CLIMATE CHANGE IN NIGERIA: ASSESSING POLICY AND PRACTICE FOR COMMUNITY RESILIENCE

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A thesis submitted in partial fulfilment of the requirement of Teesside University for the degree of Doctor of Philosophy

April 2021

Declaration

This dissertation is the result of my own work and includes nothing, which is the outcome of work done in collaboration. It has not been previously submitted, in part or whole, to any university or institution for any degree, diploma, or other qualification.
In accordance with Teesside University School of Health and Life Science guidelines, this thesis does not exceed 47,969 words, and it contains less than 150 figures.

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ACKNOWLEDGEMENTS

I am glad to acknowledge the following people whose contributions provided assistance and support for the completion of this thesis.
Thank you to my supervisors Dr Tracey Crosbie, Dr Komang Ralebitso-Senior and Garry Evans for supporting me that one cannot express in writing; giving me guidance, offering advice, finding time regardless of their tight schedules, and effecting corrections where necessary throughout the duration of my study. I am grateful.
I also extend my thanks to my friends and colleagues for making my study worthwhile with their constructive debates and discussions during our time spent together.

To my husband Owoicho Ogah, thank you so much for always believing in me even in the face of difficulties. Thank you for constantly challenging me to every task that I face and making me know that I can make it through any circumstance. Thank you for sacrificing so much to sponsor this programme. I love you and am forever grateful. To my lovely daughters Ehi Ogah and Oyine Ogah, thank you for being such a blessing to my life.

I must acknowledge and be greatly indebted to all the authors and researchers whose material and words I used to enrich my work. My profound gratitude goes to my family, friends and all whom in one way or the other contributed their quota to the realisation of this dream of mine.

I like to appreciate all the participants that took part in this research - thank you.

My deepest gratitude goes to my God and maker for the grace to finish this programme. Thank you for sustaining me throughout this study. I am very grateful.

ABSTRACT

Aim: This research aims to inform the development and implementation of policies to support community resilience in the face of climate change.

Background: Climate change events such as heavy rainfall, flood, storm, drought, heat wave and sea level rise are affecting many parts of the world. Hence, the concept of community resilience towards climate change has received a great deal of attention from researchers and policy makers. However, there is no clear definition of community resilience and therefore disagreement about the methods of achieving it. The perplexity associated with the definition and measurement of community resilience has also made assessing the efficiency of the policies addressing community resilience problematic.

Methods: The research process was made up of four stages. An initial literature review, a systematic literature review to address specific research questions related to how community resilience is conceptualised and measured and a Grounded Delphi Method (GDM) study. The latter focused on how experts in Nigeria define community resilience and how it should be measured in the context of developing countries. The GDM study consisted of interviews with 21 relevant Nigerian experts and two rounds of surveys to gain a consensus on the definition of community resilience and how it can be measured. Participants in the GDM study were recruited via snowball sampling.

Finding: The initial literature review presented in this thesis identified policies designed to support community resilience in Nigeria. It also identifies a lack of clarity in the definition of community resilience and methods applied to measure levels of community resilience. The systematic review identified three distinct ways that community resilience is conceptualised namely coping, adaptive and transformative capacity. The findings from the systematic review and the GDM study suggest that these different capacities represent a process of stages from coping to adaptation to climate change through to transformation in the face of climate change that communities need to go through to become resilient to climate change. This research also identified indicators, categorised under eight elements, for measuring community resilience at the different stages of this process focusing on those that are most relevant to reducing the effects of climate change in developing countries. It is important to note that the experts in Nigeria do not include the concept of transformation in their conceptualisation of community resilience illustrating a gap in their perceptions of the requirements related to how communities become fully resilient. However, it is accepted that, some of the indicators identified in the systematic literature review are not currently applicable to low income countries such as Nigeria due to the stage at which communities are in terms of the process of becoming resilient and limited funding. As such this research identified elements and indicators relevant to developing countries that can be prioritised for measuring the effectiveness of current policies designed to support community resilience to climate change.

Conclusion: This research provides a method of prioritising specific, measurable indicators to inform policies designed to reduce the impacts of climate change by supporting community resilience in the context of developing countries with limited funding. The findings also suggest that the lack of empirical research into the impact of current policy on levels of community resilience at the national, regional and local scales is limiting the usefulness of the concept of community resilience in policies designed to help communities deal with climate change.

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LIST OF ABBREVIATIONS AND ACRONYMS

BRIC	Baseline Resilience Indicator for Indicators
BNRCC	Building Nigeria's Response to Climate Change
CART	Community Advancing Resilience Toolkit
CCR	Coastal Community Resilience
CDM	Clean Development Mechanism
CDRI	Community Disaster Resilience Index
COP	Conference of the Parties
CRDSA	Community Resilience to Disaster in Saudi Arabia
CRI	Community Resilience Index
DROP	Disaster Resilience of Place
FCTEMA	Federal Capital Territory Emergency Management Agency
GDM	Grounded Delphi Method
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GNI	Gross National Income
IFRC	International Federation of Red Cross
INDC	Intended National Determinant Contribution
IPCC	Intergovernmental Panel on Climate Change
IQR	Interquartile Range
NAPA	National Adaptation Programme of Action
NASPA-CCN	National Adaptation Strategy and Plan of Action on Climate Change for Nigeria
NEEDS	National Economic Empowerment and Development Strategy
NEMA	National Environmental Management Agency
NCCP-RS	National Climate Change Policy Response and Strategy
NPCC-RS	National Policy on Climate Change Response and Strategy
PCA	Principal Component Analysis
ResilUS	Resilience United State
RIM	Resilience Inference Measurement

SCCU	Special Climate Change Unit
SD	Standard Deviation
SEEDS	State Economic Empowerment and Development Strategy
THRIVE	Toolkit for Health and Resilience in Vulnerable Environment
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WA	Weighted Average
WHO	World Health Organisation

1 Introduction

1.1 Introduction

The aim of the research presented in this thesis is to inform the development and implementation of policy to support community resilience in the face of climate change in developing countries. This chapter outlines the background, focus of the research and the research aim and objectives. It also presents a summary of the research methods used, their relationship with theory, and the relevance of the research to policy and theory debates. The chapter concludes with a description of the contents of the subsequent chapters of the thesis.

1.2 Research Context

1.2.1 Background

Climate change events such as heavy rainfall, floods, storms, drought and heat waves are affecting many parts of the world (Vogel and Henstra, 2015; Bushell *et al.,* 2017; Nkoana *et al.,* 2018). The impact of any given shock at the community level is determined by the magnitude of the hazard combined with the community's vulnerability to that shock and their capacity to withstand it. In the most catastrophic cases, a shock can completely overwhelm a community to the point of collapse. Some studies (Adger *et al.,* 2003; IPCC, 2007; Wood *et al.,* 2014; Mulligan *et al.,* 2016; Miah *et al.,* 2017) have found that the impacts of climate change vary according to geographical locations as some regions will be affected more negatively than others. It has been acknowledged that the impacts of climate change at the community level are linked to the vulnerability to the shock and resilience capacity of the affected individuals (Schwarz *et al.,* 2011; Proag, 2014; Tambo, 2016; Barret and Bosak, 2018). Notwithstanding this, it remains unclear why some cities and communities are more

resilient than others or why a shock could completely overwhelm a community to the point of collapse in the most catastrophic case.

Studies addressing these issues are increasing and research has focused on identifying the interplay between policies and community resilience (Wilson, 2013; Matthews and Baker, 2019). In fact, in the last twenty years (2000 – 2020), research on disaster management organisations have sought ways to reduce vulnerability and build resilience (Cutter *et al.,* 2008; Tompkins *et al.,* 2010; Ford *et al.,* 2013; Imperiale and Vanclay, 2016; Toseroni *et al.,* 2018). It is also acknowledged that adaptation and mitigation have been very slow to transition from theory to practice due to many questions around policy activities (Schipper *et al.,* 2012). Nonetheless, there are widely referenced examples of policy actions on adaptation (Ford and Berrang-Ford, 2015; Sherman *et al.,* 2016) and mitigation (Brechin, 2016). This has led governments, policy makers, industries and stakeholders to design policies to support community resilience (Feliciano *et al.,* 2014; Rykkja *et al.,* 2014; Saunders and Becker, 2015; Campos *et al.,* 2017; Pietrapertosa *et al.,* 2017; Sian Ng *et al.,* 2017), and propose actions that mitigate or facilitate adaptations to deal with the negative impacts of climate change on communities (Puppim de Oliveira, 2009; Barua *et al.,* 2014; Gillard *et al.,* 2017).

Following the arguments above, it is unsurprising that the concept of community resilience has received a great deal of attention from researchers, as well as policy makers (Norris *et al.,* 2008; Cutter *et al.,* 2014; Sharifi, 2016; Summers *et al.,* 2017; Rus *et al.,* 2018). However, there is no clear definition of community resilience and therefore there are no clear methods for its assessment. If we cannot define and measure community resilience, how can we learn from the impact of policies and understand what is working and what is not. Without measurement and study there is no learning and without learning there is no forward progress other than what might occur accidentally. The research presented in this thesis explores how we might define and measure community resilience in order to

inform the development and implementation of policy to support community resilience in the face of climate change.

1.2.2 Research Focus

The subject of climate change and its impact, particularly in developing African countries such as Nigeria, have taken centre stage in contemporary political economic discourse *(*Parry *et al.,* 2001; Ikeme*,* 2008; Ogbuabor and Egwuchukwu, 2017; Choko *et al.,* 2019). Climate change is posing complex problems that far outweigh solutions suggested by conventional analytical tools traditionally used for guiding responses to major environmental challenges.

Climate change impacts is significant on developing countries, including the natural resources they own and rely on, not because of the differences in projected changes but because of vulnerability and adaptive capacity which vary across countries and regions (IPCC, 2007). Developing countries are more vulnerable and most affected by the impacts of climate change, due to their Gross Domestic Product (GDP), Gross National Income (GNI) and high dependence on agriculture which is a climate sensitive sector (IPCC, 2014). Also, there is a high number of poor people, who are more vulnerable and will feel the effects of climate change in these countries (Yohe and Tol, 2002). Also, vulnerability to climate change seems to be very high in African countries, as 33 of the 59 vulnerable countries to climate change are in this continent (Brooks *et al.,* 2005). Most African countries are in the sub-tropical area where natural climate variability is high.

Nigeria is situated in the West African region along the Atlantic Ocean's Gulf of Guinea. It lies roughly between Latitudes 4^{O} and 14^{O} North and Longitudes 3^{O} and 15^{O} East and has a land mass of 923,768 km^2. Nigeria has a warm typical tropical climate with relatively high temperatures and two seasons (dry and wet), with the wet season lasting from April to October and the dry season from

November to March. The maximum temperature in the coastal areas of the south is 37°C while the minimum temperature is 10°C. The climate is dryer further north where extremes of temperature ranges from 35°C to 60°C are common. A major feature of Nigeria's coastal and marine environment is the Niger Delta, which covers an average area of 70,000 km^2, making it one of the largest wetlands in the world. The country's mangrove forests rank as the largest in Africa and the third largest in the world (FRN, 2008). Nigeria is the most populous country in Africa, with an estimated population of about 183 million people (National Bureaucratic Statistics Nigeria, 2015). Most of the Nigerian population live in rural areas and rely on subsistence agriculture as well as migratory livestock farming. Agriculture is a significant contributor of over 24.48% to Gross Domestic Product (GDP) for Nigeria (Ojo *et al*., 2014) as well as extraction of natural resources such as fossil fuels, metals and mining (Ebele and Emodi, 2016).

Nigeria, like any other developing country, is affected by climate change and this poses a huge threat to poverty eradication and sustainable development (Ebele and Emodi, 2016). In terms of vulnerability, Nigeria has about 95.6 million people living in rural areas who depend on natural resources, which are climate sensitive for their livelihood (Ogbuabor and Egwuchukwu, 2017; World Bank, 2019). Rural areas and social groups were identified as the most likely to experience the effects of climate change unequally (Preston *et al.,* 2014). This is in addition to Nigeria's natural ecosystems including freshwater and coastal resources that are highly exposed to the impacts of climate change prompting its classification among the ten most vulnerable countries in the world in the 2017 climate change vulnerability index (World Bank, 2017). Crucially, the vulnerable such as the elderly, children, ethnic minorities, homeless, low income communities and people in high risk areas, mostly lack an awareness of climate change impacts and the ability or capacity to adapt to climate change disturbances (Lindley *et al.,* 2011).

Climate change will affect societal classes, income groups, occupation, age and gender in different ways (Amobi and Onyishi, 2015). Due to the climate impact on agricultural sector, women will be affected disproportionally as most women are poor farmers who rely on small scale and rain-fed agriculture (Onwutuebe, 2019) and will affect more women due to cultural division of roles between men and women. Women mostly depend on natural resources and are responsible for gathering wood for cooking, collecting the household water supply, and ensuring food security for the family. Children are also affected as flood could result in their absence from schools, particularly within communities with poor transportation and scarcity of food, which could lead to hunger and undermine children's ability to learn (Amanchukwu *et al*., 2015).

The economy of Nigeria is highly affected by climate change due to climate sensitive sector like agriculture and productivity can have an adverse effect on Gross Domestic Product (Ebele and Emodi, 2016; Ogbuabor and Egwuchukwu, 2017). Agriculture has been a source of livelihood to communities for centuries. Over 70 percent of the population depend on agriculture for their livelihood (Shiru *et al.,* 2018; Onwutuebe, 2019). Nigeria resides in a semi-arid region which is largely affected by changes in temperature and rainfall, causing drought and floods, thus agriculture in these regions is predicted to become unsustainable (Ludwig *et al.,* 2007). Most researchers have reported that climate change leads to significant decrease in agricultural productivity in Nigeria (IPCC, 2014; Onyeneke *et al.,* 2017). Similarly, changes in climate is projected to affect crop cultivation and yield in most parts of the country, making it difficult for farmers to plan their operations (Ayanlade *et al.,* 2017; Anabaraonye *et al.,* 2019). Moreover, climate change events like flood and drought can undermine economic growth through losses in production and infrastructure and need for extraordinary spending (Ogbuabor and Egwuchukwu, 2017).

There is evidence that climate change has a huge effect on human health (WHO, 2006; Raimi *et al.,* 2018). The impact of climate change on human health in Nigeria could be direct or indirect, with vulnerable people such as children, pregnant women, elderly, poor population, and individuals with disabilities and chronic sickness affected the most (Hathaway and Maibach, 2018). One of the main consequences of climate change on the health of Nigerians are cerebra-spinal meningitis, cardiovascular respiratory disorder in the elderly, high blood pressure, skin cancer, tuberculosis, malaria, diarrhoea and cholera (Omoruyi and Onafaluj, 2011). These infectious diseases are potentially exacerbated by climate change. Due to excessive heat in Nigeria, incidences of meningitis has been on the rise (Akingbad, 2010). About 35% of reported cases from World Health Organisation (WHO) on meningitis outbreaks in Africa are from Nigeria, with 95% of the diseases from the northern part of the country (Abdussalam *et al.,* 2014). In addition, due to fluctuations in rainfall, high temperature and problems around unhygienic environment, climate change has brought about increases in water-borne diseases such as malaria, which accounts for over 45% of all outpatients and over 50% of Nigeria population suffers one episode of malaria each year (Ayeni, 2011). This is because of increased incidence of pools, standing waters around communities and flooding which contaminate fresh water, creating breeding grounds for insects that carry diseases such as mosquitoes and heightening the risk of water-borne diseases. Other health impacts include air pollution from burning of fossil fuel from generators and transportation industries. As a result, the World Health Organisation projected that by 2070, over 400 million people will be at risk of malaria due to high and low emissions (Ayeni, 2011; WHO, 2015).

The energy sector is also affected by climate change through its impact on hydroelectrical and thermal generation (Ebele and Emodi, 2016). The drought in the northern part of Nigeria, for example, decreases the availability of trees and biomass for fuel as it affects hydroelectric output. In addition,

due to flooding in the coastal area, it affects power generation as damages are made on transmission lines and substation equipment (BNRCC, 2011). Nigeria's legislation on the environment became operational in 2007 as the National Environmental Standards and Regulations Enforcement Agency (NESREA). The agency helps to enforce compliance with the international agreements, protocols, conventions and treaties on the environment which Nigeria is a party to. The agency also enforces compliance on the guidelines and legislations on sustainable management of the ecosystem, conservation, biodiversity and the development of the natural resources in Nigeria.

Previous efforts to tackle climate change issues in Nigeria have come from various international and national governments, citizenry and non-governmental climate agencies (Oluduro, 2012; Onyeneke *et al.,* 2020). However, understanding and responding to the physical science of climate change and its unpredictability have been described as a complex problem due to the associated social, economic, ethical and political challenges (Twigger-Ross *et al.,* 2016). This may explain the difficulty of developing sound strategies in Nigeria for responding to climate change and building community resilience. Recognising the social, economic, ethical and political conundrum and its inherent features is crucial to designing sound response strategies. This has prompted suggestions for the deliberate use of decision frameworks that allow decision makers to weigh trade-offs to act in the face of incomplete information, and to learn and adjust "modus operandi" over time (Meehl and Tebaldi, 2004; Trenberth, 2018). This is crucial since climate change is posing more complex problems that far outweigh conventional solutions (Puppim de Oliveira, 2009). Nigeria has identified long-term policy measures in its national communications to the United Nations Framework Convention on Climate Change (UNFCCC), and other policy interventions. Most of the measures are yet to be fully implemented which leaves the many community members without a good understanding of the challenges faced due to climate change (Choko *et al.,* 2019; Onyeneke *et al.,* 2020). As recommended

by Pradhan *et al.* (2017), there is a need to examine the effectiveness of climate policies (and this includes Nigeria) which can be measured in terms of impacts on the ground at the local, regional and national responses. Apropos of this, Nigeria has yet to respond to the climate change problem through a unified policy framework and this remains a major challenge for the country (Apata, 2011; Ekpoh, 2014; Choko *et al.,* 2019). Hence as stated above, policy development and implementation are currently coordinated largely at the national level (Federal Ministry of Environment), who then help to build capacities and facilitate policy adoption and implementation at state and local government levels (Oladipo, 2010; Choko *et al.,* 2019; Onyeneke *et al.,* 2020).

Based on the complex nature of the policy strategies, less attention is given to what affected communities can do for themselves and ways to strengthen them (IFRC, 2012). Likewise, community resilience concept is necessary for understanding how communities can prepare and respond to climate change while developing and maintaining critical community functions (Choko *et al.,* 2019). One suggested approach is the development of policies tailored to the specific needs and understanding of the local community (Wilson, 2013) or the development of community resilience initiatives that have been adapted from an international context to the local one (Chandra *et al.,* 2011). Therefore, systematic action is required across the policy planning and implementation pathway in Nigeria (national, state, local) for a resilient sustainable future. It is on this premise that the current research focuses on the Nigerian context.

The overarching rationale for the current research focus is underpinned by the need to provide communities in developing countries with measures that can strengthen their resilience through the designing of effective policy strategies (Pradhan *et al.,* 2017; Choko *et al.,* 2019). This is in addition to understanding the needs of national and state government to promote the development of effective policies that can address specific vulnerabilities of communities. The relevance of this research can

be recognised and positioned in both scientific and societal areas, since community resilience as a topic is integrated within these arenas. It is apparent that more research is needed on: i) how current policies support community resilience; and ii) how the concept of community resilience is operationalised within academia, industry and in government perspectives.

1.3 Research Aim and Objectives

This research aims to inform the development and implementation of policy to support community resilience in the face of climate change in developing countries such as Nigeria.

1.3.1 Research Objectives

To achieve its aim the research presented has met four key objectives (Figure 1.1).

1. The identification of international climate change policies that are translated and implemented in Nigeria's environmental regulations and interventions.
2. The identification and clarification of the key different way community resilience is operationalised within the academic literature.
3. The exploration of how community resilience is operationalised within the context of Nigeria and its implications for policy.
4. The provision of a methodology by which consensus can be reached between experts on how competing issues can be prioritised to improve community resilience in developing countries.

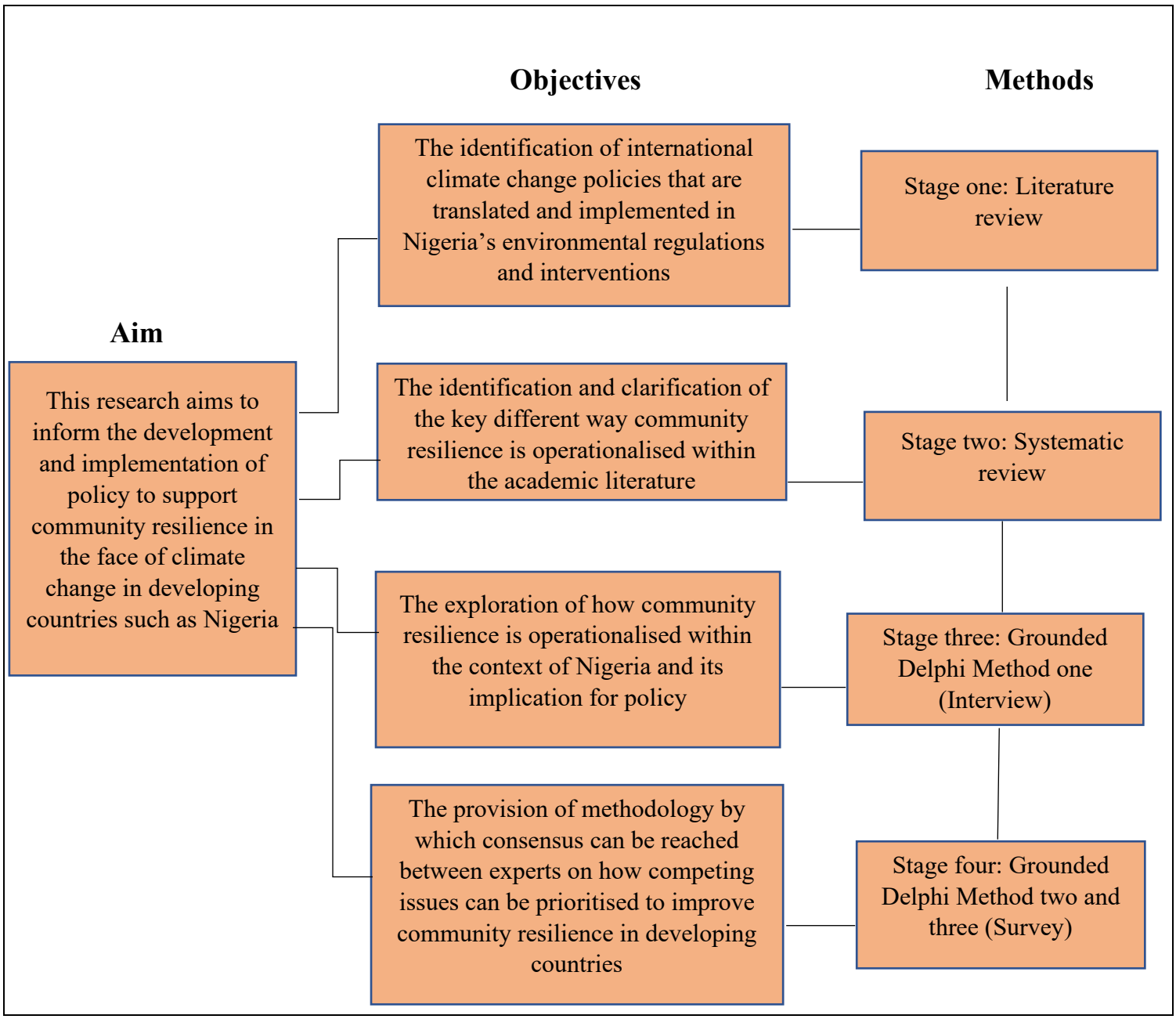

Figure 1.1. Summary of the research aim, objectives and how they link to the stages of the research

1.4 Research Methodology

The first stage of the research conducted a literature review to identify the international climate change policies adopted in Nigeria. This identified a gap in the literature in relation to measuring or monitoring the effectiveness of the policies that have been implemented. A systematic review was

conducted in the second stage of this research which identified that there are multiple ways of operationalising the concept of community resilience within the academic literature and that the meaning of community resilience is contextual. This stage of the research also identified the different ways in which community resilience is measured within the academic literature allowing the identification of key elements and indicators that can be used to measure levels of community resilience in different contexts.

