and participants will be invited to participate by posting this link on various social media spaces with Nigerian users including Facebook, Twitter, Instagram, and WhatsApp

Stakeholders (Key informants) interview:

Emails will be sent to the key informants inviting them to participate in the study; direct messages will be sent to the key informants (the two Twitter influencers) who can easily be reached through their social media platforms.

9. Explain concisely how you **obtain informed consent from participants**. You need to ensure it is easy for people to withdraw consent and tell them how.

Twitter Data

One ethical concern emerges due to the inability of the researcher to share an informed consent form to each user whose tweet was streamed. However, this ethical issue is overcome considering that Twitter discloses that all content posted on the platform may be used for research and marketing purposes and allows users to set their tweets as either private or public mode (<https://twitter.com/en/privacy>; <https://help.twitter.com/en/safety-and-security#ads-and-data-privacy>; <https://help.twitter.com/en/safety-and-security/how-to-make-twitter-private-and-public>).

Climate Change Knowledge Survey:

The introductory part of the survey is an informed consent form that allows participants to confirm if they are willing to participate in the study. The informed consent discloses the purpose of the survey including the fact that participants records will remain anonymous thus ensuring the data collection process via the tool remains ethical and all participants' rights are protected. Through the informed consent, the procedure of data collection is disclosed and participants are informed that they can opt out of the survey at any time they want to. As a means of safeguarding the participants, the "demographic" section of the survey is placed at the end of the tool and participants are informed prior to this section that the data will help the research classify their answers.

Stakeholders (Key informants) interview:

Key informants will be informed of the purpose of the study and asked to confirm and provide consent their willingness to participate in the interview by responding to the email and direct message. On the day of the interview, before commencing the main questions of the interview, all key informants will again be informed of the purpose of the interview and asked to consent that they were willing to continue. The researcher will also inform these participants that they can decline to respond to any question or even opt out of the interview at any point.

10. Explain how you will **maintain data protection**. State what personal and/ or sensitive data you may collect and how this will be stored (see guidance [UK General Data Protection Regulations \(GDPR\)](#)).

Twitter Data

Twitter data contains personal identifiable information of users, such as username, and locations, and such information raises ethical issues as the tweets can easily be linked to the users. In response to this ethical concern, all twitter data used for the study will exclude username and handle names, which are the identifiable parameters in any twitter dataset. Data related to handle names will be codified as handle_ref and data on usernames will codified as user_ref. Data will be archived only on the local machine of the researcher and destroyed after the results of the dissertation are released.

Climate Change Knowledge Survey:

No personal identifiable information about participants will be collected. The tool is an online based tool and all information collected is anonymous and cannot be traced to any participant.

Stakeholders (Key informants) interview:

All participants’ identities will be kept anonymous and confidential, and no information about them will be revealed in the research output. Data will be deleted after award of the degree.

11. Explain concisely how you will offer **review opportunities**, a debrief or, follow up for participants (as appropriate).

12. Briefly describe each of your **data collection and analysis methods** (you may just have one method)

Method 1

Twitter Data Mining: The Tweepy Python Library will be used to mine tweets related to the hashtags and sentiment analysis will be conducted using Python's Natural Language Processing Tool Kit (NLTK). One technology that has been used for mining data from twitter is the Tweepy Library (Shelar and Huang, 2018). Python’s Tweepy library is an open-source library, that makes it possible


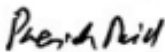
	<p>for python to interact with Twitter’s Application Programming Interface (API) for the purpose of capturing current and historical Twitter data (Sourav, Arijit, Varma and Tiwari, 2018). The Tweepy library allows developers to specify the parameters of a tweet to include in the dataset, including username, location, account creation date, tweet, number of followers, number of tweets, and verification status (Shelar and Huang, 2018).</p>
Method 2	<p>Climate Change Knowledge Questionnaire: A questionnaire was designed to understand the awareness levels of the participants about climate change. This questionnaire, coined the Climate Change Awareness Tool (CCAT), is coined from the UNICEF Climate Change Knowledge Survey (Armenia) contextualized to Nigeria (for example, snow is switched for harmattan). The CCAT also includes questions on participants’ choice and frequency in social media use. The data emanating from the implementation of the CCAT is quantitative in nature and can be analyzed using descriptive and inferential statistics.</p>
Method 3	<p>Stakeholders’ (Key informant) interviews: Three categories of key informants representing the stakeholder groups in Nigeria’s social media continuum for climate change are interviewed for the study. The interviews are delivered in a way to instigate open ended interactions between the researcher and the key informant. Therefore, the interview questions will serve as starting points to</p>

	understand the stakeholders’ level of social media communication in the topic of climate change.
Method 4	