The next stage of the research adopted a Grounded Delphi Method for the third and fourth stage. It looked at how community resilience can be operationalised in the context of Nigeria, and how a consensus can be reached on the way in which competing issues can be prioritised to improve community resilience in Nigeria. Grounded Delphi Method offers a new methodological addition to the Delphi method. It combines the features of Grounded Theory in regard to data analysis with the Delphi Method. According to Paivarinta *et al.* (2011) integrating the elements of Grounded Theory with Delphi helps to enhance the theory capabilities of the Delphi approach.

1.5 Relevance of the Key Findings to Policy

Given that government carries out policy processes (design to implementation), policies regarding measuring community resilience may be informed by the findings from this research. Although international bodies and governments mostly fund policy activities, most of these activities are not carried out, as there is inadequate funding in many impoverished developing countries. Therefore, a method of prioritising actions toward community resilience in these countries is required. This research focuses on how actions and policies for developing community resilience in the face of climate change can be prioritised. It offers specific, measurable indicators that can be used to inform policies on reducing the effects of climate change and supporting community resilience in the context

of limited funding. Given the current limited funds in Nigeria and other developing counties, the methodology proposed offers a practical way to prioritise policies. However, it must also be accepted that community resilience can only be usefully conceptualised as a process of stages that communities go through moving from simply coping with climate change, to being resilient to climate change, to eventually transforming into a community that can thrive despite climate change.

1.6 Relevance of the Key Findings to Theory

The findings provide relevance to theory by improving future practice on how community resilience is operationalised. This helps in establishing appropriate factors to consider the term 'community resilience' as a collection of coping, adaptive and transformative capacities which is a process of stages that communities go through, by moving from simply coping with climate change to being resilient to climate change to eventually transforming into a community that can thrive despite climate change. This research highlighted the need for transformative capacity and their relevant indicators when measuring community resilience to climate change. The understanding of community resilience in terms of transformative capacity as a concept is very important especially in the context of Nigeria. Transformative capacity would provide direction and give a long-term structure for preparedness for communities to reach a sustainable future. This research highlights some enhancements that could be made on community resilience elements and their indicators that are needed for the communities in Nigeria and similar communities in developing countries. To be useful, measures of community resilience need to be applicable, relevant and easily accessible for policy makers (NAS, 2019; Cutter, 2019). Therefore, the elements and their indicators identified in this research could be very useful and feasible in the Nigerian context as the indicators could be prioritised relative to inadequate funding in the implementation of policies to measure the levels of community resilience. Most of the findings

will have considerations for community resilience, climate change and policy field separately. This research highlighted the need for further empirical research into measuring the levels of community resilience in the face of climate change as research in this area is changing from an emerging concept to a consolidated topic. Finally, this is the first Grounded Delphi Method research within the community resilience and climate change field.

1.7 Structure of the Thesis

Following this introduction, the thesis is divided into six chapters.

Chapter 2: This chapter presents a critical appraisal of the international climate change policies that have been adopted in Nigeria's environmental regulations. It also presents an overview of the different approaches to defining and operationalising the concept of community resilience. It therefore discusses how community resilience is measured, and different community resilience frameworks presented in the academic literature to date.

Chapter 3: This chapter presents the theoretical approach underpinning this research, the methods, data processing and analysis strategies used. These included a critical review of the literature on climate change policies, a systematic review of how the concept of community resilience is operationalised in the academic literature, and a GDM to identify how community resilience is operationalised by expert stakeholders in the Nigerian context and how a consensus can be reached on the way in which competing issues can be prioritised to improve community resilience in Nigeria.

Chapter 4: This chapter presents the results of the systematic literature review. As such this chapter presents an overview of how community resilience is defined and measured in the academic literature. It discusses in detail the community resilience elements and their indicators presented in the current

literature that are used to measure and enable communities to be resilient towards climate change issues.

Chapter 5: This chapter presents and discusses the results from the semi-structured interviews from Delphi round one which explored how community resilience is operationalised by experts in Nigeria. As such it presents a critical analysis of how those involved in the policy process in Nigeria understand the concept of community resilience and the indicators which can be used to measure it.

Chapter 6: This chapter presents an analysis of rounds two and three of the GDM. It illustrates how this method can be used to develop a consensus among the expert opinions on which community resilience indicators are essential to manage climate change in the context of Nigeria.

Chapter 7: This chapter summarises the overall study. It presents the conclusions and the main findings. It illustrates how the research's aims and objectives were addressed, the research's contribution to knowledge and the limitations of the research. Finally, it makes recommendations for future research useful for developing future policy actions supporting community resilience in the face of climate change.

2 Literature Review

2.1 Introduction

This literature review incorporates existing research that has explored policies that support community resilience in the face of climate change. Therefore, Chapter 2 begins by setting out international policies on climate change and follows with international climate change policies adopted in Nigeria's environmental regulations. A further critical review of the literature assists in establishing the existing knowledge gaps and justifying and positioning the current research within the topic of community resilience.

2.2 Legislative Framework and Policy Context

Climate change, according to the Intergovernmental Panel on Climate Change (IPCC), is a change in the climate variability over a long period of time (IPCC, 2007). These changes result from the dynamic processes on earth and external forces like variations in sunlight intensity and human activities (IPCC, 2014). Human activities such as the burning of fossil fuel, over the past 70 years, have increased carbon dioxide and other greenhouses gases in the atmosphere that affect global climate. There is a rise in sea levels and melting glaciers while precipitation patterns are changing, all of which are becoming extreme and frequent (IPPC, 2014). This has affected the global economy and people's health, and it could result in 250,000 deaths per year between 2030 to 2050 because of infectious diseases, scarcity of water and food, and extreme weather events (WHO, 2014). The rise in temperatures raises the concentrations of ozone and other air pollutants that then cause cardiovascular and respiratory diseases. In addition, more than half of the world populations who reside in over 60 km around sea areas could be forced to relocate to higher grounds with subsequent increasing risks of health effects (from mental disorder to communicable diseases). Likewise, changes

in rainfall patterns can affect fresh water supply, and lack of water can result in low hygiene, but high incidences of water borne disease, drought and famine (IPCC, 2014).

Climate change has a big effect on global economy as heatwaves make it difficult for people to work which reduces productivity; flood displacing millions of people, increasing poverty levels and loss of infrastructures; and decrease in harvest caused by drought that results in food shortages (Anthoff *et al.,* 2010; Zivin and Neidell 2014; Sudarshan *et al.,* 2015). The impact of climate change will also affect the world's GDP by more than 20% which is comparable to the great depression when GDP fell to 26.7%. However, the impact of climate change on GDP will be permanent with devastating effects (Marc, 2010). Most global economy depends currently on energy that is derived from burning fossil fuels with carbon dioxide as a by-product. Overall, the effects of climate change are linked to diminishing economic productivity and increasing harm to global welfare (Woodard *et al.,* 2019).

Efforts by local, regional, national, and international stakeholders in enacting policies to reduce the impact of climate change have been varied and far-reaching (Berrang-Ford *et al.,* 2010; Heinrichs *et al.,* 2013). For example, several countries (Australia, Bangladesh, Pakistan, India, China, Zimbabwe and Nigeria) have adopted and integrated international climate change policies and plans into their national policies and regional strategies to combat climate change (IPCC, 2014). This section presents an overview of the international policies adopted, treaties and challenges inherent in applying existing international environmental law to national climate change issues.

2.2.1 International Policy Context

International climate change policies and environmental law comprise of global treaties, agreements, regulations and policies with the aim of protecting the environment and its natural resources from negative climate change impacts. The United Nations has been the main forum for international

climate change action that led to the Framework Convention on Climate Change (UNFCCC). Over the past decades, there have been binding agreements on protecting the environment against the impact of climate change at the global level (UNFCCC, 2018). The different bilateral negotiations that have consumed both the human and financial capacity of member states have not fully achieved the implementation of climate change policy (Kammerer and Namhata, 2018) broadly.

Their goal was to reduce a billion tonnes of greenhouse gases (GHG) in the atmosphere. This has been a long-standing issue as the atmospheric GHG rose to about 70% between 1970 and 2004 (IPCC, 2007). However, other international approaches have since been established (Dieter, 2009; Barau *et al.,* 2014). For example, over the course of COP conferences, three elements were introduced (mitigation financing, technology transfer and adapting to climate change) into the international structure on the discourse on climate change. As a result, countries are increasingly adopting domestic policy strategies to mitigate greenhouse gas emissions and facilitate adaptation to climate change (Gillard *et al.,* 2017; Pietrapertosa *et al.,* 2017).

With the increase in global surface temperature, countries will experience high increases in temperature and the impacts of climate change will be felt everywhere (Wood *et al.,* 2014; Pradhan *et al.,* 2017). More than twenty-five years ago, scientists and policy makers framed climate change as a global problem requiring global solutions (Laukkonen *et al.,* 2009). The UNFCCC recognises the importance of adaptation to climate change with more focus on vulnerable regions in developing countries and is complementary to mitigation of climate impact (Ford *et al.,* 2013; Barau *et al.,* 2014). However, international policy through UNFCCC has focused more attention on climate change mitigation than adaptation strategies when addressing climate change problems (Bulkeley, 2010; Feliciano *et al.,* 2014). This is because of mitigation strategy being used for climate protection for a long time. Mitigation strategies try to reduce human impact on the environment with the global efforts

to achieve a reduction in the emission of greenhouse gas (Hoppe *et al*., 2014). The reluctance to focus on adaptation was linked to debates on compensation, liability, fairness and equity, that developed nations wanted to avoid (Paavola *et al.,* 2006). According to the 2001 Marrakesh accords agreement under UNFCCC, international policy recognises the importance and synergy of mitigation and adaptation to managing climate change impact (UNFCCC, 2007). Mitigation and adaptation policy strategies can, for example, align easily with national policies that focus on managing energy transition, renewable energy, enhance energy efficiency and reducing vulnerability and increasing resilience (Stringer *et al.,* 2009; Hoppe *et al.,* 2014).

At the international policy level, in terms of climate change, the UNFCCC developed some strategies, some of which are: Carbon tax, Clean Development Mechanism (CDM), Intended Nationally Determinant Contribution (INDC), Reducing Emission from Deforestation and Degradation (REDD), and National Adaptation Program of Action (NAPA), which are very important strategy for developing countries (Kalame *et al.,* 2011; Nordhaus, 2015; Stults *et al.,* 2017; Chan *et al.,* 2018). Developing countries contain 84% of the world population made up of regions of Africa, Asia, South America and the Oceania. The United Nations statistics division specifies developing countries based on common practices, low income, politically marginalised and with high poverty rates (Allwood *et al.,* 2014). According to Sperling (2003), a general consensus has been reached that poor people in developing countries will suffer more from climate change. This is due to developing countries having more vulnerable populations such as the poor and marginalised groups, who will be affected the most by the impact of climate change. Most developing countries economy rely on climate sensitive sector like agriculture, have low adaptive capabilities, and lack financial and technical capacity to respond to climate change threats, which vary across regions and countries (Ludwig *et al.,* 2007; Mikulewicz, 2017). However, most developing countries are adopting the international strategies due to their

international commitment rather than buy-in at the national policy level; although they attract the support of different actors in identifying activities to prioritise in adapting to the impact of climate change (Ford *et al.,* 2013). The NAPA strategy was adopted in most developing and least developing countries in 2001, which approves existing coping strategies at the community level in a country by building on them to identify priorities, reduce vulnerabilities and build resilience. Activities such as diversified services and resources help to build resilience (Steiner and Markantoni, 2013). Also, the capacity to respond in terms of assets, improve quality of life, different skills, learning, networks, infrastructures, social, economic or the institutional capital, makes communities resilient when facing challenging periods of change (Fazey *et al.,* 2018). There is a link between resilience and adaptation strategies as adaptability is important and even equated with resilience (Gallopin, 2006; Townshend *et al.,* 2015). A comprehensive national climate change plan (Intended Nationally Determinant Contribution) INDC was at the heart of the Paris agreement with various countries agreeing on efforts to reduce emissions and adapt to the impact of climate change. The implementation of the Paris agreement relied on countries translating their commitments set out in the INDC. However, this policy is not sufficient to keep the global warming from increasing to below 2°C (Spash, 2016; Du Robiou Pont *et al.,* 2017). In summary, the progress of climate change policies at the international level has been slow (Nordhaus, 2018). This appears to be due to institutional and cultural factors (lack of coordination, synergy, determination and social factors) that act as a massive challenge than technical and financial capacities (Burch, 2010). However, due to the years it takes to negotiate treaties, international environmental law has its challenges of not responding quickly to an emergent situation or adequately protecting the environment (Birnie *et al.,* 2009).

2.2.2 National Policy Context

By adopting international policies and agreeing to their ratification when they come into force, Nigeria has obligations under numerous international treaties and agreements related to the environment (Oladipo, 2010). A nation with a focused climate change policy and mitigation and adaptation techniques ought to be in a better stage of readiness to react to climate change impacts than a country that has none (Pradhan *et al.,* 2017; Onyeneke *et al.,* 2020). Policies are essential for a strong national adaptive capacity to then reduce the effects of climate change.

In recent years, it has been recognised that climate change adaptation and resilience inform each other (Gupta *et al.,* 2016; Berbes-Blazquez *et al.,* 2017). Adaptation refers to the anticipation and taking actions to prevent and minimise damages caused by a disturbance. Also, adaptation requires long-term strategies and is needed at every level of society. According to Bhan *et al.* (2017), adaptation measures include efficient use of water, adapting building codes to climate conditions in the future, building flood defences and resilient infrastructures like raising dykes, creating drought resilient crops, good forest practice and proper land use management. Generally, adaptation is significant in building resilience and reducing vulnerability (Engle, 2011; IPCC, 2014; Murtinho, 2016; Ferro-Azona *et al.,* 2019). Adaptive capacities need to be built and resources made available to track climate patterns, make forecasts, and assess risks to then make informed decisions and provide information on time to people. Policies should be focused on upstream strategies that would benefit communities, for example, by developing more diverse crop tolerant for different conditions such as heat, salt and drought; developing early warning systems; bolstering social capital and resilience; and improving infrastructures (Smith and Wandel, 2006; IPCC, 2014).

Resilience notions have roles in increasing climate adaptation and mitigation. Specifically, resilience can inherently address issues of uncertainty and complexity (Nelson *et al.,* 2007; Wardekker *et al.,*

2016; Ferro-Azona *et al.,* 2019). Resilience insights help to move climate change policies from predict-and-prevent approaches to building-resilience strategies that will respond to a broader range of climate change impacts (Tyler and Moench, 2012). According to the IPCC report of 2007, developing countries will suffer more from the effects of climate change as their livelihoods are mostly depended on climate sensitive sectors. Also, there is a high number of poor people who are more vulnerable and will, as a consequence, experience the negative effects of climate change more within these countries (Yohe and Tol, 2002). Developing countries typically lack the economic and technological capacity to adapt and mitigate against climate change impacts, which makes policy implementation difficult (Ford *et al.,* 2013). Despite the complex problems arising from climate change policies in developing countries, a resilience approach can help frame and prioritise the challenges. Due to the country's high vulnerability, as discussed in Chapter 1, section 1.2.2, Nigerian communities are highly vulnerable, in terms of the large population living in rural areas who depend on climate-sensitive natural resources for their livelihood (Choko *et al.,* 2019). For example, livelihood activities that depend on agriculture (land) as the key natural asset can subsequently impact other forms of capital and household revenue as soil quality changes, affecting crop yields (Reale and Handmer, 2011). The impact of climate change such as drought and flood are more pronounced on rural communities as it affects rural infrastructures, agriculture and their ecosystems, with direct implications for livelihood, income and settlement patterns (Abaje *et al*., 2016). In Nigeria, most of the rural communities are in the northern region with very high levels of poverty and low education rates (Bloch *et al*., 2015). The high impact of climate change on rural community's livelihood has resulted in rural-urban migration for a different livelihood in other sectors for better wages. For example, Bloch *et al*. (2015) stated that most males migrate to urban areas in search of jobs and education while females stay back to farm and look after the family. This is also due to lack of markets, schools, health facilities and reliable transport systems in the rural areas. In addition, most

rural people depend on economic help from their relatives in the cities such as cash and gifts, while people in the rural areas send food items to their relatives in the urban areas. However, these support mechanisms have been greatly affected by climate change. Other differences between the rural and urban areas in Nigeria include the fact that rural areas have populations that are more vulnerable to climate change, lack necessary infrastructures and have low adaptive capacity (Choko *et al*., 2019).

Climate change policies like mitigation and adaptation, with capacities and resources, were adopted to help reduce the impact of climate change on communities (World Bank, 2012; Oluduro, 2012; Ifeanyi-obi and Nnadi, 2014; Onyeneke *et al.,* 2020). However, some various international policies that are adopted into the national policies and plans are either directly or indirectly addressing climate change adaptation (Murtinho, 2016). The Federal Ministry of Environment created the Special Climate Change Unit (SCCU) with the responsibility to adopt and develop short- and long-term policies and strategies to enable Nigeria to reduce the impact of climate change and build resilience (the Federal Republic of Nigeria, 2008; Oladipo, 2010). Nigeria's response to climate change impact in the context of policy development framework remains a significant challenge (Oladipo, 2010). However, several existing policies are adapted and implemented to reduce climate change impacts and vulnerability in the country. Only a few of the strategies deal with climate variability and climate change directly, but most of them have a few measures that have links with climate change. Some of these policies are considered in the remainder of this section.

The National Environmental Policy was adopted in 1999 to deal with the difficulty of addressing critical environmental problems such as deforestation, desertification, land degradation, air and water pollution, coastal and marine environment erosion, urban decay and municipal waste, including hazards of drought, tidal surges, floods and erosion. This policy was aligned with Nigeria's Vision 2020 and aimed to achieve sustainable development and reduce the effect of climate change on socio-

economic development by promoting environmental education, strengthening environmental governance, and optimising economic benefits from sustainable environmental management (Ekpoh, 2014). In addition to the National Environment Policy, the National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) was adopted in 2011 to build Nigeria's Response to Climate Change (BNRCC, 2011). This policy was acknowledged by the UNFCCC prior to the COP18 in Doha as a model policy document from which other countries could learn from (UNFCCC, 2012). The policy outlined climate change responses in crucial sectors such as agriculture, water resources, forestry, energy, health, tourism and transport. However, this policy strategy did not get official support (London School of Economics and Political Science, 2013) and was replaced by the National Climate Change Policy and Response Strategy (NCCP-RS) which was adopted in 2012. The 2012 policy aimed to provide a framework for responding to climate change impact. In 2013, the policy was modified and developed into the National Policy on Climate Change and Respond Strategy (NPCC-RS) as the global and national urgency to address climate change impact increased (New Climate Institute, 2015). This policy promotes low-carbon and economic development and aims to build a resilient society (UNFCCC, 2015; Ogbuabor and Egwuchukwu, 2017). Also, the policy helps to specify the objective, national goal and strategies to mitigate and adapt to climate change impacts. However, against the backdrop of low human and financial capacity, a developing country such as Nigeria lacks the resources to implement this on their own (UNFCCC, 2007; Choko *et al.,* 2019).

In 2015, Nigeria also adopted and developed its intended nationally determinant contribution to providing development benefits, sustainable growth and delivering of government priorities. The implementation is managed under the NCCP-RS, which is coordinated by the Department of Climate Change to carry out appropriate implementation activities. There is no actual legislative process to curtail emissions in Nigeria.

Nigeria has not yet enacted any climate change specific law (Adebayo, 2010; London School of Economics and Political Science, 2013) and this remains the case as evidenced by a critical analysis of the literature in 2020. Further to this, the effective implementation of policies and their potential to support communities to be resilient are yet to be fully realised. However, in addressing its climate change problems, the federal government has adopted the related environmental policies (BNRCC, 2011) mentioned earlier, where adaptation to climate change could apply. Nonetheless, the implementation of these policies to support climate change adaptation and mitigation to build community resilience is limited (BNRCC, 2011; Ekpoh, 2014), for example, due to greenhouse gases that have been emitted and accumulated over the years. While it is apparent that climate change is inevitable and difficult to address, the success and failure of these policies are too early to determine since they have been adopted relatively recently (FRN, 2020). Meanwhile, communities need to prepare and cope with climate events and a joint action that is well coordinated is needed.

The development of mitigation and adaptation strategies has resulted in the need for policies to be monitored and measured. This measure involves data collection based on pre-defined indicators that helps stakeholders to examine if a policy process or project is having its desired impact (Ryakkja *et al.,* 2014; Klostermann *et al.,* 2018). This process helps in the effective implementation of mitigation and adaptation policies to assess the resources commitments, and to provide information on good practice (Harley *et al.,* 2008). At the level of climate change policy, Nigeria adopted all international climate change policies and since the adoption of the climate change policies are still at the stage of development, there seems to be no universal standard of measuring or monitoring their effectiveness – a paucity which this research will try to address.

2.3 Concept of Community Resilience

Before defining community resilience, it is important first to define what a community means in general and for the context of this research.

2.3.1 Defining Community

There is no universally accepted definition for a community in the literature (Mulligan *et al.,* 2016). Despite this, Cohen *et al.* (2016) posited that a community is a multidimensional, multifunctional and multifactorial structure that involves a group of people living and working in it. Even though the community involves mainly people, it also includes their livelihood, and it is a unit of belonging and identity, which depends upon the resources, natural assets and their distribution and other environmental traits of its geography (Sherrieb *et al.,* 2010; Wilson, 2013). Furthermore, it involves people who share common interests and culture, participate in shared activities and identify with each other (Ungar, 2011). Likewise, it is considered as people living within a geographical boundary (Allen, 2006). Although community is viewed in various levels of size and length, i.e. ranging from a small village to regional, national, and global community (Wilson, 2012), its function depends upon ties: at intra-communal and inter-communal social structures; between people, natural resources and native species; and among different stakeholders (Kais and Islam, 2016). Hence, the community will be influenced by many factors related to its counterparts such as environment, society, economy and institution.

Most literature has defined community as a diverse group of people in a shared geographical area, with a common interest, which is connected by dynamic socio-economic ties and is involved in collective actions (Twigg, 2009; Frankenberger *et al.,* 2013). It was argued by Mulligan *et al.* (2016) that to draw community boundaries is difficult, and with the changes in movements and communication technologies, community boundaries can change over time. They also stated that a

community could be part of a broader community, and a community member can belong to more than one community.

For this research, the community is defined as an area defined by geographical boundaries, located at the household, local, regional and national level. This acknowledges the fact that community involves people with a dynamic tie that cuts across all scales. According to Sherrieb *et al.* (2010) community should be defined based on a case-by-case basis and using the different levels (neighbourhood to national) which can be used as a unit of analysis when assessing resilience.

2.3.2 Defining Community Resilience

Resilience is defined in numerous ways in many disciplines including sociology, psychology, anthropology, economics, political science, public health, ecology, geography, mathematics, physics, engineering, disaster management and policy development (Cutter *et al.,* 2008; Norris *et al.,* 2008; Sharifi, 2016; Summers *et al.,* 2017). The definition that is given by Holling (1973, p.17) marks one of the earliest and highly generalised definitions for resilience. He defined resilience as a measure of the ability of a system to persist by absorbing the changes in state and driving variables. This definition was modified by the same author in 1996 as the buffer capacity of a system to absorb agitation, or the amplitude of the unrest that the system can absorb before it changes its integral structure. The expanded definition suggests the need to consider context before using the word resilience. These definitions appear not to be coherent; therefore, it is highly recommended to identify the context before using the word resilience.

Within social science, the concept of resilience is used to describe individual, social and community resilience (Norris *et al.,* 2008; Cutter *et al.,* 2010). Individual resilience is necessary for overcoming adversity; it is a personal sense of the ability of a community to deal successfully with the ongoing

external or internal events and how to bounce back from such an event, with a subsequently positive impact on the community (Eachus, 2014). When applied to an individual, the term 'resilience' is highly influenced by the physical, social and economic status of the person to evaluate how far they can respond to a disaster (Jabeen *et al.,* 2010). Also, the person's ability in integrating themselves with their community would provide extra support in the form of social capital (Kadushin, 2004), which is also applied to social resilience. Hence, it is recommended to anticipate and prepare for probable climate change events (Berker *et al.,* 2003; Cutter *et al.,* 2008). Meanwhile, social resilience is the capacity of human communities to combat external shocks to social, economic, environmental and political upheaval and take responsibility and control of their development path (Folke, 2006). Numerous studies suggest a linkage between individual and community resilience (Paton *et al.,* 2006; Bosher and Dainty, 2011). Community resilience is significant as it reflects the ability of a community to prepare for, withstand, recover from and adapt through activities that build community resilience (Chandra, 2011).

The focal point in the current research has been narrowed down to 'community resilience'. Since the 1970s, the concept of community resilience has been increasingly discussed in academic and policy domains (Skerratt, 2013; Steiner, 2013; Abramson *et al.,* 2015). The concept of community resilience is vital within the context of climate change (Twigger-Ross *et al.,* 2016). In the same way, the concepts of community resilience in the perspective of climate change were developed and applied in many studies (Adger, 2000; Paton and Johnston, 2001; Tobin and Whiteford, 2002; Klein *et al.,* 2003; Allen, 2006; Bergstrand *et al.,* 2015; Kais and Islam, 2016; Twigg-Ross *et al.,* 2016). The Joseph Rowntree Foundation defines community resilience as a community's ability to reduce exposure to, prepare for, cope with, recover better from, adapt and transform as needed to, the direct and indirect effects of climate change, where these can be both shocks and stresses (Twigger-Ross *et*

al., 2016). Community resilience enables communities to respond to a broader range of single and rapid shock events, stressors or disruptions. It describes the important qualities necessary of a community to be able to prepare, withstand and adapt in the face of a disturbance (Coles and Buckle, 2004; Walters, 2015). Norris *et al.* (2008) definition of community resilience and its applications is one of the widely cited. They defined community resilience as a regulated linkage of a networked adaptive capacity to a positive and sustainable trajectory of community's functioning and adaptation in the targeted population after the climate change-related shock. This describes adaptive capacity as being robust, abundant, and with rapidly available resources which can be accessible to the communities like social capital, community competence, economic resources and communication (Norris *et al.,* 2008). Making these resources available to communities, helps them to recover well from an event, be better prepared and adaptable to future events, and being productive and less vulnerable (Allen *et al.,* 2012; IFRC, 2012; Rogers, 2013). Other authors also considered different capitals to build community resilience such as social, economic, infrastructural, institutional, environmental, health and wellbeing, demographic (Adger, 2000; Cutter *et al.,* 2008; Wilson, 2012; Steiner and Markantoni, 2013; Alshehri *et al.,* 2015; Sharifi, 2016). These considerations help keep communities together and enables them to function well (Wilson, 2012). Wilson (2012) also stated that resilience could function at different levels, e.g. individual, community and state.

Community resilience is a community's ability to absorb, manage and bounce back after a disastrous event. The definitions of community resilience as bounce back have been criticised for being narrow, which only reproduce vulnerabilities (Jorden and Javernick-Will, 2013; Doorn, 2017). Some studies refer to the post-disaster phase as that where the communities are assessed based on their adaptive and absorptive capacity through coping mechanisms following a disaster (Smith and Wandel, 2006). This calibration allows the communities to extrapolate their status in terms of their responsive agility

and capacity in managing their future disastrous events brought on by climate change. However, all these theoretical aspects of community resilience depend on the type of vulnerability the communities face, and the resources and capital available in that community (Magis, 2010; Walters, 2015). When defining community resilience, the state and driving variable is to be mentioned or described along with the measures taken to support the capacities of the community. This justifies the applicability of the concept of resilience into targeted communities.

From the definitions given so far, the core traits of community resilience have focused upon not only the ability to anticipate and minimise loss during disastrous events, but also post-disaster restoration of community's natural function along with community's and relevant stakeholders progressive learning from the self-experience (Patel *et al.,* 2017; Alam *et al.,* 2018). Despite the numerous available sources of literature on community resilience, the concept is still challenging and evolving (Tanner *et al.,* 2017; Manyene *et al.,* 2019). This is because there is a lot of literature on the meaning and context of community resilience but no consensus on a singular definition of community resilience. Community resilience is a contested concept that is subject to different interpretations, which is reflected in the existing definitions (Norris *et al.,* 2008; Ainuddin and Routray, 2012; Berbes-Blaquez *et al.,* 2017; Doorn, 2017; Patel *et al.,* 2017. The diversity of the definitions poses epistemological and methodological issues, and the operationalisation becomes difficult (Manyene *et al.,* 2019). Due to the disagreements and contradictions within the discourses surrounding the meaning of community resilience, this research intends to try to fill this gap by understanding how community resilience is defined within the academic literature and in the context of Nigeria.

2.4 Measuring Community Resilience

Measuring community resilience is recognised as an essential step toward reducing climate change risk and being better prepared to withstand, recover and adapt to a broad array of natural and human-induced disasters (Alshehri *et al.,* 2015). Furthermore, community resilience, a community's sustained ability to withstand and recover from adverse events, has progressed from theory to becoming the dominant framework guiding disaster preparedness and recovery planning and programming, globally (Eisenman *et al.,* 2016). However, if a community returns to its previous state, then it may have recovered from the event, but it has not necessarily increased its resilience to similar circumstances. Instead, resilience must be thought of as containing elements of learning and adaptation to events so that community resilience can be increased.

More attention has been given to the measurement of community resilience in recent years; nevertheless, this is still evolving and has little empirically based research on its measurement (Cohen *et al.,* 2016; Cutter, 2016). Also, there is no agreed use of a framework to measure community resilience (Norris *et al.,* 2008, Cimellaro *et al.,* 2010; Jordan and Javernick- Will, 2013, Ainuddin and Routray, 2012) hence some frameworks have been used to measure different forms of community resilience (Mayunga, 2009; Graugaard, 2012; Leykin *et al.,* 2013; Cutter *et al.,* 2014). Measuring community resilience is said to be challenging and has a complicated process (Cutter *et al.,* 2008; Frankenberger *et al.,* 2013; Asadzadeh *et al.,* 2017). Some of these challenges include the complex interactions between people; their communities, environment and societies; lack of methods in identifying resilient communities as a result of no shock or stressors when the projects were carried out; and weighting of each community resilience indicators to show the impact of each indicator on resilience (Frankenberger *et al.,* 2013). However, measuring community resilience over time is important (Ahmed *et al.,* 2016) as it provides insight about the attributes, capacities and processes

perceived at different scales, e.g. individual, household, community, state, national. Also, measuring community resilience to climate change gives a better understanding of its impacts (Ewing and Synolakis, 2011) and enables policymakers to develop an effective intervention to climate change (Tianzhuo and Linyan, 2014).

There is a need for an assessment tool to allow communities to build their resilience (Davis *et al.,* 2005) and the community resilience capacities can, in turn, be used to measure the resilience of a community by looking at the best way to manage them (Buckle, 2006). However, it is necessary to identify the weakness and vulnerability of the community when measuring community resilience (Kirmayer *et al.,* 2009). This has led different authors to develop various frameworks and categories of community resilience (Tierney, 2006; Cutter *et al.,* 2003). For example, a Toolkit for Health and Resilience in Vulnerable Environments (THRIVE) was developed, which is used to support community's development factors (Davis *et al.,* 2005). Coastal Community Resilience (CCR) is an assessment tool that is used to measure community resilience (U.S. Indian Ocean Tsunami Warning System Program, 2007). Norris *et al.* (2008) provided an approach to measure resilience with four sets of networked resources which include social capital, economic development, information and communication, and community competence. Cutter *et al.* (2008) propose the 'Disaster Resilience of Place' (DROP) that is used to measure resilience at the community level using six community resilience capacities to describe the relationship between vulnerability and resilience. In 2014, they also proposed a Baseline Resilience Indicator for Community (BRIC) which uses the resilience capacities to measure pre-existing community resilience (Cutter *et al.,* 2014). Likewise, the Community Resilience Index (CRI) is used in measuring community resilience to coastal disaster (Ewing and Synolakis, 2011). Climate Disaster Resilience Index (CDRI) framework used five resilience capacities natural; physical; social; economic; and institutional to measure resilience to

climate-related disasters (Joerin and Shaw, 2011). Resilience united states (ResilUS) is used to measure the recovery of critical infrastructures over time. Meanwhile, Community Advancing Resilience Toolkit (CART) is used to increase community resilience by bringing stakeholders together through a process (assessment, feedback, planning and action) to addressing community issues. This tool includes a field-tested survey on community resilience and other assessment mechanisms (Pfefferbaum *et al.,* 2013). Alshehri *et al.* (2015) proposed Community Resilience to Disasters in Saudi Arabia (CRDSA) to measure community resilience to disaster by using six community resilience capacities.

Looking at the characteristics of community resilience, most of the assessment tools include several capitals. A number of authors have elaborated on different types of capitals (social, economic (financial), institutional (governance, political), infrastructural, environmental (natural), community, health and wellbeing) to build and measure community resilience (Norris *et al.,* 2008; Cutter *et al.,* 2010; Jordan and Javernick-Will, 2012; Alshehri *et al.,* 2015). These capitals provide a more comprehensive view of community resilience measurement and the significance of each of them to a community's capacity to prepare, plan for, recover from and adapt to an event, which is established more in recent years in the literature (NRC, 2012; Cutter 2016; Markantoni *et al.,* 2019). However, these community resilience capitals and their indicators, lack consistency in grouping within them (Bene, 2013).

The emergence of numerous frameworks, assessment tools, indexes and resilience projects to measure the progress of community resilience has increased since the last decade (Sharifi, 2016). These various frameworks have applied different processes (NRC, 2012; Zebardast, 2013; Ostadtaghizadeh *et al.,* 2015; Cutter, 2016; Sharifi, 2016; Asadzadeh *et al.,* 2017). As a result, there are no set ways of measuring community resilience. Sharifi (2016) assessed 36 resilience frameworks,

which were based on six criteria such as being comprehensive, cross-scale relationship, temporal dynamism, addressing uncertainties, types of methodology, operationalisation and establishing action plan. He concluded that there is no framework that covers all the criteria. Cutter (2016) also examined 27 resilience tools, based on four criteria such as theory focus, spatial orientation, type of methodology and domain area. Her conclusion was in line with Sharifi (2016); that is, no framework covers all the criteria since the factors that contribute to resilience are place-based and multi-scalar. Due to the comparative analysis given by these overviews, communities now decide which assessment tool or measurement efforts could be best for their purposes. Nonetheless, the measurement efforts still lack community resilience views by thinking that the measurement of one or more community resilience capitals is the same as measuring the overall community resilience. Hence, they ignore the notion that community resilience is multi-dimensional (NAS, 2019), and these efforts in measuring the whole nature of community resilience are incomplete. Most measurement approaches focus on varying community resilience definitions, the schematic framework and indicators but not on operationalising the definitions, collecting and testing data, and/or being applied more than once in a community (NAS, 2019). Community resilience measurement in practice is not fully established, and the validation of several exiting methods is still lacking (NAS, 2019). Notwithstanding the numerous available community resilience frameworks or assessment tools for measurement, this is still lacking. As there is no set tool among the countless assessment tools that are adaptable for all communities, they are thereby leaving policy makers uncertain of which tool to use to capture changes and to measure the effectiveness of policies that supports community resilience. While there is a lot of literature on measuring community resilience, there is no standard way of measuring community resilience. Instead, they present different methods for measuring the impact of policies to support community resilience. As a result, this research set out to understand how community resilience is operationalised within the academic literature and in the Nigerian

context, to recognise that the new structures from the community resilience discourse are part of the previous and current knowledge.

2.5 Conclusion

This literature review has identified three significant gaps in research. Firstly, there is a gap in relation to measuring the effectiveness of policies that have been implemented in Nigeria's environmental regulations and interventions. Different international policy strategies that have been adopted in Nigeria's environment regulations are identified. However, there is no way to know if they are successful in achieving their intended impacts for communities to build resilience. Secondly, while there is a lot of literature on the meaning and context of community resilience, there is no singular or universally accepted definition of this concept. Thirdly, the review presents a different framework and assessment tools, or different methods, for measuring community resilience. Notwithstanding the various methods for measuring community resilience, there remains a gap to be addressed. To fill this gap, this research conducted a systematic review and the application of Grounded Delphi Methods analysis of how community resilience is operationalised within the academic literature and in the context of Nigeria.

3 Methodology

3.1 Introduction

This chapter introduces the philosophical underpinning of this research, and outlines and justifies the methods used to address the aim and objectives (section 1.3.1) that inform the development and implementation of policy to support community resilience in the face of climate change. It discusses the research process consisting of the literature review, systematic review and use of the Grounded Delphi Method (GDM). This chapter introduces the social constructivist research paradigm that underpinned this research and explores how appropriate and relevant this is to achieve the research objectives. Also, the chapter outlines the theoretical aspect of Grounded Delphi Method (GDM) as the chosen methodology, highlighting how the Grounded Theory and Delphi methods are incorporated to form a more refined research approach. This combines the structured data collection process of the Delphi method with the rigour of the Grounded Theory analysis procedures. In addition, the chapter details the application of the GDM to this research, focusing on the first-round semi-structured interview and the second and third online survey rounds. In doing so, it links the different stages of the research. The stages of the research process conducted in this study are:

- Stage one – Literature review
- Stage two – Systematic review
- Stage three – Delphi round one (semi-structured interview)
- Stage four – Delphi round two and three (survey).

3.2 Justification of Theoretical Approach

This research was undertaken from a constructivist paradigm or interpretivist tradition. This is achieved by adopting, specifically, the viewpoint of social constructivism that is based on the social

process and interactions when constructing knowledge and reality (Schwandt, 2007). It can be argued that all research is interpretative (Creswell and Poth, 2018; Denzin and Lincoln, 2018). It influences the research in the type of questions being asked and the attached interpretations to these questions. A research paradigm incorporates questions relating to ontology (what is the nature of reality), epistemology (how we come to know what we know) and methodology (how the knowledge should be gained) (Denzin and Lincoln, 2011). Likewise, axiology (ethics) is seen as another element which is incorporated to form the philosophical underpinnings that characterise each paradigm and embody the researcher's beliefs or worldview (Nutt *et al.,* 2009). This is used to inform the research process and guide researchers in the selection of method and the general principle and prescriptions of the paradigm (Lincoln and Guba, 1994).

The key constructivist paradigm of the current research suggests the interpretivist tradition (Denscombe, 2010; Grix, 2010; Denzin and Lincoln, 2018). This strategy shows the interpretivist approach reacts to the positivist idea that social research can be studied in the same way, employing the same paradigms and methods used in natural science (Spender, 2008) such as conducting experiments to test theories. The interpretative paradigm influences the type of questions the researcher asks, and the interpretations attached to these questions. Irrespective of this, choosing a paradigm influences the way researchers view the world, how they acquire knowledge and the type of strategy adopted in answering the questions in the study (Denzin and Lincoln, 2018). Constructivist-interpretivist paradigm, which was chosen for the current study is in line with the aim of the research as it acknowledges the subjectivity of the research, including the multiple realities of the participants in this research.

3.2.1 Relationship of Research to Practice in the Interpretivist Tradition

Researchers need to employ methods that are most appropriate for addressing their research questions and objectives (Charmaz, 2014). Hence, choosing a method should give a natural setting, allow

modification of questions to follow up development concerns from the collection of data rather than imposing the researcher's etic viewpoint, and be specific for the context and time of the research. This study adopts a research practice that brings together the researcher and expert group (government officials involved in the climate change policy process) within climate change fields. This supports an interpretivist approach where practice activity and research inform each other (Willis, 2007). This shows that the reflection of experienced experts, or stories of people with relevant experience, is a prized source of knowledge and understanding. An interpretivist using these data is not problematic to some degree, as all researchers are viewed as being subjective. Also, an important consideration for an interpretivist methodology is that contextual data is more valued than data gotten out of context (Sandberg, 2005; Willis, 2007). In addition, this research adopted a GDM which allows insight into the development and implementation of policy that supports community resilience in the face of climate change. This approach emphasises the relevance of the meaning within context, and the process for the studied community that interprets situations or occurrences in terms of the meaning people bring to them (Denzin and Lincoln, 2005; Paivarinta *et al.,* 2011). This research uses GDM by adopting semi-structured interviews and online surveys which were deemed to best align with the research paradigm to achieve the aim and objectives of the research. By selecting the expert group within the government body that are involved in the climate change policy process as participants for the current research, an interpretivist tradition is a suitable approach.

It has been shown that ontology, epistemology, methodology and method determine and underscore the whole research process (Guba and Lincoln, 2005; Bryman, 2016). The process of aligning the social constructivist paradigm within the interpretivist tradition have been discussed within this research and is considered to be the most appropriate approach to use in meeting the objectives of this research (see Figure 3.1). This has led to the adoption of Grounded Delphi Method (GDM) as a fitting choice for the work.

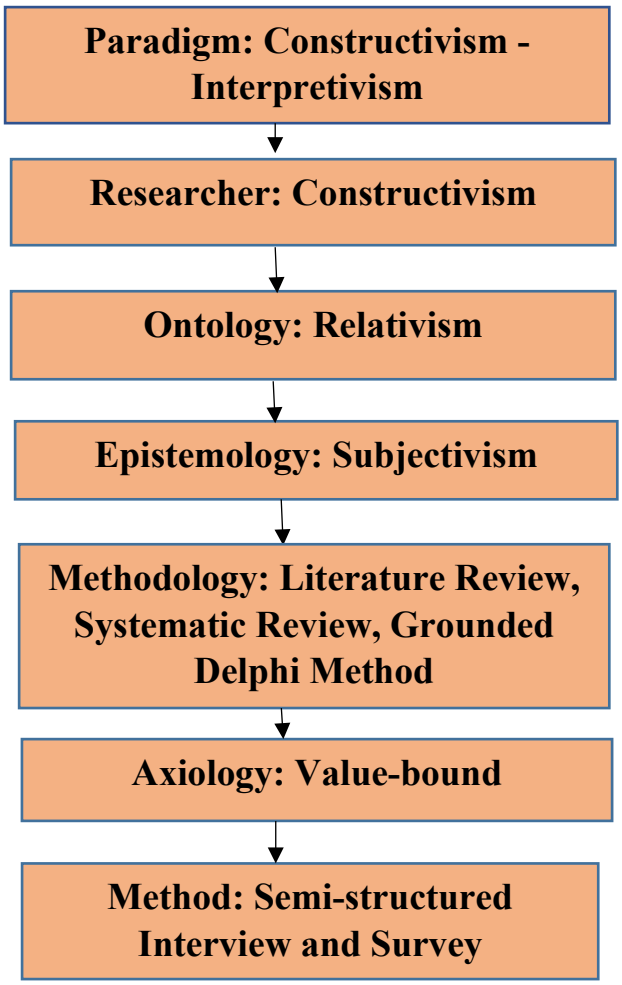

Figure 3.1. Theoretical framework of this research

3.2.2 Method: The Grounded Delphi Method

This research was conducted using GDM, which is relatively a new research method that combines the features of Grounded Theory and Delphi Method. This method was developed and first used in a study on the issues related to information technology procurement in the public sector in Norway information technology research by Paivarinta *et al.* (2011). It has also been used in two doctoral dissertations: the first in 2012, in the area of business decision making; and the second in 2015, in a research programme that explored the skills, knowledge, qualities and professional education needs of information professionals in galleries, libraries, archives and museums (GLAM) in Australia, by Howard (2015) and in her publication in 2018.

GDM helps to improve theory building in the Delphi method by including the features of Grounded Theory in the collection of data and analysis phases. In Grounded Theory, the theory should emerge rather than be built (Okoli and Pawlowski, 2004), which is the approach that will be used in this research. Precisely, this research will follow the Delphi process of a series of data collection rounds with selected expert group from the climate change policy field. Furthermore, the Grounded Theory data analysis adopted in this research is carried out concurrently with the collection of data and uses the techniques of open, axial and selective coding. Hence, data analysis generates a set of categories after each data collection rounds, which forms the base for the next round of data collection.

3.2.2.1 Delphi Method

Delphi method is used as a tool to reaching experts, under anonymity to each other, and address situations in which the relationships between variables are very complex (Musa *et al.,* 2015). Delphi method is also a communication tool for groups, and a means to reach consensus on a given topic amongst experts (Hsu and Sandford, 2010). It helps to reduce ambiguity and increase accuracy (Forsyth, 2010). It is also a structured method for the data collection process and provides a design for conducting research (Howard, 2018). The choice of a specific design and the methodology of a Delphi process relies on research questions/objectives defined by the researcher and varies significantly among studies (Hallowell and Gambatese, 2010). The process involves multiple rounds of data collection from the same set of participants, with the results informing each round. According to Okoli and Pawlowski (2004), the use of an experts' has been occasionally problematic as regards to data collection. This is largely because even if experts are knowledgeable on a topic, if not carefully selected, will result in bias (Howard, 2018). Also, keeping the experts might be challenging when the number of data collection rounds and ranking increases. Despite this, the use of expert groups is very useful if the panellists form a representative assemblage (Hsu and Sandford, 2010). Delphi method used in this study was devised to assess a list of pre-defined indicators for measuring community

resilience in the face of climate change. This approach can be used to collect qualitative data, as reflected in this research.

The major advantage of Delphi method is in the preservation of the anonymity of each participant. It helps to achieve group decision-making and eliminates face-to-face interactions where people in authority or stronger personalities might dominate some members. Likewise, one of its limitations is that it is time-consuming for the researcher and participants. A considerable amount of time goes into the design, conduct, data collection and analysis, giving feedback to the expert groups, and repeating the process. However, the use of online tools has reduced the issue of time considerably. Time was not an issue for the current work as the researcher was registered full-time with the research programme completed over a period of four years. There is also a challenge with low response rates and dropouts, participant selections and the interpretation of the qualitative data. Despite these limitations, this research was able to reduce these issues, as discussed in section 3.6.1.1.

3.2.2.2 Grounded Theory

Grounded theory is defined as a method for theory development that is grounded in the systematic data collection (Charmaz, 2014). Grounded theory method comprises of a logical approach to qualitative analysis for constructing theory (Charmaz, 2017). Grounded theory values construction of theory over description; patterns in data over stories of individuals; and developing new theories over theory application; which makes it different from other qualitative approaches (Charmaz, 2017, p.2). The construction of theory from data collection underpins the choice of using this method as appropriate for this research, which can inform policy and practice (Fulton and Hayes, 2012; Charmaz, 2014; Birks and Mills, 2015).

Just like the Delphi method, the processes of data collection and analysis for grounded theory are linked and iterative. The analysis process helps in generating categories that commence when the first

data set is collected, and open coding is used to create these initial categories by using constant comparison (Urquhart *et al.,* 2010). The data collection continues until saturation of the identified categories is achieved (Urquhart *et al.,* 2010; Charmaz, 2014). The element of Delphi method is incorporated to form the GDM to improve the theory building in this research.

Grounded theory is criticised in the aspect of theory development as very few studies get to actually develop a theory (Urquhart *et al.,* 2010). This led to the method being viewed as a way of coding data only. Authors have suggested various guidelines to the coding process (Urquhart *et al.,* 2010; Charmaz, 2014; Birks and Mills, 2015). The developer of the GDM adopted the Straussian approach to grounded theory coding process using the steps of open, axial, and selective coding (Paivarinta *et al.,* 2011) and this process will be followed in this research.