13. Risks	Explain any risks that your research participants might face because of the research project (this might include psychological and reputational risks)	Describe how you will control the risks you have identified
1	Users’ personal opinions may be used against them.	All data will be anonymized to ensure confidentiality.
2		
3		
4		

14. Other ethical considerations
Explain any risks that you may face as a researcher, and what steps you will take to control them. NIL
Explain briefly any benefits that your research participants may gain from participation. The issue of climate change affects everybody, making everybody a stakeholder in climate adaptation. This research will be beneficial for Nigerian climate change communication stakeholders as it will highlight the extent to which climate change is communicated through social media, and the need, if any, for improvement
Explain briefly how you will collect each type of data– such as hard copy paper / digital / audio / video.
State a date when you will destroy by shredding, burning or deletion your data files. Note: this should be after the award of a confirmed grade for your degree. All data will be deleted after award of the degree.
15. Check you have considered each issue below and fully explained it in your application, then put x in the box

I have identified and taken steps to control any physical, emotional or psychological risk to participants	Yes
I have identified and taken steps to control any cultural offence that might be caused	Yes
I have identified any vulnerable groups involved and taken steps to control the risks	Yes
I have explained how I will get permission from managers to recruit participants on their premises	Not Applicable
I have made clear that no deception is involved in the study	Yes
I have explained the level of anonymity for participants and how it will be maintained	Yes
I have explained how participants will be informed and have the chance to ask questions beforehand	Yes
I have explained how participants may make follow up enquiries after their part in the study	Yes
I have explained how data will be kept secure and destroyed after the study	Yes

16. Role	Name	e-Signature	Date
You (Student)	Caleb Ikyemum		16 April 2023
Your Supervisor	Dr Patrick Reid		24 th April 2023

Supportive Materials Checklist

Please attach all necessary supportive materials and indicate in the checklist below.

Supportive Material	Version and Date
Research protocol or research proposal	
Participant Information Sheet	
Debriefing Sheet	
Consent Form	
Letter of invitation	
Other (such as interview schedule, questionnaires, measures: please state, and explain)	<ul style="list-style-type: none"> • Link to Questionnaire: https://enketo.ona.io/x/6zX4feQ1 • Key informant interviews will be open ended discussions around the theme of climate change communication, its importance,
	and ways to improve engagement of stakeholders on the topic of climate change

APPENDIX 4

INVITATION LETTER – KEY INFORMANTS

Dear BB (Participant's Name),

I trust this finds you well.

My name is Caleb Terhemba Ikyernum, a student of Robert Kennedy College and I am conducting interviews as part of a research study to understand the level of climate change discussion amongst social media users and influencers like yourself. The results of this study will help improve stakeholders' participation in climate change communication.

As a social media influencer (communications specialist with XX company; director with XX government institution), I believe you are in the best position to offer valuable information from your own experience.

This interview is informal and should take about 30 minutes during which I will simply be trying to get your own perception on this subject.

Your identity and responses to the questions will remain confidential, and no information about you will be revealed in the research output.

There will be no remuneration for participating in this study nevertheless, your contribution to this study will be highly valuable and better coordination of climate change discussion through effective media spaces.

However, you can decline to participate in this research or choose to discontinue at any time during the interview.

Kindly respond to this message confirming your willingness to participate in the research.

Thank you and waiting to hear from you.

-Caleb

APPENDIX 5

LIST OF ANALYSIS FILES

https://drive.google.com/drive/folders/1KsSGkcM6HqcG1kF1fVvjTKNdZtM8bUW-?usp=share_link