3.3.3 Alternative Experimental Designs

3.3.3.1 Qualitative Approach

Qualitative approach is an in-depth investigation of phenomena through the collaboration of rich material using a flexible study design (Polit and Beack, 2010). This approach entails a detailed understanding and compares social phenomena such as policy. Researchers use this approach as an excellent way to retain the integral and meaningful characteristics of real-life situation. According to Bryman (2012), theory is the target of qualitative research. This approach relies on text rather than data (Saunders *et al.,* 2007). Qualitative research tends to be inductive and interpretivism and this approach uses several tools and techniques such as narrative, phenomenology, grounded theory and case study to develop a good understanding of how people perceive their social realities and act within their social world (Birks and Mills, 2013). According to Creswell (2007), data are collected for qualitative research using interviews, focus groups, small size survey, observation, expert's

consultation and participant observation. Wolf and Moser (2011) assert that the use of qualitative approach will enable the researcher to better understand climate change policies.

3.3.3.2 Quantitative Approach

Quantitative approach investigates the phenomena that lend themselves to measurement and quantification, involving rigour and controlled design (Polit and Beck, 2010). Quantitative research is about collecting numerical data to explain a phenomenon. According to Bryman (2012), it needs a deductive approach that links to hypotheses, which are drawn from theory. Quantitative approach involves different type of designs such as survey, quasi-experiments and classic experiments (Saunders *et al.,* 2007). Table 3.1 shows the distinction between qualitative and quantitative approaches.

Table 3.1. Distinction between qualitative and quantitative design

Qualitative	Quantitative
Hypothesis and theory development	Hypothesis and theory testing
Action based	People's behaviour
Small sample size	Large sample size
Words	Numbers
Contextual understanding	Generalisation
In-depth, rich data	Structured
Process	Static
Micro	Macro
Theory emerges	Theory testing
Researcher close to participants	Researcher distant from participants
Low reliability	High reliability
High validity	Low validity

3.3.3.3 Mixed Method Approach

Mixed methods approach involves the collection and analysis of both qualitative and quantitative data within the same study (Creswell and Plano, 2011). The main strength of mixed methods is the opportunity to use different approaches to provide a better understanding of an event that would not be possible by just using a single method (Bowling, 2009; Bowers *et al*., 2013). Moreover, Saunders (2009) pointed out that there are two main advantages for choosing multiple methods in the same research. The first benefit is that using different approaches can achieve different objectives in a study improving confidence in the findings. The second advantage is the possibility of using triangulation that refers to the use of more than one method in the same study such as interviews and questionnaires (see Table 3.2). The mixed method also helps by strengthening the weakness of the other designs. Similarly, Tashakkori and Teddlie (2003) argued that mixed method has a lot of benefits which are to: help answer research questions that the other methodologies cannot; and offer great diversity of the divergent views. Therefore, this research employed this approach using Grounded Delphi Method by using semi-structured interview and small-sized survey.

Table 3.2. Types of methods and their advantages and limitations

Methods	Advantages	Limitations
Questionnaire	Large amount of data collected from large population	Difficult to understand
	Can involve someone else other than the researcher	Cannot tell how truthful a respondent is being
	Results are quickly quantified	Respondent may be forgetful
	Analyzes more scientifically and objectively	Cannot tell the thought of the respondent
	Can be used to create new theories	Ask only a limited amount of information without explanation
Interview	In-depth information collected	Complications with interview planning
	Questions can be tailored to get rich data	Missing some information during the interview
	More information can be gathered during data collection	Difficulties in coding data as it is time consuming

	Detailed descriptive data	Difficult to compare with other populations
	Insight into people's experiences	
Focus group	Used in exploring cultural values and health beliefs	Lack of privacy or anonymity
	Examines why people think in a particular way and how it influences their believes or values	Balancing groups appropriately (culturally and gender) is difficult
	Explore complex issues	Not allowing other attitudes or beliefs
	Develop hypotheses for further research	Group can be dominated by one or two persons
	Participants do not have to be literate	Time consuming to conduct and analyse
Observation	Free of observe bias	Missed interaction
	Reliability can be strong	A measure of unreliability
	Generalisability	Ignores the temporal and spatial context of data collection
	It is precise	Not good in insight generation
	Provides a structure for the research	It ignores process, development, flux and change
Case study	Can formulate a valid hypothesis	A vague process
	Provides insight for further research	No limitation of study
	Provides detailed rich information	Based on several assumptions
	Permits investigation of unethical situations	Based on comparison with past life
	Gives good knowledge that is useful for personal and public life	Time consuming, expensive and complex

3.3.4 Justification for using Grounded Delphi Method

In any research undertaking, it is important to select a method that can help address the research aim and objectives. Importantly, it needs to correspond with the philosophical tradition selected to guide the research. The constructivist tradition is being used within this research as discussed in Section 3.2. The constructivist believes that there is no singular path to knowledge that is right and no special method that leads to an intelligent process automatically (Charmaz, 2014). However, method selection is not a random decision, but rather a constructivist value that there are many possible ways a research problem can be understood and there should be no arbitrary restrictions in the choice of method. The use of GDM supports the aim and objectives of this research and is recommended for

exploratory research in emerging research areas (Paivarinta *et al.,* 2011). The benefit of the GDM is that due to multiple iterations, it allows time for reflection as it supports the emergent purpose of the research. Furthermore, the GDM was the appropriate method to use due to the participants being geographically dispersed, thereby, saving valuable time and resources for them and the researcher by avoiding the need for face-to-face meetings and the limitations that come with such approaches. According to Williamson (2002), face-to-face meetings with a large group can be ineffective. The target number of participants for this study was 35, which would have made face-to-face meetings very difficult to facilitate even if it could be possible or more time would have been spent. Therefore, the benefits of using GDM outweigh the disadvantages of the method, especially as it helps to minimise any issues that could be encountered. GDM is also suitable for data collection where problems or issues have no previous research or there is no available documented information (Hsu and Sandford, 2010). As discussed in Chapter 1, there is little empirical research undertaken in the area of community resilience in the face of climate change, and there are no studies found with a Nigerian focus as an example of developing countries. Therefore, the use of GDM in this research is highly appropriate.

3.3 Research Process

As recommended by several researchers (Berg, 2007; Bryman, 2016; Creswell, 2013; Fletcher and Marchildon, 2014), the complex interaction between community resilience and climate change was explored through an exploratory mixed method approach with the application of GDM. The research design is divided into four stages (Table 3.3) and the research methods adopted include a literature review, a systematic literature review and a three-round Delphi interview and Delphi survey data collection and analysis.

Table 3.3. Research process

Aim: To inform the development and implementation of policy to support community resilience in the face of climate change			
Objectives	Stages	Key findings	Chapters
To identify international climate change policies that are translated and implemented in Nigeria's environmental regulations and interventions.	Literature review	There is a gap in the literature related to measuring the effectiveness of policies that have been implemented in Nigeria's environmental regulations and interventions. While there is a lot of literature on the meaning and context of community resilience, there is no singular definition of community resilience. They present different definitions of community resilience and different methods for measuring the impact of policies.	Chapter 2
To identify and clarify the key different ways community resilience is operationalised within the academic literature.	Systematic review	A systematic review was conducted to examine the different meanings of community resilience and how it is measured. The review identified: Three different ways community resilience is defined (coping capacity, adaptive capacity, coping and adaptive) and their combinations. 49 indicators that are relevant to reducing the effect of climate change. There is a lack of consensus relating to what community resilience is and how the impact of policy might be measured and monitored.	Chapter 4
To explore how community resilience is operationalised within the context of Nigeria and its implications for policy.	Delphi one (Interview)	Interviews were conducted with Nigerian experts involved in the policy process to understand how community resilience is defined and how it is measured and monitored in practice. The interviews identified: Two different ways community resilience was defined (coping capacity and adaptive capacity) and their combination. 17 indicators that are relevant to reducing the effect of climate change were identified.	Chapter 5
To provide a methodology by which consensus can be achieved between experts on how competing issues can be prioritised to improve community resilience in developing countries.	Delphi two (survey)	Delphi survey was conducted to examine how significant each of the 17 indicators is, and where stretched finances need to be the focus in developing countries such as Nigeria, to achieve a consensus from the expert panel. The survey outcomes were: All the indicators were identified as important to measuring community resilience and reducing the effect of climate change in Nigeria. Only ten indicators gained consensus among the 20 experts. Three more indicators were suggested by the experts bringing the total indicators to 20.	Chapter 6
	Delphi three (survey)	The third round of Delphi survey was conducted for experts to review and give their final rating for each community resilience indicators and feedback from the first round was sent out to the expert. The second survey showed that: All the indicators were identified as important to reducing the effect of climate change in Nigeria. All 20 indicators gained consensus among the 20 experts, and the indicators were ranked.	

The initial literature review conducted in stage one of this research identified international policies adopted in Nigeria and a research gap in relation to measuring the effectiveness of the policies that have been implemented. The review also identified how community resilience is conceptualised in the literature. There is an abundance of literature on the different meanings, frameworks, and different contexts employed that have different conclusions about community resilience. Given this, it is important to identify the different meanings and to understand how they are being applied by decision-makers, researchers or communities to understand, measure and build the resilience to climate change. Thus, a systematic review (stage two) was conducted to examine the different meanings of community resilience and how it is measured within peer-reviewed publications. The review identified that three different ways – coping capacity, adaptive capacity, and transformative capacity – were used to define community resilience. It further identified 49 indicators that are relevant to reducing the effect of climate change and measure community resilience, and a lack of consensus on what community resilience is and how the impact of policy might be measured or monitored.

In stage three, Delphi one (semi-structured interview) was conducted with Nigerian experts involved in the policy process (design, implementation and evaluation of climate change policies) to understand how community resilience is defined and how it is measured and monitored. The interviews identified two different ways of defining community resilience – coping capacity and adaptive capacity – and identified 17 indicators that are relevant to reducing the effect of climate change.

Stage four consisted of Delphi two and three (survey) which was conducted to examine how important each of the 17 indicators is, in the context of financial limitations in Nigeria, and to achieve a consensus from the expert group. The Delphi two identified all the indicators as

important to reducing the effect of climate change in Nigeria, but only ten indicators gained consensus among the 20 experts. Furthermore, three more indicators were suggested by the expert panel to be included, which brings the community resilience indicators to 20. The Delphi three (survey) was conducted to ensure that consensus was reached on all 20 community resilience indicators and to provide feedback to the experts. The Delphi round three identified indicators that can be used where stretched finances need to be focused on in Nigeria, as an example of developing countries, to enable communities to be resilient to climate change. The consensus was reached on the 20 community resilience indicators which were categorised under eight community resilience elements identified from stage two (systematic review), and the community resilience indicators were ranked under these elements.

3.4 Stage two Systematic Review

In stage two of the research, a systematic review was conducted to address objective 2 and examine the different meanings of community resilience and how it is measured within the academic literature in the face of climate change. This systematic literature review employed both qualitative and quantitative data analysis as described by Ford *et al*. (2011) and Berrang-Ford (2015). A period of 2008 – 2017 was considered following the IPCC calls for greater community resilience in 2007 (IPCC, 2007). To ensure the academic quality of the material considered, resources such as books, book chapters and grey literature were excluded while only peer-reviewed publications were included in the review. These were extracted from Elsevier Scopus, Thomas Reuter Web of Science and Science Direct databases. Multiple databases were used to prevent European (Scopus) or American (Web of Science) bias (Biesbroek *et al*., 2013). To identify the relevant papers, the search terms <community

resilience>, <climate change>, and <policy> were used (Table 3.4) and limited to the title, keywords and abstracts.

Table 3.4. Search configuration for the systematic review

Search	Configuration
Scopus	(TITLE-ABS-KEY (community resilience)) AND ((policy) OR (strategy) OR (approach) OR (scheme) OR (programme) OR (schedule) OR (guideline*) OR (rule*) OR (procedure) OR (practice)) AND ((climate AND change) OR (climat* AND variability) OR (climat* AND extrm* AND event) OR (global AND warming) OR (climat* AND risk) OR (climat* AND uncertai*))
WOS	TS= ((Community Resilience) AND (Policy OR strategy OR approach OR scheme OR program* OR schedule OR guideline* OR rule* OR procedure OR practice) AND (climat*-change OR climat*-variab* OR climat*-extrem*-event OR global-warming OR climat*-risk OR climt-uncertai*))
Science direct	TITLE-ABSTR-KEY ((Community Resilience) AND (Policy OR strategy OR approach OR scheme OR program* OR schedule OR guideline* OR rule* OR procedure OR practice) AND (climat*-change OR climat*-variab* OR climat*-extrem*-event OR global-warming OR climat*-risk OR climt-uncertai*))

Also, the search area was limited to environmental science and social science to ensure relevance in the search results, as suggested by Phuong *et al*., (2017), which resulted in 1036 articles after duplicates were removed (Figure 3.2).

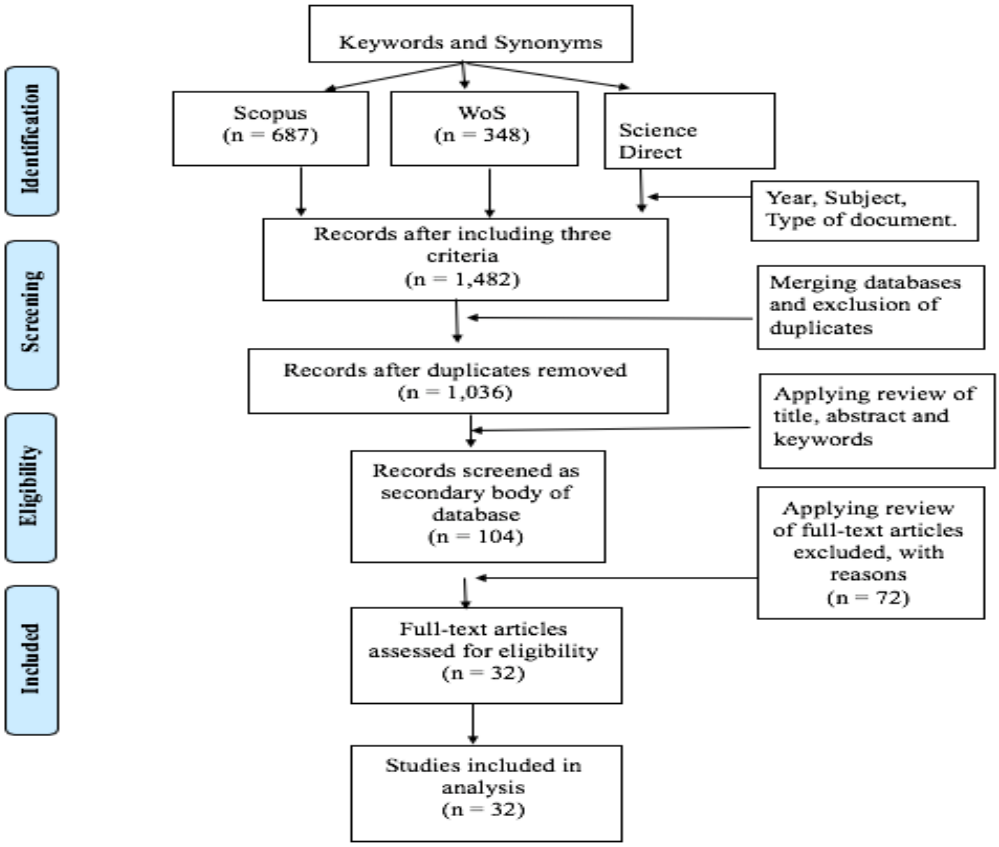

Figure 3.2. The data collection process for the systematic review

The 1036 articles were exported to RefWorks and filtered further by reading the title, abstract and keywords to identify articles that focused on community resilience in the context of climate change. Articles that did not consider climate change were excluded. This resulted in 104 articles, which were read in full to identify those that operationalised measurable indicators to measure community resilience and applied those indicators to real-world cases. This systematic review resulted in 32 papers that are included for analysis (Appendix 8.1). The results and analysis are discussed fully in Chapter 4.

3.4.1 Limitations of the Systematic Review

The systematic review focused only on peer-reviewed publications. Other sources such as grey-literature (including non-peer-reviewed research, policy documents and reports) were excluded. As a result, reports that provide other evidence on community resilience to climate change could have been omitted. Likewise, in including keywords and search strings, some publications might have been excluded from the searched databases used, due to the difference in keywords that may refer to similar events. Some examples include neighbourhood resilience, social resilience, strategies, and disaster. Also, only three scientific databases were used; however, more publications might have been included with the use of other databases such as Google Scholar. Notwithstanding, having more databases does not mean all publications in the field will be included as some will still be left out due to restrictions such as language. In this case, only publications written in the English language were included with relevant resources written in other languages omitted. Hence, there is some degree of relevant publications relating to community resilience that were not picked up by these search terms (inclusion criteria).

3.4.2 Systematic Review of Data Analysis

Descriptive statistical analysis and thematic synthesis (Gough *et al*., 2012; Berrang-Ford *et al*., 2015) were applied to analyse the results of the systematic review. Descriptive statistics were used to describe the trends across the year of publication, group the publications on the focused areas and what methods they used. Thematic analysis was done by analysing the content in each of the selected articles to identify set themes on the definition of community resilience and indicators used in measuring community resilience. This involved reading the articles forensically to discover patterns, themes or categories. Three different ways of defining community resilience were identified – coping, adaptive, and transformative capacity – along

with 49 indicators used in measuring community resilience. These indicators were subsequently grouped under eight community resilience elements of demographic, social, economic, infrastructure, institution, environment, training and awareness, and health and fatality. Other studies have also shown that the resilience concept in relation to disaster is categorised under the following: social, economic, institutional, infrastructural, community, natural, communication, and health and wellbeing (Twigg, 2007; Cutter *et al.,* 2008; Norris *et al.,* 2008; Ainuddin, 2012; Alshehri *et al.,* 2015; Cutter, 2016). Although there were different approaches to defining community resilience and how it is measured, there was a lack of consensus on what community resilience is and how the impact of policies might be measured and monitored. Principal component analysis (PCA) was then used to check if the community resilience indicators are positive or negative.

3.5 Application of the Grounded Delphi Method

The application of the GDM in this research is discussed in this section. It begins with the first-round semi-structured interview using the exploratory Delphi approach. This includes the discussion of the selection of experts and the guides that form the data collection instrument, and then a description of how the second and third rounds were conducted. Each round involves compiling, pilot testing and using a separate data collection instrument and finally analysing the data. The analysis of each round identified a set of indicators, which were used to inform data collection for the next round.

3.5.1 Stage Three: Round One (Semi-structured Interview)

Stage three of the research was used to address the research objective 3. Hence, a semi-structured interview was conducted with Nigerian experts involved in the policy process to understand how community resilience is defined and how it is measured and monitored. The rationale for the use of a semi-structured interview in this research was to provide a form of

structure in the interview process. The use of semi-structured interview was recommended by Birks and Mills (2015) to cover situations where experience is shared by participants when asked or prompted with specific questions. The use of semi-structured interview also helps the interviewer to not run out of questions to ask (Charmaz, 2014; Birks and Mills, 2015). The interview questions were piloted, which allowed informed modifications before the questions were used (Teijlingen and Hundley, 2001; Jacob and Ferguson, 2012; Clibbens *et al*., 2012). Piloting of interview questions has been shown to help in strengthening the interview protocols (Castilo-Montoya, 2016). Four participants from the government ministry, both my supervisors and six PhD colleagues were used to pilot the questions and were all excluded from the subsequent interviews for the study. The results and analysis are presented and discussed in detail in Chapter 5.

3.5.1.1 Selecting Expert Group

Expert selection is one of the most important parts of the Delphi method. However, in relation to Delphi study, what constitutes an expert remains ambiguous with little guidance from the literature (Hsu and Sandford, 2007). Nonetheless, according to Donohoe (2011), experts are typically selected on the basis of the following characteristics and criteria: knowledge and experience of the study field; more than five years of working experience in the area of interest; ability and willingness to participate; adequate time to participate; and effective communication skills. Some of these procedures were also adopted by Päivärinta *et al.* (2011) and Howard (2018) in their Grounded Delphi studies, and it was appropriate to employ this procedure for the current research for its successful adoption of the combined GDM. An important aspect of developing an expert panel is to ensure that the participants are highly relevant to the questions asked, which would ensure their interest throughout the Delphi process (Donohoe, 2011). Therefore, the expert panel was made up of experts from federal and state government levels. These are government officers involved in the design, implementation

and evaluation of climate change policies and are able to influence these factors differently within their own capacities. According to Feliciano *et al*. (2014), the success of policy implementation strategies is reliant on consultation or involvement of key stakeholders from all levels.

There are no clear guidelines on the size of an expert panel (Donohoe and Needham, 2009). However, similar studies have used different panel sizes that included 15 to 60 participants (Clayton, 1997; Hasson *et al*., 2000; Jirwe *et al.,* 2009; Alshehri *et al.,* 2015). Okoli and Pawlowski (2004), suggested that a typical panel size is ten to 18 members while others considered 12 participants to be adequate as larger sizes could have diminishing returns on the validity of the findings (Powell, 2003; Okoli and Pawlowski, 2004; Baker *et al*., 2007; Nguyen and Giang, 2017). The size of the panel for the current research, its characteristics and composition ensured that all the relevant expertise were represented, and the panel was compatible with the research in question which was based on Delphi. Therefore, thirty-five experts were invited to participate in this research; however, theoretical saturation which indicates no further data collection is required, was used where data was collected until the categories were saturated. This was considered a priority in grounded theory research (Charmaz, 2014) as adopted in this research. As a result of the saturation, only 21 experts were interviewed in the first round, and these same experts were asked to take part in the second and third round with 20 of them completing the last two rounds.

One of the disadvantages of using the Delphi study is that participants can drop out between rounds. To minimise this, Jirwe *et al*. (2009) highlighted the need to inform all experts involved in the research about the importance of the study and the need for them to engage with every aspect of the process. To this end, each expert was contacted through electronic communication, using email and telephone calls to explain the purpose of the research. Consent

forms were sent to the participants by email, informing them of the entire procedure and all the possible applications of the information, ensuring that participants can withdraw from the research at any time, awareness of audio recordings and how the data would be stored. All the interviews were stored with a code name from A – U on the researcher's secure university-allocated personal computer for transcription and a laptop protected using a strong password from any other access. All participants were made aware that the data would be kept confidential (Byrne, 2001), which is in line with the ethical requirement.

Snowball sampling was used to ensure that the experts met a pre-defined definition of expertise in the fields. This sampling method is a type of purposive sampling where further participants are obtained from the existing participants (Cloke *et al.,* 2004; Taherdoost, 2016). The snowball sampled experts identified have at least five years' work experience with extensive knowledge about climate change policies and community resilience. Generally, this sampling method was chosen to help overcome the problem associated with the sample size (Faugier and Sargenant, 1997; Cloke *et al*., 2004).

At least 21 informed experts from national and state levels involved in policy process were interviewed around three key areas: how government officers understand community resilience; if they think current policies support community resilience; and how levels of community resilience might be measured (see interview questions in Appendix 8.2.2). Upon receipt of the participant's consent, the interview was arranged according to the availability of the participant. The phone call interview provided the participants with the right to withdraw from the interview at any point they felt uncomfortable during the interview (Wilson *et al*., 1998). These, when compared with face-to-face approaches, helped reduce the absentee rate, facilitated the ease of rescheduling interviews and ensured that time and financial resources were not lost (Smith, 2005; Musselwhite *et al*., 2007). All interviews were audio-recorded, and

an interview guide was used to ensure that all the questions were covered (Krauss *et al*., 2009). The interviews included open-ended questions which lasted between 30 minutes to one hour. The participants were still told verbally about the purpose of the research and asked if they are still happy to be involved (King and Horrock, 2009). This data collection took place from March to April 2019. The participants remained the same throughout the Delphi rounds, which is in line with Delphi and GDM procedures.

3.5.1.2 Delphi One Data Analysis

The drive of the round one analysis was to identify any common themes or if any issues emerged. All the data from the interviews were audio-recorded, transcribed and manually analysed which enabled good engagement with the data by assigning codes and developing categories. The transcript took about four hours to type. However, it is a good way to get familiar with the data (Bell, 2009). Verbatim quotes from the interviews were used in the analysis, which is important to ensure that the richness of the participant's language and wording is not lost (Cloke *et al*., 2004). After transcription, these data were subjected to the coding technique as they underwent a sifting and categorisation process. Open coding was done to highlight distinctive words and phrases for further analysis and subsequently commonly occurring themes were identified, and significant parallels and contrasts were noted—the use of open coding is an identifying concept commensurate with the Grounded Theory aspect of this research. The process identified that three different ways – coping capacity, adaptive capacity and transformative capacity – were used to define community resilience. Likewise, it identified 17 measurable indicators that were further categorised under eight elements (demographic, social, economic, infrastructural, institutional, environmental, training and awareness, and health and fatality; see Table 3.5). These were found to be relevant and to correlate with the analysis of the empirical material from the systematic review literature. Therefore, the findings of the systematic review were applicable to the Nigeria context and to

other developing countries. Furthermore, new indicators were identified from interviewing the experts that were different from the systematic review themes. For example, different indicators were identified as relating to different levels of community resilience in the face of climate change in the interviews conducted with experts in the field. Hence, in trying to find out the significance of each of these indicators in the Nigerian context and to achieve a consensus, Delphi round two and three (survey) was conducted. The round one was used to inform the round two.

Table 3.5. Example of few interview transcripts and coding process leading to the construction of the core category

Interview transcript	Open coding	Axial coding	Selective coding
People are more knowledgeable now about the climate change impact and are involved in preventing flooding from damaging their houses and farms, by using sandbags, irrigation and building on highland area.	Resilient infrastructures	Resilient infrastructures and maintenance	Infrastructural
The monitoring is done through a framework which is coordinated by the budgeting team and the monitoring and evaluation team from the ministries by conducting surveys, visiting sites, checking reports and giving feedback.	Improved awareness	Monitoring and feedback mechanism	Training and awareness
Communities have been trying to adapt through crop rotation which helps the soil to regenerate over the years, storing of grains for the future, tree planting have been encouraged greatly, re-afforestation of the forest with government collaboration with the community member, which a project was introduced by the government called the 'great green wall' and introducing law enforcement to arrest anyone poaching.	Crop rotation, storing of grains, tree planting, re-afforestation,	Sustainable agricultural practices	Environmental
There is a need for community engagement and empowerment across all board. Communities need to be part of the process as it is only on this basis, they will know the government have their interest at heart and community engagement and community participation like in awareness campaign, festivals, support system, are key to community resilience.	Engagement, empowerment, part of process, participation	Community engagement and empowerment	Social
Introducing ecological fund help reduce the effects of climate change. Because of the policies introducing ecological fund, people were able to move to shelters during a flood event and move back	Funding, cost	Ecological fund	Economic

to their communities and homes afterwards, without incurring a lot of cost'.			
Government is beginning to see that these rural communities are at the receiving end of climate change impact and are trying to increase education and advocacy in the communities. Education is also a very important component which enables people to have the knowledge to deal with climate change impact, and lack of education is a serious problem in the community	Education, advocacy,	Educational attainment	Demographic
The department for climate change has the responsibility to coordinate all climate change programs in the country and other sectoral ministries and bodies report back to them.	Responsibility, coordination	Equal distribution of responsibility	Institutional
Health issues relating to the environmental impact should be looked at and improved. Community members should live a healthy lifestyle and learn skills to manage stress. People should be able to access hospitals and doctors when they are ill, which is lacking in most local communities'	Health, healthy lifestyle, access to hospitals and doctors	Access to health assistance and facilities	Health and fatality

3.5.2 Stage Four: Round Two and Three (Survey)

The stage four was conducted following two rounds of online survey to address research objective 4, ' to provide a methodology by which consensus between experts on how competing issues can be prioritised to improve community resilience in developing countries'. These two rounds involved the use of an online survey to achieve a consensus. The concern about participants being less likely to explain their opinion in an online survey (Schneider *et al.,* 2002) was not a problem for the survey questions for this research. Although the research is considered to be exploratory, the survey would be exploring the themes generated from the interview. Also, a free-text comment box is included within the survey questions in this research and participants were asked to elaborate on their response and make suggestions. The results and analysis are extensively discussed in Chapter 6.

3.5.2.1 Delphi Round Two

The online survey was conducted to examine the significance of each of the 17 indicators identified in Delphi round one. These indicators can be used where stretched finances need to be considered in developing countries and to achieve a consensus from the expert group. The expert group were also asked to suggest other relevant indicators. The Delphi method suits the requirements of this research as one of its features is to provide discussion and assist in reaching consensus on various issues and validates the results which rely on experts judgements (Skulmoski *et al*., 2007; Bowling, 2009; Donohoe, 2011; Linstone and Turoff, 2011; Musa *et al.,* 2015).

The round two online surveys were used to assess a list of pre-defined indicators for measuring community resilience to climate change. Respondents gave answers using a 5-point Likert-type scale which allows for a degree of opinion in responses, and therefore, quantitative data can be obtained (Asun *et al*., 2016; Bryman, 2016). Twenty-one experts from the previous round one was invited by email to participate in the second round, but only 20 experts completed the second round. A copy of the second-round survey questions can be found in Appendix section 8.3.1. The survey was administered using SurveyMonkey with the link sent by email, which lasted for about three weeks (February to March 2020). The participants were asked to rate the importance of community resilience indicators. Additionally, the experts were asked to provide further indicators that they considered important for community resilience to climate change in Nigeria. The criteria of checking the agreement rating of the impact assigned to the responses included 5 very important; 4 important; 3 moderately important; 2 slightly important and 1 unimportant—this data set was collected in March 2020.

3.5.2.2 Delphi Round Two Data Analysis

Data were exported from SurveyMonkey using its in-built advanced spreadsheet export facility, which is a suitable option if the data is in a numerical format (SurveyMonkey.com 2013). The data were reviewed to ensure there were no errors and then analysed with Microsoft Excel spreadsheet. In measuring for consensus, the methods of standard deviation, weighted mean and interquartile range (IQR) were used in this research as also recommended by Bailie (2011) and Habibi *et al.* (2014).

In the analysis, the weighted average was analysed first to determine the level of importance, then secondly to establish whether there was a consensus reached among the 20 experts and the ranked indicators. The weighted average range in this round shows that all the indicators were significant. The weighted average was used as a method of understanding the experts' judgment on the significance of the indicators (Greatorex and Dexter, 2000). These indicators were significant if more than 60% of experts were in agreement (Diamond *et al*., 2014; Slade *et al.,* 2014; Musa *et al.,* 2015).

Standard deviation was used to measure the consensus (Holey *et al*., 2007) to determine how far each response is from the weighted average (Rayens and Hahn, 2000). Furthermore, a standard deviation of the individual response to each indicator (≤ 1) was calculated. A standard deviation close to zero is considered strong consensus while more than one is reflected as a weak consensus (Goldman *et al.,* 2008).

The IQR less than or equal to one (≤ 1 or = 1) is considered as strong consensus (Murphy *et al.,* 1998) whereas an IQR more than one (>1) is considered a weak consensus. The IQR is very important as it is computed by using data lying along the first quartile (25%) and the third quartile (75%) (Musa *et al.,* 2015). Similar to the findings of the standard deviation, the IQR showed that there was no consensus for three of the 17 community resilience indicators. The

main purpose of using a Delphi method is achieving a consensus from the expert group, which this Delphi round failed to achieve (see Figure 3.3). Thus, a Delphi three (survey) was conducted.

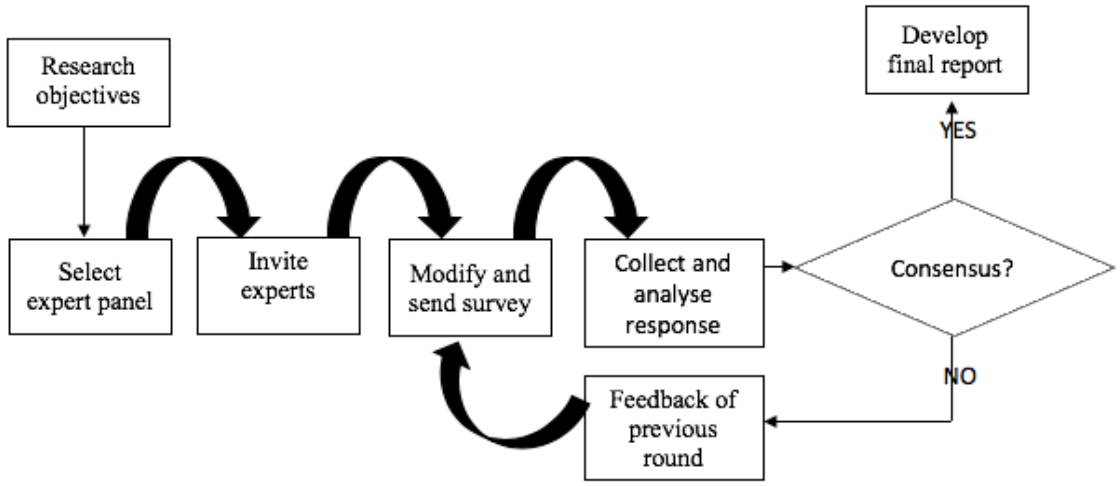

Figure 3.3. Summary of the applied Delphi method (Adapted from Alshehri *et al.,* 2015)

3.5.2.3 Delphi Round Three

The third-round Online survey was conducted to achieve consensus on all 20 community resilience indicators amongst the experts, and feedback was given to the expert group on the second round. According to several studies, expert panels have the opportunity to revise their judgments and to change their answers in order to achieve the required consensus as the Delphi process is iterative and incremental (Okolo and Pawlowski, 2004; De Vet *et al*., 2005; Bailie, 2011). Therefore, the third-round questionnaire was developed in response to the previous-round answers and a survey link was sent to all the 20 experts, which included all the indicators that gained consensus and the ones that did not gain consensus, including the rating summarised from the previous round as feedback to the expert group. All respondents from the previous round were invited by email to participate in the last round, and the invite included the link to the questionnaire. The experts were given a chance to change their judgement of the

relative importance of each community resilience indicator, give their opinion about the importance of the three new indicators that have been added, and then rank the indicators again. Thus, the experts were again asked to rate the answers on a 5-point Likert scale (1= unimportant, to 5= very important) as suggested in various Delphi studies (Duffield, 1993; Mertens *et al*., 2004; Musa *et al.,* 2015). The selection of a 5-point Likert scale is motivated by evidence from the literature which suggests that it "*provides more precise information about the intensity with which an individual may hold specific value*" (Alshehri *et al.,* 2015). This is considered important given the nature (community resilience) of the consultation. The copy of the third-round survey can be found in Appendix 8.3.1. This survey was completed by the 20 experts in April 2020.

3.5.2.4 Delphi Round Three Data Analysis

The analysis was conducted using Microsoft excel. Three indicators were added to the 17 indicators which were suggested by the expert group, bringing the total to 20. In the analysis, the weighted average on all indicators showed to be important. Likewise, the standard deviation and inter-quantile range were between 0 and one (≤ 1) indicating that consensus was reached on all 20 indicators. The consensus on the indicators was categorised under eight elements to support community resilience to climate change in Nigeria.

3.6 Grounded Delphi as Applied in this Current Research

There seems to be a difference in the GDM process between this research and in the two other published studies (Paivarinta *et al.,* 2011; Howard, 2018). To date, the GDM studies that the researcher is aware of employed an exploratory approach of Delphi research although the use of data collection technique to conduct brainstorming rounds was achieved differently (via email by Paivarinta *et al.* (2011); face-to-face focus groups by Howard (2018); and semi-structured interview for the current research). Likewise, the studies all had a validated

component in the concept discovery phase. Nonetheless, it involved the entirety of the two rounds in the case by Paivarinta *et al.,* (2011) and looking at the roles and responsibilities including an addition to the validation component by Howard (2018), while this current research sought for indicator importance and tried to achieve a consensus with other indicators added for subsequent validation (Table 3.6).

Table 3.6. Grounded Delphi process as used in this research

Phase	Task	Round number
Data collection	Selecting expert group. Brainstorming via a semi-structured interview.	1
Concept discovery	Forming the round two survey questions via open coding to identify indicators that are relevant to reducing the effect of climate change to support community resilience. Validate the consolidated list of indicators. Move towards achieving a consensus. More indicators suggested by the expert group. Further analysis of round two via open, axial and selective coding to discover indicators importance and priority.	2
Concept prioritisation	Survey question created from round two data analysis. Move towards consensus. Rank the indicators via selective coding to discover core elements.	3
Theory development		4

3.7 Conclusion

This chapter discussed an overview of the philosophical underpinnings of this research. It explains the research paradigm and methodology used in the research. The forming of the GDM was discussed linking the relationship of Grounded Theory and Delphi Method. The application of the GDM to this research was explained. The justification for the choice of research methodology was provided. The research was divided into four stages of literature review, systematic review, Delphi round one (semi-structured interview) and Delphi round two and three (survey). These methods were used specifically to address the aim and objectives of the study. Specific details of these methods are presented as relevant in each of the subsequent chapters.

4 Understanding Community Resilience

4.1 Introduction

This chapter shows the results and discussions on how community resilience is understood within the academic literature. It is a synthesis and combination of both qualitative and quantitative analysis. It gives an overview of how community resilience is defined and how it is measured. Also, the main findings of the systematic review are presented. The methodology for this chapter has been presented in Chapter 3, section 3.4.

4.2 Systematic Review Data Analysis

The 32 articles as identified through the methodology in Chapter 3, section 3.4 were analysed to examine (1) date of publication, (2) methods of data collection (i.e. primary and secondary), (3) geographical scale (i.e. local, regional and national) and (4) methods of data analysis (indicators used to measure community resilience). Strobe tool was adopted for the individual quality appraisal for this research. A checklist was used (see Appendix 8.1.1) to ensure a clear presentation of what was planned and carried out in the studies.

Measurable community resilience indicators were identified from each publication and subsequently grouped in terms of similarity and difference to form the categories of community resilience elements. The descriptive trends of the systematic review results from the identified publications are presented in Figure 4.1. The frequency of publications showed a gradual increase during the years considered. Also, 72% of the papers used primary data collection while 28% used secondary data collection. In terms of geographical interests, 66% of the publications included focused at the local community level, 25% addressed city level and 9% at the national level. The resulting data are presented as a summary table (Appendix 8.1.3) to ensure that all the reviewed articles can be accessed quickly (Berrang-Ford *et al*., 2015).

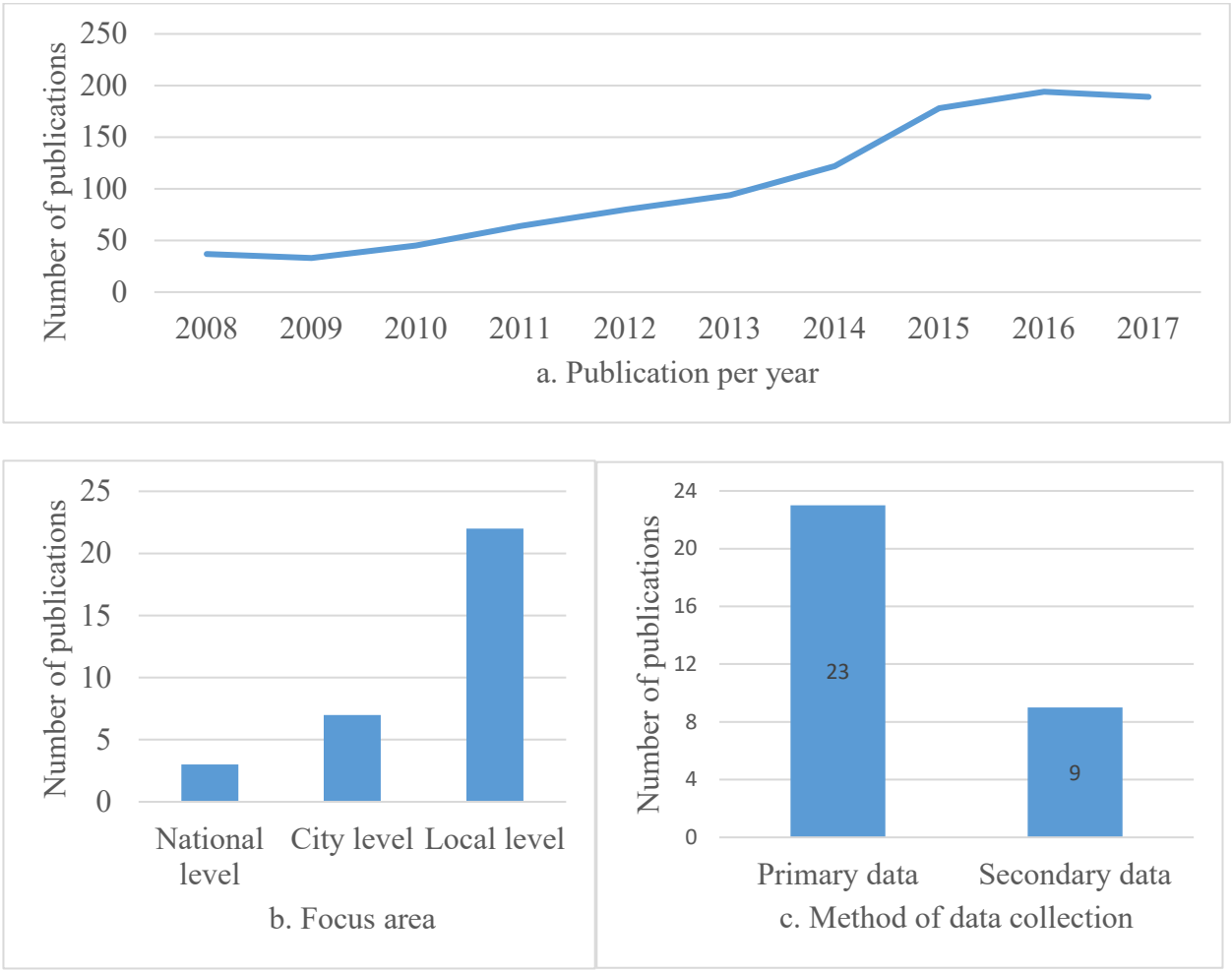

Figure 4.1. The number of publications for each year between 2008 and 2017 (a) with the focus area (b) and method of data collection (c) identified

Descriptive statistical analysis and thematic synthesis (Gough *et al*., 2012; Berrang-Ford *et al*., 2015) were applied using the questions of: how is community resilience conceptualised; and how is it measured? Qualitative analysis of the content of each of the selected articles was done to identify set themes on the definition of community resilience and identified indicators used in measuring community resilience. This involved reading the articles forensically to discover patterns, themes and categories. The methods used (qualitative or quantitative), the study country and whether this was a developed or developing nation, are summarised in Table 4.1. Three different ways of defining community resilience were identified - coping, adaptive, and

transformative capacities - along with 49 indicators that measure community resilience. These indicators were subsequently categorised under eight community resilience elements of social, economic, demographic, infrastructure, institution, environment, training and awareness, and health and fatality. A detailed explanation of how community resilience is defined and how it is measured or monitored are explored in section 4.2.1.1 of this chapter.

Table 4.1 Summary of the identified publications by country and methods used

Groups	Country	Methods	Publications
Developed	Norway	Quantitative	Amundsen, 2012
	Israel		Cohen, 2016
	Oregon, USA		Jacob, 2017
	Sunshine Coast, Australia		Singh-Peterson, 2016
	USA		Smith, 2012
	USA	Dataset	Bergstrand, 2014
	Mississippi,USA		Cai, 2016
	USA		Cutter, 2014
	London/Ontario		Irwin, 2016
	Florida, USA		Kim, 2015
	USA		Lam, 2015
	Australia	Mixed method	Boon, 2014
	Hawaii		Henly-Shepard, 2015
	Israel		Leykin, 2013
	Sunshine coast, Australia		Singh-Peterson, 2015
	New Earswick, UK	Qualitative	Cinderby, 2015
	Scotland		Connon, 2017
	New York, USA		Fox-Lent, 2015
	NSW, Australia		Khalili, 2015
Developing	Sri Lanka	Dataset	Abenayake, 2016
	South Africa		Kotzee, 2016
	China		Qin, 2017
	Bangladesh	Mixed method	Ahmed, 2016

	Fiji, Ghana, Sri Lanka and Vietnam		Bene, 2016
	China		Lo, 2015
	Muzarabani, Zimbabwe		Mavhura, 2017
	Fiji	Quantitative	Gawith, 2016
	Chennai, India		Joerin, 2012
	Khyber Pukhthunkhwa, Pakistan		Qasim, 2016
	Bangladesh	Qualitative	Islam, 2017
	Philippines		Orencio, 2013
	Bangladesh, Bhutan, Maldives, Cambodia		Sovacool, 2012

4.2.1 Defining the Concept of Community Resilience to Climate Change

From the 32 publications analysed, three different definitions of community resilience are identified namely: (i) coping capacity (a process characterised by stability), (ii) adaptive capacity (a situation characterised by flexibility), (iii) transformative capacity (an ability to promote structural changes) and their combinations. The Venn diagram (Figure 4.2) shows the different definitions of community resilience and how they are linked. The overall summary of these different definitions of community resilience is presented in Table 4.2.

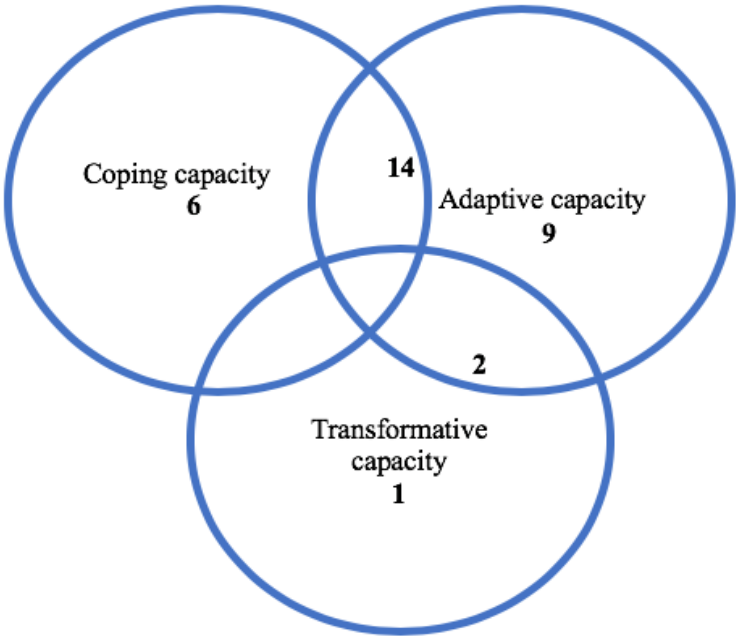

Figure 4.2. Community resilience definition linkages

4.2.1.1 Defining Community Resilience

Defining community resilience as coping capacity is the short-term ability of a system to manage and cope with external shock and stress, which was identified by six (n=6) of the publications analysed. Coping capacity is based on the means that people or a system use resources, skills and opportunity to deal with the impact of climate change (IPCC, 2012). Coping capacity takes the characteristics of a community that enable it to prepare, act, achieve and manage resources, or characteristics that are linked with absorptiveness and mobilisation during an event (Cutter *et al*., 2008; Tierney, 2014). Practically, coping capacity relates to the things that influence a community's ability to anticipate, prepare, absorb, and recover from an event.

One of such publications considered community resilience as the community's capacity for coping with environmental changes and emergencies (Cohen *et al.,* 2016, p.497). Another publication by Bene *et al.* (2016, p.153) defined community resilience as the ability of people to endure shocks and stressors and bounce back. Bouncing back as shown from the publication means the ability of the community to return to the state of functioning that was in place before they were exposed to climate change. Lo *et al.* (2015, p.1) defined community resilience as the level of economic losses a system can sustain while retaining the same function, after experiencing environmental stresses or shocks. These coping capacity definitions of community resilience are mostly associated with short-term situations that are characterised by stability. Community resilience as coping capacity is not sufficient to absorb a hazard. This results in making the communities weaker than before, thereby, suffering from damages, losses and remaining vulnerable to future events (Cohen *et al.,* 2016). Also, there is a concern that

before, during and after an event timeframe, resources may have become low and strained until the services and productivities are restored (Yohe and Tol, 2002).

The systematic review shows that nine (n=9) of the publications analysed defined community resilience in terms of adaptive capacity. This is characterised by the community's ability to learn and improve the capacity to manage an event proactively in light of anticipating future stress or shock (Galopin, 2006). Adaptive capacity is associated with long-term timeframes and implies that some learning, either before or after an event, or change in condition, occurs, i.e. a situation characterised by flexibility. Cai *et al.* (2016, p.2) defined community resilience as the ability of a community to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. Likewise, community resilience deals with changes that need a rapid and flexible response (Khalili *et al.,* 2015, p.249). Kim and Marcouiller (2015, p.1) also defined community resilience as the ability of community residents and local decision-makers to garner necessary intergovernmental resources and foster leadership to coordinate an effective rapid response. Furthermore, community resilience is defined as the degree to which a complex, adaptive system is capable of self-organisation and can build capacity for learning and adaptation (Lam *et al.,* 2016, p.2). Similarly, it also involves the ability to make informed decisions and to learn, adapt quickly and build momentum and flexibility for positive and radical change over time (Irwin *et al.,* 2016).

In these definitions, the properties that underscore community resilience are not only the ability to anticipate and minimise loss during an event, but also the capacity for the post-disaster rebuilding of community's natural function, along with continuously learning by community members and other relevant stakeholders through self-experience. Hence, the higher a community's experience of an event, the better they would be through learning in enhancing their preparedness for an event (Mishra and Suar, 2007). The conceptualisation of community

resilience as adaptive capacity equated resilience to the process of linking resources (adaptive capability) to an outcome (adaptation). Relatedly, the conceptualisation of community resilience as adaptability is in agreement with other studies (Norris *et al.,* 2008; Levin *et al.,* 2013; Baggio *et al.,* 2015; Baggio and Calderon-Contreras, 2017; Ferro-Azcona *et al.,* 2019). The critical aspect of community resilience as adaptive capacity is accepting that change is ongoing, and it is highly unpredictable, which is why adaptive capacity is about flexibility, and the ability to make ongoing changes through the continuous process of adjusting, learning and innovation.

Community resilience was defined using a combination of the parameters of coping and adaptive capacity, and this was identified by a majority (n=14) of the publications. One of such publications defined community resilience as the ability to cope with the risk and uncertainty that has been exacerbated by the variations of climate-related disasters (Abenayake *et al.,* 2016, p.2). Also, Amundsen (2012, p.2) defined community resilience as the ability of a system to sustain or absorb the consequences of shock while keeping the function and form of the system. Ahmed *et al.* (2016, p.3) defined community resilience as the ability of individuals, communities, organisations or countries exposed to disasters, crisis and underlying vulnerabilities to anticipate, prepare for, reduce the impact of, cope with, resist and recover from and adapt to the effect of a natural or human-made hazard. The levels of coping and adaptive capacity of a community or system are necessary for absorbing and managing an event, which is crucial in enhancing their resilience.

The characterisation of community resilience as transformative capacity was identified in only one (n=1) publication (Jacobs and Cramer, 2017). Community resilience was defined as the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function,

identity and structure, while retaining the capacity for adaptation, learning, and transformation (Jacobs and Cramer, 2017, p.1). Transformative capacity is associated with changes in the deep structures that cause vulnerability and risk, as well as addressing the structure and root causes of issues, i.e. a situation characterised by structural change. Transformative capacity is a positive attribute of a resilient system that refers to the ability to promote transformation (Folke *et al.,* 2010) so a new development trajectory can occur. Smith and Stirling (2010) argued that in building community resilience, it is necessary to also focus on the long-term adaptive and transformative capacity.

From the identified publications, two (n=2) defined community resilience by linking adaptive capacity and transformative capacity (see Table 4.2). From the analysis, Cutter *et al.* (2014, p.65) defined community resilience as the ability of a community to prepare and plan for, absorb, recover from and more successfully adapt to actual or potential adverse events (heat wave, drought, flooding, sea level rise) in a timely and efficient manner, including the restoration and improvement of essential functions and structures. Also, community resilience was defined as the capacity of a community exposed to hazard to maintain functional levels, withstand loss or damage to recover from the impact of a disaster and reorganise for ultimate protection (Orencio and Fujii, 2013, p.63). These definitions highlight that community resilience is more than just managing risk but having the ability to grow, improve and transform in the face of climate change. Other research has suggested that communities will benefit from building their transformative capacity and working together to enable a desired future state (Keck and SakdaPolrak, 2013; Arnall, 2015).

A resilient community is defined in this research as a community that is an intrinsic part of a multi-layered governmental institution with a well-established and effective policy system. This enables the targeted communities to plan, prepare for, respond to, recover from, adapt to

and transform in the face of climate change disturbance, which can be done through the proper application of standards, regulations, local knowledge and information without having to face unpredictable and uncontrollable repercussions. Community resilience calls for the involvement of procedural enablers such as sources of experience that provide policymakers with essential information on how to improve a community's preparedness, recoverability and adaptive and transformative capacity to reduce vulnerability from climate-related disaster. Figure 4.3 presents the community resilience flow chart developed from the publications reviewed. This shows the process through which community resilience can be achieved and sustained. Furthermore, some common community resilience indicators were found in the analysed publications based on these different definitions and how the various researchers tried to measure it.

The publications have described community resilience as it relates to scale of influence from the individual, community, people-centred and systems in a large geographical unit. This is acceptable as community resilience can be understood and addressed at different levels of analysis (Cutter *et al.,* 2014). An individual scale may consider the social and economic aspects of how they might respond to an event. For example, in defining how well a person integrates into his or her community and their relations with other communities to get support in times of an event, is one of many scales of resilience (Joerin *et al.,* 2012). Hence, building community resilience requires everyone to be better prepared in case of an event. In the literature, it has often been said that 'the whole is greater than the sum of its parts', meaning that a collection of resilient single scales of influence does not guarantee a resilient community (Rose, 2004). From the systematic review, community resilience was mostly studied at the community level (Leykin *et al.,* 2013; Orencio and Fujii, 2013; Qin *et al.,* 2017). It was also observed that people in communities cannot be resilient alone but can be more resilient together (Norris *et al.,* 2008).

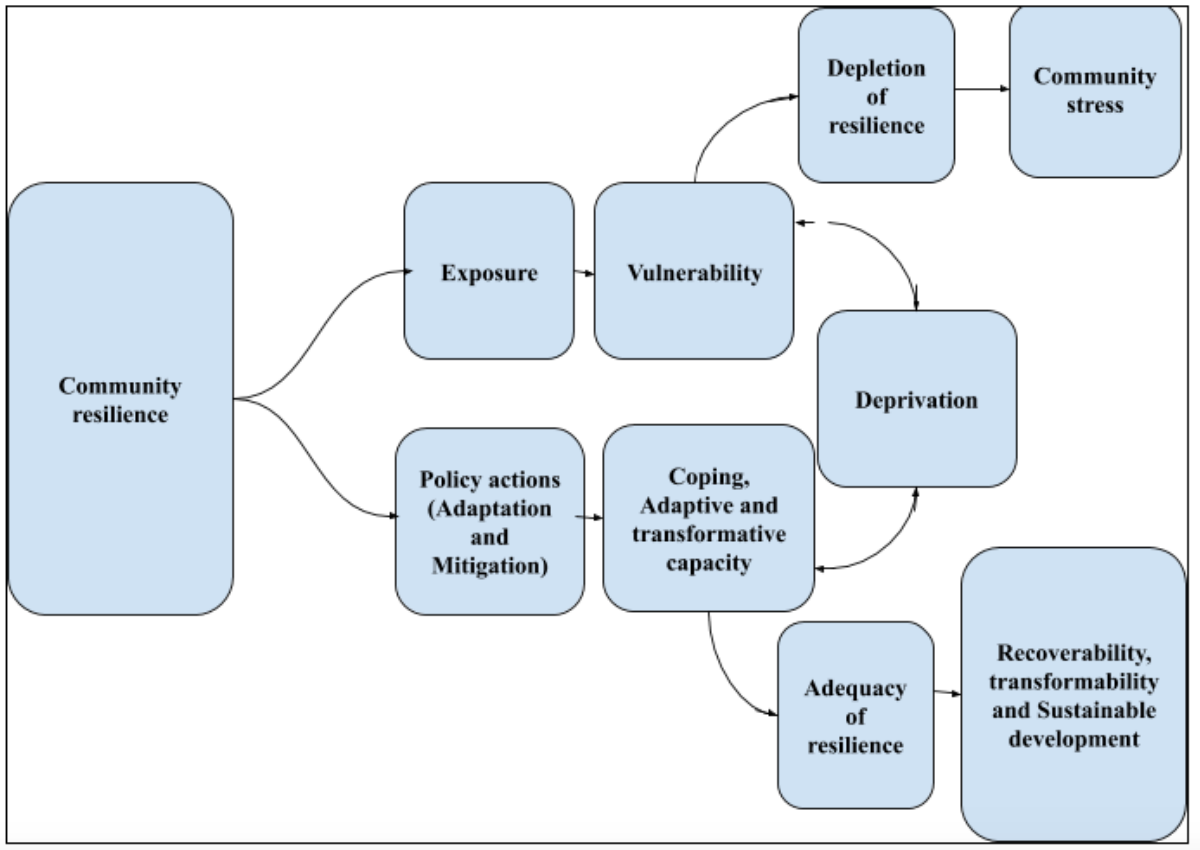

Figure 4.3. Flow chart of community resilience process

Table 4.2. Defining the concept of community resilience

Category	Scale of influence	Direct quote	Publications
Coping capacity	People-centred	The ability of people to endure shocks and stressors and bounce back p.153	Bene *et al.,* 2016
	Community	Community resilience as the ability of communities to withstand hazards p.684	Boon, 2014
		Communities capacity for coping with environmental changes and emergencies p.497	Cohen *et al.,* 2016
		Communities recovery from disaster p.325	Islam and Walkerden 2017
		Community's ability to withstand crisis or disruptions p.314	Leykin *et al.,* 2013
	System	The level of economic losses a system can sustain while retaining the same function, after experiencing environmental stresses or shocks. p.1	Lo *et al.,* 2015
Adaptive capacity	Individuals	It deals with changes that need a rapid and flexible response p.249	Khalili *et al.,* 2015
	System	The degree to which a complex, adaptive system is capable of self-organisation and can build capacity for learning and adaptation p.2	Lam *et al.,* 2016
		The capacity of the socio-ecological system to adapt to, cope with, and shape uncertainty and surprise, and offer a possible avenue to deal with these challenges p.45	Kotzee and Reyers, 2016
	Community	The ability of community residents and local decision-makers to garner necessary intergovernmental resources and foster leadership to coordinate effective rapid response p.1	Kim and Marcouiller, 2015
		The ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events p.2	Cai *et al.,* 2016
		The ability of a community to anticipate risk and understand behavioural responses to the number of damages and promoting the capacity of communities to deal with disasters p.2	Qin *et al.,* 2017
		The ability of communities to face up to and address disaster risks, as well as their capacity to adapt to climate change p.756	Singh-Peterson *et al.,* 2015
		Members of the community are connected and work together to function and sustain critical systems, adapt to social, political and environmental change and be self-resilient and learn from experiences p.3	Singh-Peterson *et al.,* 2016
	Individuals, community, and system	The capacity of an individual, community or institution to dynamically and effectively respond to shifting climate impact circumstances while continuing to function at an acceptable level p.84	Sovacool *et al.,* 2012
Coping and adaptive capacity	Individuals	The flexibility through which individuals can cope with and adapt to changes in environmental conditions p.2	Smith *et al.,* 2012
	Community	The ability of a community to cope with the risk and uncertainty that has been exacerbated by the variations of climate-related disasters p.2	Abenayake *et al.,* 2016
		The existence, development and engagement of community resources by community members to thrive in an environment characterised by change, uncertainty, unpredictability and surprise p.345	Henly-Shepard *et al.,* 2014
		How communities can cope with, recover from, or adapt to hazard p.3	Berstrand *et al.,* 2014
		The ability of neighbourhoods or local communities to cope with threats and hazards associated with social, economic and environmental change p.1	Cinderby *et al.,* 2015

		The community's ability to absorb, manage and bounce back after a disaster p.45	Joerin *et al.,* 2012
	System	The ability of a system to sustain or absorb the consequences of shock while keeping the function and form of the system p.2	Amundsen, 2012
		The capacity of community systems to withstand, absorb and adapt to shock and stresses brought on by environmental change p.113	Connon, 2017
		The capacity to continue performing critical functions through disruptive events p.209	Fox-Lent, 2015
		The capacity of a system to absorb a spectrum of shocks or perturbations and to sustain and develop its fundamental function, structure, identity, and feedbacks through either recovery or reorganisation in a new context p.2	Gawith *et al.,* 2016
		The measure of a systems ability to resist, cope with, recover from and evolve to accommodate the impacts of a hazardous event as rapidly as possible p.2	Irwin *et al.,* 2016
		The capacity of a system to pursue its ecological, social and economic goals while managing its environmental hazards over time in a mutually reinforcing way p.248	Mavhura, 2017
		The ability of a system to respond to and recover from disasters and includes those inherent conditions that allow a system to absorb the impacts and cope with an event p.101	Qasim *et al.,* 2016
	Individuals, community, system and country	The ability of individuals, communities, organisations or countries exposed to disasters, crisis and underlying vulnerabilities to anticipate, prepare for, reduce the impact of, cope with, resist and recover from the effect of a natural or human-made hazard p.3	Ahmed *et al.,* 2016
Transformative capacity	System	The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity, and structure, while retaining the capacity for adaptation, learning, and transformation p.1	Jacobs and Cramer, 2017
Adaptive and transformative capacity	Community	The ability of a community to prepare and plan for, absorb, recover from and more successfully adapt to actual or potential adverse events in a timely and efficient manner including the restoration and improvement of essential functions and structures p.65	Cutter *et al.,* 2014
		The capacity of a community exposed to hazard to maintain functional levels, withstand loss or damage to recover from the impact of a disaster and reorganise for future protection p.63	Orencio and Fujii, 2013

4.2.2 Elements of Community Resilience

This research uses **elements** as an area of measurement which is the preferred term (instead of domain, dimension, category or components) and **indicators** as a specific measure which is the preferred term (instead of factors, criteria or variables). This work reviewed publications that are relevant to reducing the effect of climate change. As illustrated (Figure 4.4), the systematic review identified eight elements of community resilience which are made up of 49 indicators that were used in the literature to measure community resilience to climate change. The elements include social, economic, demographic, infrastructural, institutional, training and awareness, environmental and health and fatality. Overall, as reported (Figure 4.5 – 4.12), no publication incorporated all the indicators identified.

Analysis of the publications identified in the systematic review specified which indicators were measured using objective quantitative data, and which were measured using more qualitative data to determine how community resilience is measured. The most frequently used elements for measuring levels of community resilience are the social and economic elements. In contrast, the least used elements identified were environmental and health and fatality (see Table 4.3). The increase in the social and economic elements of community resilience in research during the last decade was based on certain vulnerability, institutional and financial limitations, and how policymakers and researchers prioritise these indicators with a focus on a particular concern or at a certain stage of addressing a climate change impact (Connon, 2017; Islam and Walkerden, 2017; Jacob and Cramer, 2017).

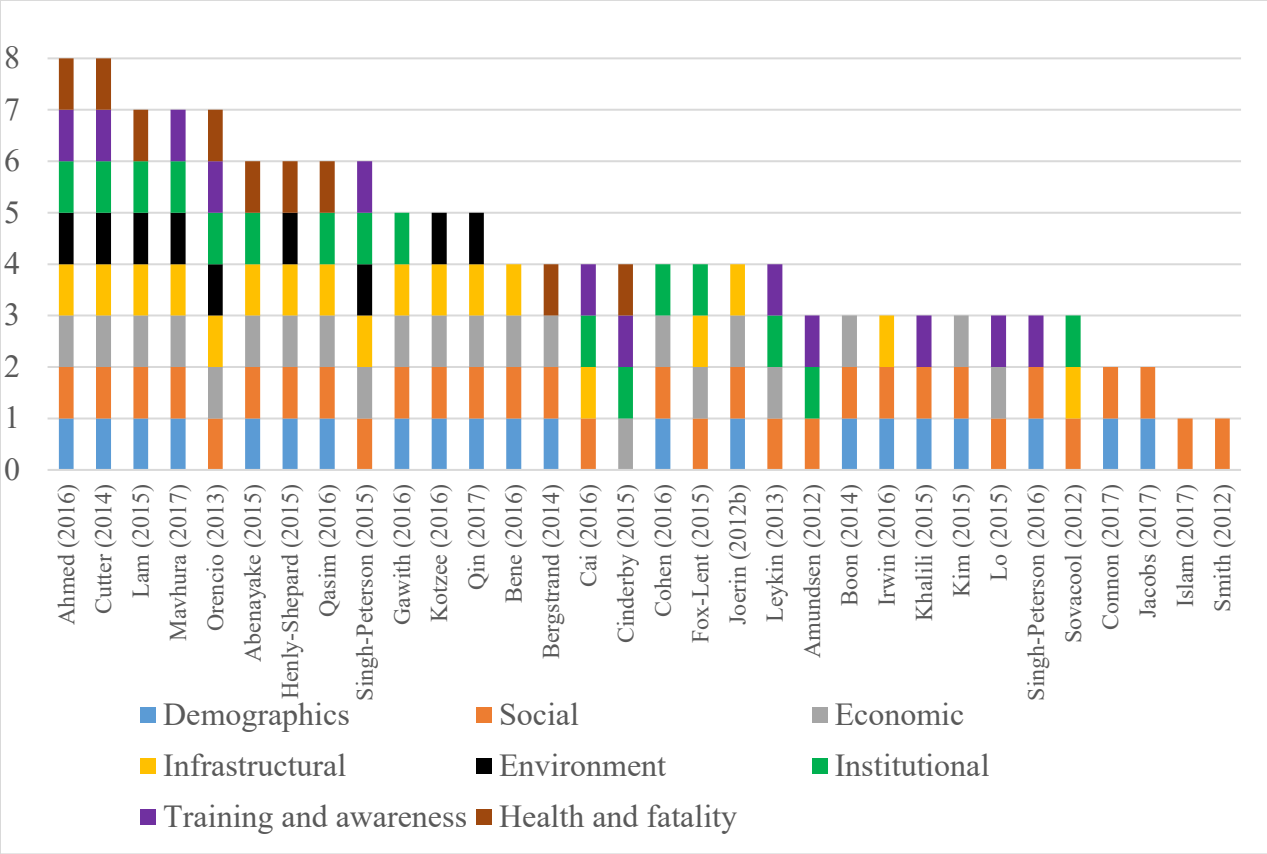

Figure 4.4. Elements of indicators used to measure community resilience by different researchers

Table 4.3. Indicators within each element identified

Community resilience elements	Number of indicators	No. of publications
Social	6	31
Economic	8	24
Demographic	5	21
Infrastructural	8	18
Institutional	7	16
Training and awareness	4	12
Environmental	5	9
Health and fatality	6	9

4.2.2.1 Social Element

The social element is the activities and processes which build the strength of broader relationships between individuals within and outside the community (Kawachi *et al.,* 2004; Aldrich and Meyer, 2014; Kim *et al.,* 2017). Here, social indicators support fast and reliable relationships that constitute a network that can help release ideas, lessen the loss and improve the community's self-reliability (Amundsen, 2012; Smith *et al.,* 2012; Orencio and Fujii, 2013; Boon, 2014; Bene *et al.*, 2016). This element is the most applied in the identified publications as can be seen in Table 4.3. Social elements can be measured using the indicators specified in Figure 4.5.

Figure 4.5. Social indicators identified in the publications

4.2.2.2 Economic Element

Economic element is assessed from the household level to the entire community and includes community finances for various purposes on different levels (Lo *et al.,* 2015; Qasim *et al.,* 2016). These finances can be in the form of income sources, assets, insurance and ecological funds (Figure 4.6). This could also include the level of asset holding of individual households and will, in no doubt, enhance community capacity to respond adequately to shocks or climate change. The

economic element is critical because the different aspects of mitigation and prevention activities for climate change impacts require resources of which households, or community with high financial capacity, will be more likely to carry out (Ahmed *et al.,* 2016). In essence, communities with higher income and rapid economic growth are more resilient than poor communities (Kim and Marcouiller, 2015; Lam *et al.,* 2016). According to Qasim *et al.* (2016), income-generating opportunities should be provided to people to reduce poverty and enhance community resilience.

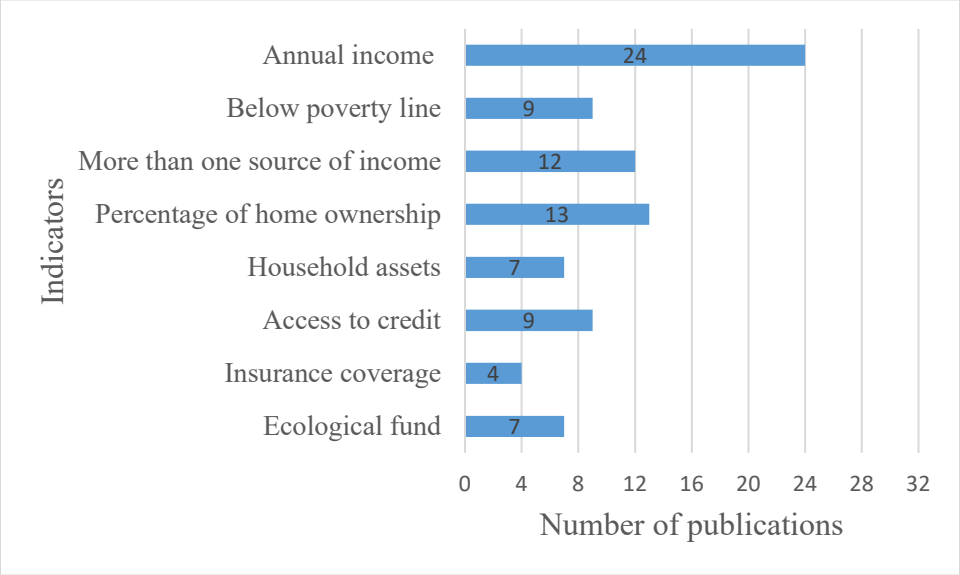

Figure 4.6. Economic indicators identified in the publications

4.2.2.3 Demographic Element

Demographic characteristics such as age, sex, education, household size and religion, indicate how individual lives are connected (Qin *et al.,* 2017). This element is mostly used to collect the attributes of the community that are used further to measure efficient implementation of policy actions. The demographic element was found to have a positive influence on community resilience because it is easier for those with higher education to be able to follow measures that will help prevent, cope and adapt to climate change than those with lower qualifications (Cutter *et al.,* 2014;

Abenayake *et al.,* 2016). These element indicators are mostly used to collect the attributes of the community, which would be further used in measuring the effective implementation of other elements (Figure 4.7).

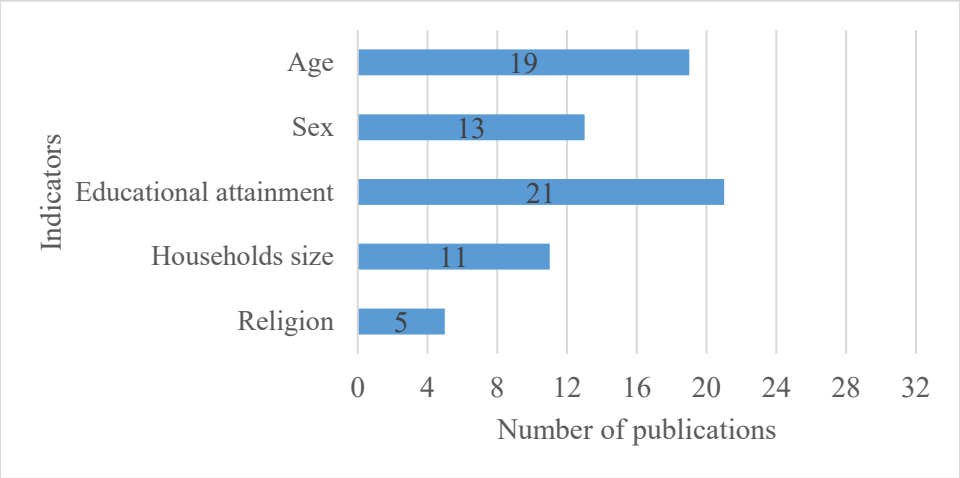

Figure 4.7. Demographic indicators identified in the publications

4.2.2.4 Infrastructural Element

Infrastructural element involves physical capital, such as water, electricity, transportation and built environment, i.e. residential, commercial and public buildings (Sovacool *et al.,* 2012; Cutter *et al.,* 2014). These infrastructures are examined from a wide range of perspectives, like their efficiency in restricting or lowering fatality and loses, during and after an event. This efficiency is necessary for decreasing the impact of climate change on construction and sustainability. Resilient infrastructure and maintenance focus on infrastructure that needs to be developed to defend the community from climate change repercussions. This element is analysed by looking at the development of resilient infrastructure and techniques that could reduce the impact of climate change effects upon the community such as barriers built for floods (Savocool *et al.,* 2012). In the publications analysed, this element is linked to barriers such as seawalls and breakwaters which were seen as substantial infrastructural barriers that are used to protect communities from flood or

sea-level rise (Cutter *et al.,* 2014; Ahmed *et al.,* 2016; Cai *et al.,* 2016; Irwin *et al.,* 2016). Infrastructural facilities can also play a significant role in the community's ability to take proactive measures towards mitigating the effect of climate change (Figure 4.8).

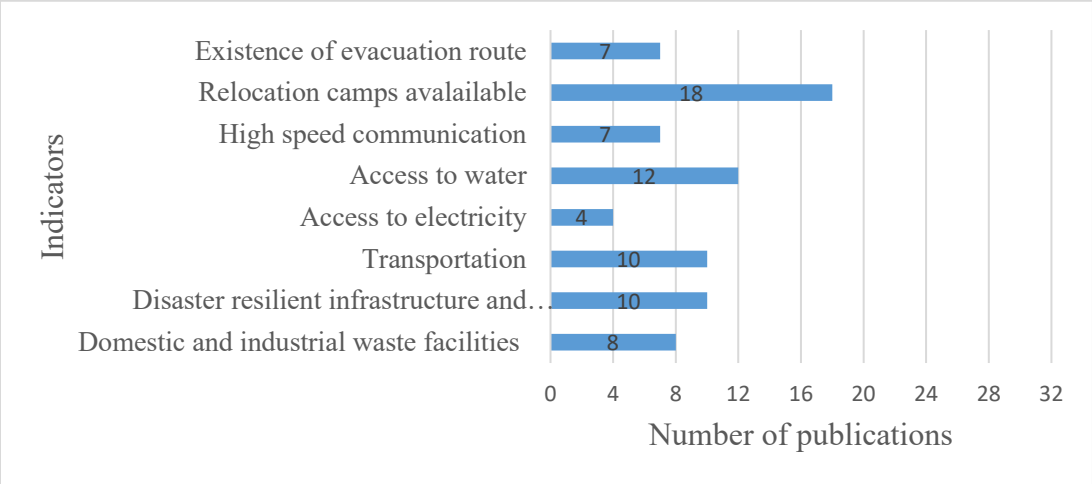

Figure 4.8. Infrastructural indicators identified in the publications

4.2.2.5 Institutional Element

From an application perspective, the institutional element is essential for establishing organisational networks to plan and execute various mitigation actions, training programmes and distribute responsibilities (Singh-Peterson *et al.,* 2015). Every community needs inclusive governance where representatives of government, business, organisations and communities work together in making decisions, coordinating activities and integrating development planning (Joerin *et al.,* 2012).

In order to measure the useful application of institutional indicators in a community, it is observed that communities with well-established institutional indicators will have the following attributes: 1. Well-defined and practicable action plan targeted towards all vulnerabilities of the community (Cutter *et al.,* 2014; Fox-Lent *et al.,* 2015; Ahmed *et al.,* 2016); and 2. Transparent responsibility

distribution among the stakeholders in the time of need (Sovacool *et al.,* 2012; Leykin *et al.,* 2013; Singh-Peterson *et al.,* 2015). These attributes are used as parameters in measuring the effective implementation of institutional indicators in any community. The identified eight indicators as presented in Figure 4.9 suggest that both top-down (e.g. disaster management base) and bottom-up (e.g. volunteerism) approaches should be involved in mitigation, creating linkages and the planning and preparedness to enable them to cope and recover from an event (Cutter *et al.,* 2014).

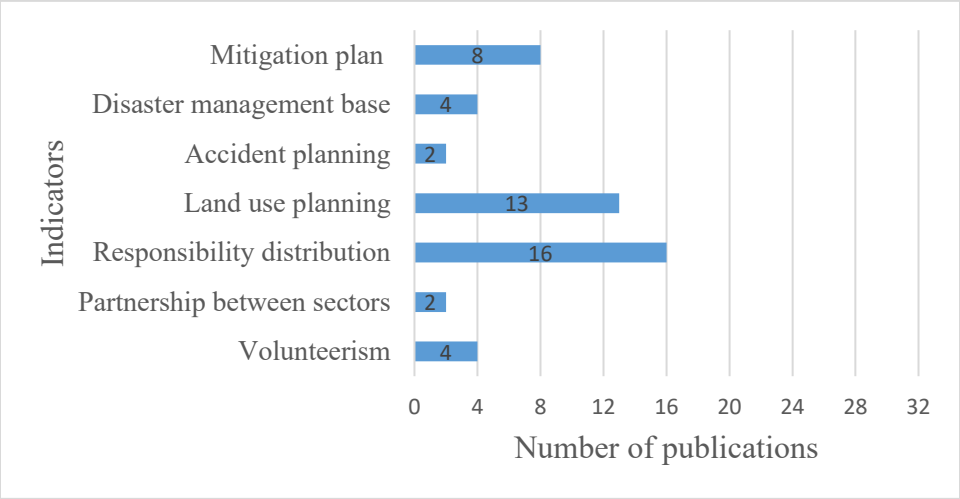

Figure 4.9. Institutional indicators identified in the publications

4.2.2.6 Training and Awareness Element

Four indicators relating to training and awareness were identified (Figure 4.10). Learning and training aims at the compatible procedures, techniques and relevant technical and infrastructural requirements to encourage various stakeholders to educate various members on community attributes, climate change, policy actions and their responsibilities (Amundsen, 2012; Sovacool *et al.*, 2012). In the case of severe climate change warnings, a direct transfer from established alert systems and electronic media would, for example, be more trusted by community members than social media (Cutter *et al.,* 2014; Alshehri *et al.,* 2015; Cinderby *et al.,* 2015; Ahmed *et al.,* 2016).

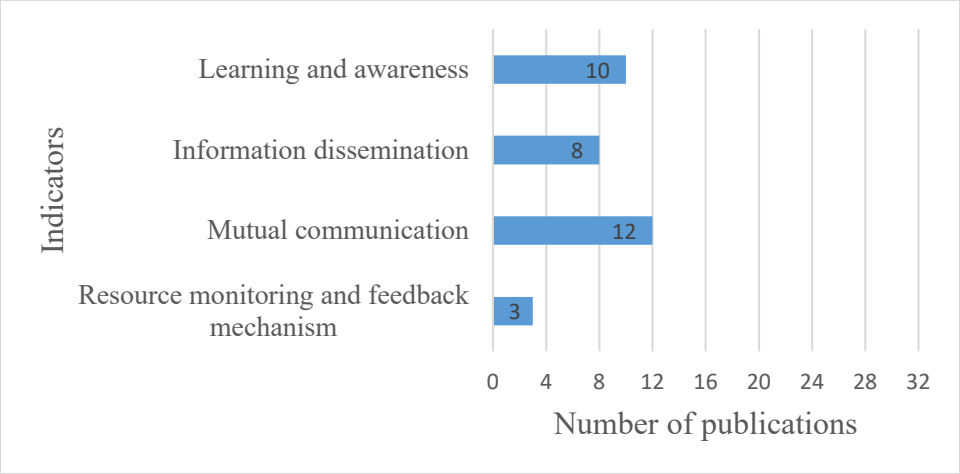

Figure 4.10. Training and awareness indicators identified in the publications

In order to sustain the livelihood of community members, their resources must be maintained, distributed and monitored. This process requires an institutionalisation of resource monitoring and management, along with an active information transfer on the status of resource availability and quality to regulate community activities and resource consumption. This aspect of the indicators has not been extensively discussed in the identified publications. Nonetheless, training and awareness indicators are fundamental in increasing resilience to climate change and yet one of the elements identified the least in the publications.

4.2.2.7 Environmental Element

The environmental element includes indicators that focus on the preservation of natural resources and their quality, livestock, biodiversity and divisible assets, i.e. trees and land (Mavhura, 2017). Therefore, improving green spaces, conserving the variety of natural resources and protecting biodiversity (Cinderby *et al.,* 2015) will help reduce the impact of climate change. Indicators of the environmental element are essential as their implementation would be the community's

contribution towards lessening global warming and improving symbiosis, which is necessary towards sustainable development (Cinderby *et al.,* 2015; Henly-Shepard *et al.,* 2015). Overall, this element is another of the least assessed in the identified publications (Table 4.3) due to its data inconsistency causing concerns on developing indicators for a significant geographical location (Singh-Peterson *et al.,* 2014). This element measures the efficiency of indicators such as effective energy use, conservation of biodiversity, agricultural practices, land remediation, and improved green space and tree planting to support community resilience in the face of climate change (Figure 4.11).

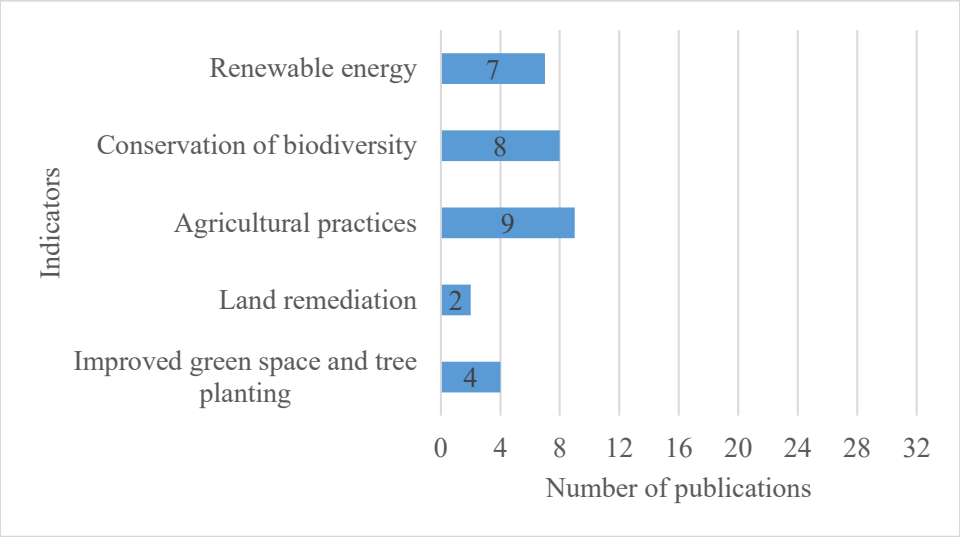

Figure 4.11. Environmental indicators identified in the publications

4.2.2.8 Health and Fatality Element

The health and fatality element seek to influence wellbeing and longevity of community members in terms of their health before, during and after a climate change event (Orencio and Fujii, 2013; Ahmed *et al.,* 2016). It represents the basic needs of any emergency planning that can potentially avert or reduce the disaster impact on the community in terms of fatality, and actions addressing the wellbeing of community members. This element is also one of the least assessed in the

identified publications. Its indicators (Figure 4.12) can be measured by looking at the number of healthcare services and assistants available, sanitation and infection control, nutritional status, special needs and cause of death, and resources available in the community towards health and against fatality (Sovacool *et al.,* 2012; Cinderby *et al.,* 2015; Singh-Peterson *et al.,* 2015; Islam and Walkerden, 2017). These indicators will help communities better as their overarching element incorporates other indicators that are not included in most national datasets (Lam *et al.,* 2016; Ahmed *et al.,* 2016).

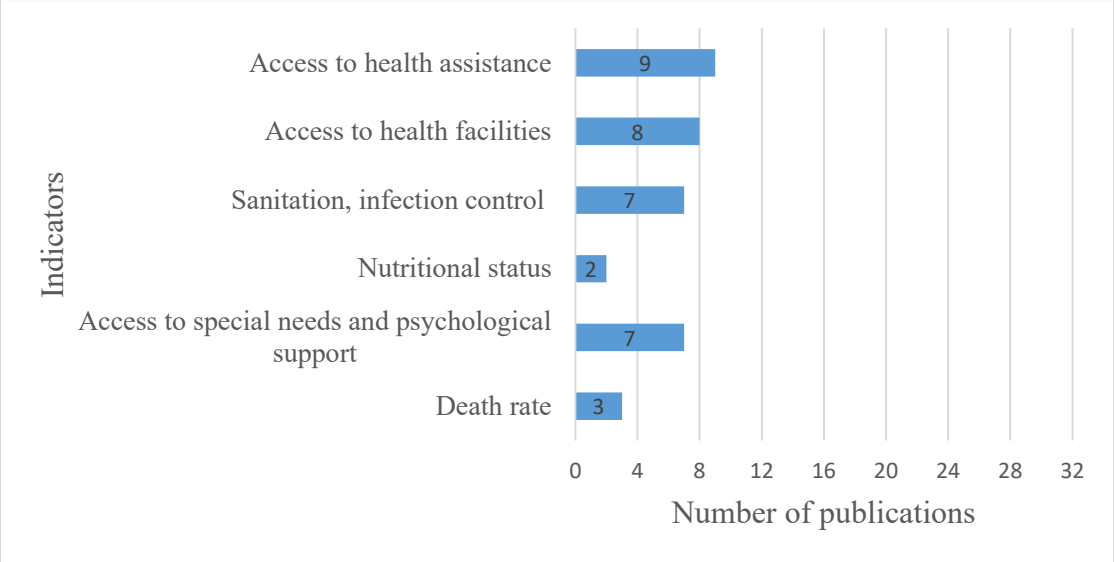

Figure 4.12. Health and fatality indicators identified in the publications

4.2.3 Classification of community resilience indicators

Data were obtained from the systematic review of 32 articles related to community resilience. Forty-nine indicators were identified, and with each indicator scored 1 if mentioned and 0 if not mentioned. The data were subjected to Principal Component Analysis (PCA) to identify the correlation and dependences among the features in the data set. Results indicate that the dimensionality of the data set can be explained by 16 principal components instead of 49. This is

because only the variables that have absolute value greater than 1 were taken into account, which is the 16 principal components (PCs) as shown in Table 4.4. The 16 principal components accounted for 86.39% of the total variance in the data set. Table 4.4 shows the variance that accounted for each of the 16 PCs in the data set. The 16 PCs accounted for reasonable percentage of the variation in the data set and hence the rotated factor loading for each of the indicators were obtained and factor loadings less 0.10 (absolute value) were removed. The rotated factor loading is shown in Table 4.5.

Table 4.4. Principal component result for indicators of community resilience

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.488	15.281	15.281	7.488	15.281	15.281	4.626	9.441	9.441
2	4.712	9.615	24.896	4.712	9.615	24.896	4.042	8.250	17.691
3	4.139	8.447	33.344	4.139	8.447	33.344	3.594	7.334	25.026
4	3.622	7.392	40.736	3.622	7.392	40.736	2.905	5.930	30.955
5	3.024	6.172	46.907	3.024	6.172	46.907	2.634	5.376	36.331
6	2.786	5.686	52.593	2.786	5.686	52.593	2.624	5.355	41.686
7	2.424	4.947	57.541	2.424	4.947	57.541	2.586	5.278	46.965
8	2.342	4.780	62.320	2.342	4.780	62.320	2.570	5.245	52.210
9	2.028	4.138	66.458	2.028	4.138	66.458	2.480	5.061	57.271
10	1.868	3.811	70.269	1.868	3.811	70.269	2.314	4.723	61.994
11	1.699	3.467	73.736	1.699	3.467	73.736	2.299	4.692	66.685
12	1.546	3.156	76.892	1.546	3.156	76.892	2.246	4.584	71.269
13	1.367	2.790	79.682	1.367	2.790	79.682	2.207	4.504	75.773
14	1.201	2.450	82.133	1.201	2.450	82.133	2.040	4.162	79.936
15	1.066	2.176	84.309	1.066	2.176	84.309	1.864	3.804	83.740
16	1.022	2.085	86.394	1.022	2.085	86.394	1.300	2.654	86.394

In the interpretation of the factor loadings in Table 4.5 preference was attached to principal component that accounted for the largest variance in the data set and in the case of any disparity in sign of the factor loading (positive or negative), preference was given to the most important principal component. Results in Table 4.5 reveal that out of the 49 indicators considered, 10

indicators have negative contribution to community resilience as measured by the rotated factor loadings. Analysis was also carried out to determine the most significant indicator that influence community resilience, and this was done using PCA with factor score on principal component 1 and 2 as the dependent variable and the 49 indicators as the predictor variables. This component was chosen as it accounted for the largest variance in the data set. The indicators of social trust (-0.31), attachment to a place (-0.38), relationship with other stakeholders (-0.21), religious adherence (-0.15), mitigation plan (-0.32), disaster management (-0.15), land use planning (-0.13), partnership between sector (-0.18), volunteerism (-0.11), information dissemination (-0.14) all have negative loading, meaning that they have negative contribution to community resilience while other indicators have positive contribution to community resilience. Therefore, out of the 49 indicators, 10 had significant negative (20.4%) contribution to community resilience and 39 indicators had significant positive (79.6%) contribution ($P<0.05$).

Table 4.5. Factor loading for each of the 49 indicators and the classification into positive and negative indicators based on rotated factor loadings

Indicators	Component																Classification
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Social trust	-0.31	-0.15	0.15		-0.22	0.15	-0.15		-0.38	-0.41	0.49	-0.11	0.29	-0.16			Negative
Attachment to place		-0.39	0.40	-0.30		0.16		0.38	-0.40	0.11			0.28	0.21		0.14	Negative
Community engagement	0.12				-0.76							0.15	0.39			0.13	Positive
Collective knowledge and experience	0.35	-0.22	0.42	0.33			-0.44		-0.18		0.20	0.16		-0.14			Positive
Inter-community relationships	0.46	0.20	0.71		-0.11		-0.20						-0.10	-0.17		-0.20	Positive
Relationship with other stakeholders		-0.21			-0.17							-0.11		0.15	0.88		Negative
Annual income	0.12	0.13		0.12		0.27				0.48	-0.30	-0.24	-0.24	-0.49			Positive
Below poverty line		0.51			0.53	0.20		-0.32			-0.15	-0.28	0.21		-0.16		Positive
More than one source of income	0.17	0.66		0.28	-0.17				0.17	-0.19	-0.34	-0.14		0.15		-0.12	Positive
Homeownership		0.83	-0.20		0.23		-0.11	0.15	-0.17			-0.12					Positive
Household assets	0.79	0.18								-0.28		-0.17			0.12	-0.16	Positive
Access to credit	0.63			0.21				0.19	0.13			-0.22		-0.16		0.45	Positive
Insurance coverage	0.34	0.42	0.18	-0.17		0.55	0.21				-0.12		0.10	0.15		0.18	Positive
Ecological fund	0.12			0.18	0.11		0.85	0.12	0.14								Positive

Age	0.19	0.32	-0.59	-0.22		-0.13	0.20		-0.10	0.24	0.32		-0.19	0.13	0.22		Positive
Sex		0.17	-0.39	-0.24		0.37	-0.31		-0.20	0.29			0.32		0.42		Positive
Educational attainment		0.34	-0.27	-0.31			0.44	-0.15		-0.18	0.16	0.25	0.42		0.28	-0.14	Positive
Households size			-0.16	-0.11				0.15	-0.19	0.85			0.22			-0.10	Positive
Religious adherence		-0.15			0.18	-0.11			-0.17	-0.13			-0.80	-0.11			Negative
existence of evacuation route		0.10	-0.13		-0.11		0.20	0.88		0.14	0.15	0.14					Positive
relocation camp available	0.42				0.19	-0.12			-0.27		-0.43	0.31		0.47		-0.19	Positive
access to water	0.28						0.62	0.48			-0.11		0.22				Positive
access to electricity	0.11		-0.15	0.25		0.87									-0.16		Positive
Transportation	0.28	0.51	0.15	-0.12	-0.11	0.29	0.26	0.27	0.20	0.12		-0.23	0.13				Positive
high speed communication			-0.27		0.54	0.27	0.42		0.30	0.12					-0.11	-0.38	Positive
Disaster resilient infrastructure	0.23	0.29	0.10	0.74		0.13	0.33			-0.13			-0.12	-0.15	-0.14		Positive
Domestic and industrial waste facilities	0.25	-0.22		0.16	0.59	-0.29	0.30		0.29	-0.10	-0.11	-0.16	0.26			0.12	Positive
Mitigation plan		-0.32	-0.14	0.14	0.17	0.20	-0.14	0.11	0.21	-0.16	-0.13	0.59	0.34		-0.30		Negative
Disaster management base		-0.15		0.54		-0.12			-0.18	0.33	0.36	-0.17	0.16	0.12	-0.48		Negative
Accident planning	0.40					0.27		0.37	0.18	0.44	0.31	0.19	-0.11	0.23	-0.29	-0.25	Positive
Land use planning	-0.13	-0.19	-0.15	0.52		-0.15		0.39		0.12		-0.15	0.49	-0.12	-0.18		Negative

Responsibility distribution			0.15									0.88		0.10			Positive
Partnership between sectors	-0.18	-0.16		0.75		0.14			0.22	-0.16		0.28				0.12	Negative
Volunteerism		-0.11	0.26	-0.17		0.70		0.26	-0.14	0.10					0.25	-0.15	Negative
Learning and awareness			0.56		-0.12		0.32	0.14	0.13	0.11	0.12	0.23	-0.28	0.45			Positive
Information dissemination		-0.14	0.54					-0.25	0.20	-0.19	0.11	0.23				0.55	Negative
Mutual communication					-0.11						0.93						Positive
Resource monitoring and feedback mechanism		0.13	0.88	-0.14					0.12		0.12				0.14	0.12	Positive
Renewable energy			-0.15					0.13						0.87	0.15		Positive
Conservation of biodiversity	0.17	0.15	0.30					0.17	0.63		0.27	0.23		0.26		0.15	Positive
Agricultural practices	0.44	0.30		0.24		0.17		0.59	0.23		-0.19			0.14	-0.11	0.17	Positive
Land remediation	0.16	0.12		0.55		-0.21		0.38	0.33	0.12		0.20		0.22		-0.38	Positive
Improved green space and tree planting		0.13	0.13			-0.15	0.19		0.84	-0.23	-0.12		0.17				Positive
Access to health assistance	0.83	0.12				0.16			0.12	0.27		0.15					Positive
Access to health facilities	0.87			-0.12		0.16	0.21				-0.12				-0.14		Positive
Sanitation infection control	0.54	0.43			0.12	0.19	0.19	0.21		0.34		0.23	0.12	-0.11			Positive
Nutritional status	0.46	0.44	0.36		0.16	0.27	0.18		-0.24	-0.20	-0.18		0.13		0.14	0.24	Positive

Access to special needs and psychological support	0.22	0.76	0.31							0.16		0.13	0.16	-0.21			Positive
Death rate		0.29	0.17		0.81			-0.12	-0.11	0.10	-0.15	0.22				0.10	Positive

4.3 Discussion

From the systematic literature review, only three percent of the 1036 publications between 2007 and 2017 on community resilience to climate change contained empirical data, which shows there is a lack of empirical research in this area. Notwithstanding, it became apparent from the identified publications that more research is being carried out on the importance of community resilience to climate change in recent times (see Figure 4.1), which have been clearly reflected and accepted broadly, as the research is changing from an emerging concept to a consolidated topic. With the Paris agreement being signed by multiple countries, the concept of community resilience was becoming more popular within the policy sphere and this led more researchers to look at community resilience in the face of climate change as the focus of their work. This finding is in agreement with studies with similar patterns (Twigger-Ross *et al*., 2016).

Community resilience indicators were measured in the publications using quantitative, qualitative and a combination of both approaches. The applications of the different methods from the identified publications were mostly (n=15) quantitative. Community resilience to climate change impact can be quantified using statistical measures. According to Engle *et al*. (2013), this quantification can be used to attract decision-makers as numerical assessments give a weighted average, rank and measure progress across policy activities and communities. In contrast, according to Parson and Fisher-Vanden (1997) qualitative data have their limitations as no clear universal definitions characterise this data type, it depends highly on assumptions, it lacks data on some indicators and has no interaction or feedback mechanism. Hence, the case of defining indicators, data development, how to measure them and interpret the results, are subjective and rely on the judgement of the indicator developer and the decision-makers or researcher that use them. As a result, the indicators can also be measured by involving stakeholder participation (Cinderby *et al*., 2015). Using these different approaches in measuring community resilience enables researchers and policymakers to understand

their assumptions, indicators selected, sources of data, and how to aggregate and interpret the results. The impact of climate change can also be measured using a participatory or Delphi consultation qualitative approach, which helps to shed light on indicators that are difficult to capture through quantitative measures (Bergstrand *et al.,* 2015; Cai *et al.,* 2016). Qualitative data give a good understanding of the significance of changes which are measured quantitatively (e.g. educational attainment, more than one source of income, and household assets). It is argued that quantitative methods are often misinterpreted as being devoid of social context (Poortinga, 2012; Rus *et al.,* 2018). As a result, researchers supplement quantitative data with qualitative findings. From the identified publications, qualitative strategies (n=7) were used in the form of interviews, workshops, participatory group and case studies. This helps the communities to understand their problems and gives insights on how or if they are resilient (Amundsen, 2012; Cinderby *et al.,* 2015). Understanding the determinants of measuring community resilience in the face of climate change is fundamental. The mixed-method strategies (n=10) were used in measuring community resilience in the identified publications, which gives a more comprehensive assessment. This capture both the quantitative and qualitative methods as it helps balance the imperative of the indicators that enhance community resilience.

Empirical research on community resilience in the face of climate change tends to focus on the local level detaching the findings from the regional and national contexts. Out of 1036 papers that were published between 2007 and 2017, 32 contained empirical research and focused mostly on the local context. It implies that they are more focus on community resilience at the local level because they are the most disaster-prone part of the general society (Abenayake *et al.,* 2016). The local level suffers the brunt of the aftermath of climate change, which it is ill-equipped to handle, maybe resulting from being deprived and having more vulnerable groups (Mavhura, 2017). These properties have led to more cases being reported at the local levels than at any other (Vogel and Henstra, 2015; Platts-Fowler and Robinson, 2016). However, at the national level, climate change policies can accomplish

transformative changes that would not be possible at the local level. This is due to greater technical and financial capacity, and environmental expertise, which are lacking at the local level (Corfee-Morlot *et al*., 2009). National level design and implementation of climate change policy has been criticised for their propensity to reduce the roles and responsibility for actions at the local level (Henfrey and Kenrick, 2015). Though, due to climate change and its challenges, the calls for community resilience and for communities to take responsibility for climate risk is on the increase and more research funds are targeted towards the local than national level (IPCC, 2014). As a result, more research initiatives are focused on how to assist citizens in recovering at the local level. However, with the complicated situation surrounding climate change events, focusing on local level alone cannot give a complete picture of the resilience of communities (Sovacool *et al.,* 2012). Concentrating on one scale will result in neglect of some indicators that will determine resilience at other scales, which can also affect the trade-offs and synergies across the scales (Peterson *et al.,* 2010). Also, identifying less resilient communities across all scales can enable resources to be distributed to different groups to increase their resilience. This systematic review shows that there is currently little work done at the regional and national levels where indicators can help capture trends and thresholds. Consequently, the failure to achieve resilience at the regional, national and global scales will hinder policy activities and programmes at the local level. This shows there is a need to balance the scale by having a cross scalar study which will help foster interactions and feedback among scales.

Another important finding of the systematic review shows that there is no standard definition for community resilience in the current literature. Six focus on the notion of coping capacity (Lo *et al.,* 2015; Cohen *et al.,* 2016), nine on the notion of adaptive capacity (Khalili *et al.,* 2015; (Cai *et al.,* 2016) and one on the notion of transformative capacity (Jacob and Cramer, 2017) or 16 of the combination thereof (Orencio and Fujii, 2013; Cutter *et al.,* 2014). Many researchers or practitioners have argued that this is because it is not possible to have a single meaning which illustrated the

contextual nature of community resilience (Cutter *et al.,* 2014; Woolf *et al.,* 2016; Koliou *et al.,* 2018). This has led most authors to develop their own ways to define community resilience with the socio-economical-ecological requirements of their communities (Patel *et al.,* 2017; Summers *et al.,* 2017). None of these are incorrect, they are merely partial. Nevertheless, combining all the definitions from the review, illustrates that community resilience is mostly defined based on three generic terms: coping capacity, adaptive capacity and transformative capacity. Community resilience can only be usefully conceptualised as a process of stages that communities go through moving from simply coping with climate change to being resilient to climate change to eventually transforming into a community that can thrive despite climate change. Community resilience as coping, adaptive and transformative capacity should not be viewed as mutually exclusive, as coping capacity in a resilient system should include the dynamics to accommodate trends and co-evolve. In a long-term timescale, adaptive capacity may be insufficiently flexible and hinder improvement (Wardekker *et al.,* 2010; Williges *et al.,* 2017). Coping capacity can be seen as a reactive approach that focuses on shock while adaptive capacity and transformative capacity are proactive approaches that focus on addressing long-term stresses. These definitions are characterised by some aspect of the concept that may lead to increased resilience in some communities. Still, they might lack resilience in some areas where some indicators were not considered or too complex and expensive to apply in all areas of the community (Sovacool *et al.,* 2012; Cai *et al.,* 2016). This theory supports the majority of the publications analysed, where the authors defined community resilience on the basis of the immediate vulnerability and needs of the communities under study while omitting some indicators that will support the communities for sustainable growth (Henly-Shepard *et al.,* 2015; Gawith *et al.,* 2016). Despite acknowledging the positive publications contributions to community resilience, the authors also stress the importance of ignoring some of the indicators to take into account the available resources (Cai *et al.,* 2016; Singh- Peterson *et al.,* 2016; Jacobs and Cramer, 2017).

Instead of establishing a generic definition, it could be more appropriate to consider the term community resilience as a process of stages that communities go through. Community resilience in this regard is explained in the form of a lifecycle (before, during and after a disaster) which is characterised by the community's ability to strengthen its coping capacity through adaptive capacity during an event. It requires transformative capacity after a disaster for a more sustainable future (Joerin *et al.,* 2012). This will enable communities to build their capacity to manage future events. Resilience and community resilience as capacities have also been discussed in some literature (Manyena, 2006; Bene *et al.*, 2012; Stein, 2013; Keck and Sakdapolrak, 2013; Patel *et al*., 2017).

Individual resilience is important when measuring community resilience. Individual resilience is the behaviours, thoughts and actions, which promote personal wellbeing, mental and social capacities (Boon, 2014). Individuals can develop the capacity to withstand, cope, adapt to and recover from an event. Similarly, to community resilience, individual resilience has indicators like self-efficacy, attachment to place, sense of coherence, relationship with others, trust and so on (Cutter *et al.,* 2008; Boon, 2014). A community is a wider structure that people are a part of. Hence community resilience incorporates the elements and indicators from the individual resilience and includes more factors such as social, economic, environmental, infrastructural and institutional, which are well connected within and outside the community. No single element can make a community resilient but the dynamic and complex relationship across all the elements build resilience (Wulff *et al*., 2015; Kais and Islam, 2016). Many elements and their indicators that have been identified as contributing to measuring community resilience are embodied in both individual and community resilience (Figure 4.13). However, individual resilience does not give a complete picture, rather, community resilience has a more robust and dynamic attribute that can achieve a complete resilience and thrive in the face of adversity (Windle *et al*., 2011). For example, if some individuals within a community lack resilience, it will be unlikely that the community as a whole will be resilient. Communities are made up of

individuals as they do not exist in isolation. So, looking at the resilience of a community will be determined by the resilience of individuals (Eachus, 2014).

One important element for both individual and community resilience is the social element. This element describes the relationships between individuals and groups and can be influenced by the other elements (Bonanno *et al*., 2010). For example, having a diverse set of networks and relationships with others is good for both individuals and community groups. Empowerment is born from collective strength (Gil-Rivas and Kilmer, 2016), and the individual and community control over policy actions promotes health and wellbeing (Stainer and Markantoni, 2014).

Figure 4.13. Proposed relationship between individual and community resilience

The review also identified some of the elements of community resilience which were broadly classified into eight elements of social, economic, demographic, infrastructure, institutional, training and awareness, environmental and health and fatality. For this research, community resilience element is in-line with other related studies (Cutter *et al.,* 2014; Alshehri *et al.,* 2015; Qin *et al.,* 2017). Also, the current study showed that community resilience measurement indicators are not the

same across all the identified publications. In alignment with Sovacool *et al.* (2012), it was proposed that community resilience indicators should place significant emphasis on determining the most cost-effective way in which targeted communities can be helped. This is because most policies that are designed to mitigate climate change disturbances are too complex to implement (Engle *et al*., 2013). This is evident in how much information is needed for measurement and in which aspects. This systematic review also established that there is a deep interlinkage across all the community resilience categories as they are activated often simultaneously in processes and activities in a community to respond to climate disturbance. For example, for a community to be resilient, ideally, resilience has to be achieved from every possible perspective so that there are no gaps left to create new vulnerability (Doorn, 2015; Rus *et al.,* 2018). According to Wilson (2010), communities with all the community resilience elements accounted for are more likely to be resilient than those with one or none of these elements. The community resilience elements cannot stand alone without the support of the rest of the elements, as every element can potentially contribute to other elements without which these elements can never become self-sufficient and hence stay incomplete.

The implication of this is that research focusing on one or two elements will not provide overall resilience in that community as other elements left out might create new vulnerability, which will impact their resilience (Frankenberger *et al.,* 2013; Constas *et al.,* 2014; Quinlan *et al.,* 2015). For example, training and awareness overlap with the institutional element of community resilience which is why enactments of institutional processes that mediate individuals' and communities' abilities to undertake different best strategies for climate change are significant in operationalising community resilience. Ideally, all these elements should be applied for a community to achieve increased resilience in all aspects. However, Islam and Walkerden (2017) argued that due to institutional and financial limitations, this might not be possible. This has led policymakers to prioritise some elements and their indicators which may be focused on for a particular situation or at a certain stage of addressing an impact (Engle *et al*., 2013). Success can be increased in building on what already exists

in the community (Markantoni *et al.,* 2019). That is why it is vital to know the capacities or what is already in the community to inform activities to support community resilience in the face of climate change.

Infrastructure and economy are studied extensively in most of the publications (Ahmed *et al.,* 2016; Sovacool *et al.,* 2012; Qasim *et al.,* 2016; Twigg-Rose *et al.,* 2016). They focused on infrastructures such as roads, emergency services, water, electricity, communication services, and critical facilities that are key to building resilience of communities. Thus, more research on infrastructure elements with focus on building infrastructure and the funding aspect are linked together. Economic and infrastructure elements are closely linked to enhance resilience in communities. The lack of critical facilities could affect the recovery process after an event and policy making (Vallance and Carlton 2015; Patel *et al.,* 2017). Training and awareness are a very useful element in mitigating vulnerabilities that are caused by how a community understands its risks and impact of climate change (Norris, 2008; Channa and Ahmed, 2010). This was one of the least elements identified in the systematic review. However, this element should be given more priority as it is a core area where resilience needs to be built especially in developing countries (IPCC, 2014). This is particularly important due to the typical characteristics of such countries including: geographical area; land characteristics; coastal locations; high natural climate variability; highly vulnerable population; and limited finance and technological capacity to adapt to climate change (Yohe and Tol, 2002; IPCC, 2014).

4.4 Conclusion

The systematic review showed that the community resilience concept is well understood in the analysed publications based on coping capacity, adaptive capacity, and transformative capacity of the community to climate change. However, these community resilience definitions differ from community to community, as many will argue that it is not possible to have a standardised set of

indicators. As a result, measuring community resilience is challenging. It needs an approach that takes account of the community's characteristics, capacities, resources and vulnerabilities, and by incorporating the three definitions as a process to achieve resilience. Eight elements of community resilience have been identified as it applies to climate change: social, economic, demographic, infrastructural, institutional, training and awareness, environmental and health and fatality. Likewise, 49 indicators categorised under the elements that are relevant to reducing the effect of climate change and used in measuring community resilience were identified. The next stage of the research sought to determine how community resilience is operationalised within the context of Nigeria as an example of developing countries.

5 Operationalising Community Resilience

5.1 Introduction

This research aims to inform the development of policy goals that support community resilience to climate change. Chapter 5 outlines how community resilience is operationalised within the context of Nigeria and its implications for policy and presents the findings (Delphi round one) of the data collected from the 21 experts. A semi-structured interview approach with the expert group provided an opportunity for a relatively open-ended individual discussion about how they understood community resilience and how it is measured. The words from the interviewed participants were transcribed and are presented in italics to support each theme discussed within the chapter.

5.2 Expert Group

The expert group, as stated in Chapter 3, consisted of 21 experts from the national and state levels of the Nigerian government (Figure 5.1) with mostly from the Department of Climate Change in the Ministry of Environment. Each expert has five to 40 years' work experience on climate change policy process and holds a PhD, masters or undergraduate degree (Table 5.1). Each member of the expert panel was given a code name from A to U, and details of their background are as follows:

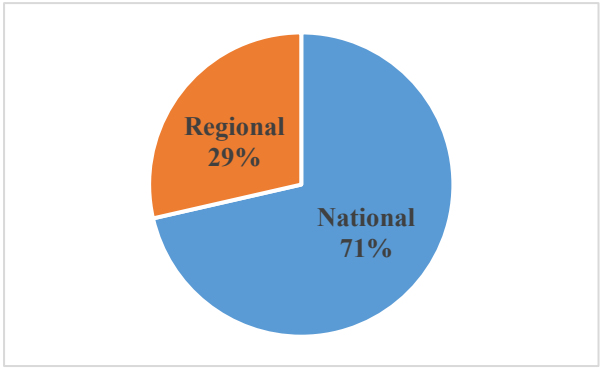

Figure 5.1. Background level of the expert group

A. This participant has a Doctorate with over 40 years of experience. He has been leading the Nigerian delegation on adaptation to the COP sessions since 2009. He is a consultant to the Federal Ministry of Environment and UNDP Nigeria on policy and other sectoral issues of climate change and energy. Also, he is an Adjunct Professor at Lagos State University leading research on energy and climate change.
B. This participant has a Master degree with over 16 years of experience and works as the senior environmental officer at Federal Capital Development Agency, Environmental Department.
C. Has a Master degree and a PhD with over five years experience and works as an officer at the Department of Climate Change, Federal Ministry of Environment.
D. Holds a Bachelor degree with over five years experience and works as a climate change desk officer at the State Ministry of Environment.
E. Holds a Master degree with over 35 years experience and is the acting director at Pollution Control and Environmental Health, Federal Ministry of Environment.
F. Has a Master degree with over five years experience and works as a climate change desk officer, State Ministry of Environment.
G. Has a Master degree with over 12 years experience and works as the regional west Africa officer on energy and environmental expert at the United Nations Industrial Development Organisation (UNIDO).
H. Holds a Master degree with over 15 years experience and works as a deputy director at the Department of Ecology, the State Ministry of Environment.
I. Holds a Master degree with over ten years experience and works as a climate change desk officer, State Ministry of Environment.

J. Has a Doctorate with over 25 years experience and holds a position as the director at the Department of Climate Change, Federal Ministry of Environment.

K. Has a Master degree with over seven years experience and works as the principal scientific officer at the Department of Climate Change, Federal Ministry of Environment

L. Holds a Master degree with over 25 years experience and holds a position as the director at the Environmental Science and Technology, Federal Ministry of Science and Technology.

M. Holds a Master degree with over eight years experience and works as an officer at the Department of Climate Change, Federal Ministry of Environment.

N. Has a Master degree with over six years experience and work as an officer at the Department of Climate Change, Federal Ministry of Environment.

O. Has a Master degree with over ten years experience and is a senior officer at the Department of Climate Change, Federal Ministry of Environment.

P. Holds a Master degree with over 30 years experience and holds a position as the director at the Social Development Department, Ministry of Budget and National Planning.

Q. Holds a Master degree with over eight years experience and works as an officer at the Department of Climate Change, Federal Ministry of Environment.

R. Has a Doctorate with over 15 years experience and holds a position as a scientific officer at the Department of Climate Change, Federal Ministry of Environment.

S. Has a Bachelor degree with over ten years experience and works as an officer at the Department of Climate Change, Federal Ministry of Environment.

T. Holds a Master degree with over five years experience and works as a climate change desk officer, State Ministry of Environment.

U. Holds a Bachelor degree with over seven years experience and works as a climate change desk officer, State Ministry of Environment.

Table 5.1. Summary of participant background

Code	Levels	Highest level of degree	Years of experience
A	National	PhD	40 years
B	National	MSc	16 years
C	National	MSc	5 years
D	Regional	BSc	5 years
E	National	MSc	35 years
F	Regional	MSc	5 years
G	National	MSc	12 years
H	Regional	MSc	15 years
I	Regional	MSc	10 years
J	National	PhD	25 years
K	National	MSc	7 years
L	National	MSc	25 years
M	National	MSc	8 years
N	National	MSc	6 years
O	National	MSc	10 years
P	National	MSc	30 years
Q	National	MSc	8 years
R	National	PhD	15 years
S	National	BSc	10 years
T	Regional	MSc	5 years
U	Regional	BSc	7 years

5.3 Result and Analysis

All the data from the interviews were audio-recorded, transcribed and manually analysed, which enabled good engagement with the data by assigning codes and developing categories. The transcript took about four hours to type; however, it is an excellent way to become familiar with the data (Bell, 2009). Verbatim quotes from the interviews were used in the analysis to ensure that the richness of the participants' language and wording is not lost during transcription (Cloke *et al*., 2004). After transcription, the data underwent a sifting process and was categorised, coding was done to highlight distinctive words and phrases for further analysis. Subsequently, commonly occurring themes were identified, and significant parallels and contrasts were noted. The themes identified were categorised under eight elements (demographic, social, economic, infrastructural, institutional, environmental, training and awareness, and health and fatality). Seventeen indicators were relevant and correlated with the analysis of the empirical material from the systematic review, which is applicable to the developing countries. Also, new indicators were identified that were different from the systematic review indicators. These new indicators were found to be relevant for measuring community resilience in the face of climate change.

5.3.1 Operationalising of Community Resilience within the Context of Nigeria

From the 21 experts interviewed, two different definitions of community resilience were identified namely: (i) Coping capacity (a process characterised by stability), and (ii) Adaptive capacity (a situation characterised by flexibility), as shown in Figure 5.2. The summary of these definitions of community resilience is presented in Table 5.1.

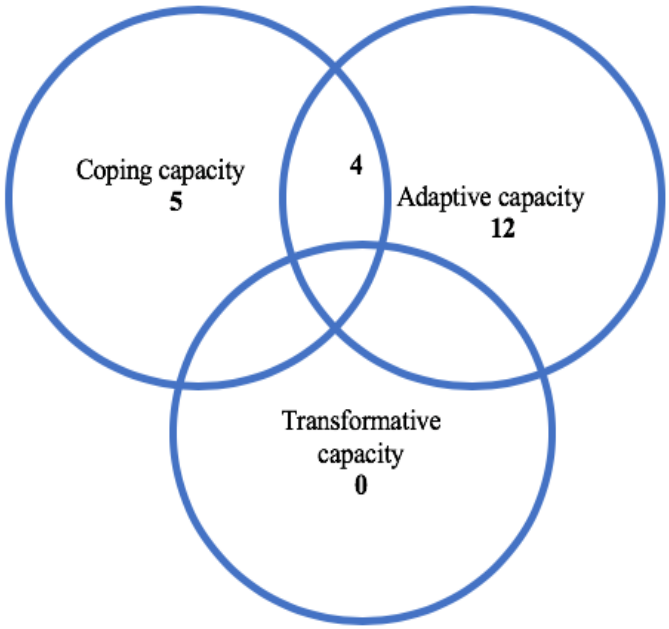

Figure 5.2. Community resilience definition linkages by the expert group

Defining community resilience as coping capacity was identified by five of the experts. One such definition of community resilience is *'the ability of a community to withstand shock or bounce back from a climate change disaster that has occurred over some time'* (H). It is also defined as *'the ability of a community to bounce back to its original state after a climate change event'* (N). Other experts likewise defined community resilience as *'bounce back to its previous state'* (A, C, F). These coping capacity definitions of community resilience are mostly associated with short-term situations that are characterised by stability. The coping capacities depend on communities' socio-economic circumstances and the characteristics of an event. According to Mavhura *et al.* (2013), coping capacities were considered to be strategies employed by people to deal with an event. Nevertheless, Thompson and Tod (1998) cautioned that coping capacity has less effect in reducing damages in more severe events.

The interview shows that a majority (12) of the experts defined community resilience in terms of adaptive capacity. Adaptive capacity is associated with long-term time frames and implies

that some learning occurs either before, during or after an event, i.e. a situation characterised by flexibility. Community resilience was defined in terms of adaptive capacity by the expert group *'as the ability of the community to put up adaptive measures in place against climate change'* (L). Similarly, community resilience is *'the ability to prepare for anticipated hazards, adapt to changing conditions and rapidly recover from disruption due to climate change'* (T). According to (U), community resilience is *'the sustained ability of a community to utilise the available resources to respond to and recover from adverse situations'*.

Furthermore, it was explained as *'the ability of a community to apply the available resources to adapt, respond to, withstand, and recover from adverse situations'.* The conceptualisation of community resilience in the form of adaptive capacity identified in this research agrees with other studies (Norris *et al.,* 2008; Levin *et al.,* 2013; Baggio *et al.,* 2015; Baggio and Calderon-Contreras, 2017; Jones *et al.,* 2018; Ferro-Azcona *et al.,* 2019). This fundamental aspect of community resilience as adaptive capacity is not static equilibrium. Instead, it is based on flexibility, and dynamic interactions, which entails accepting that change is ongoing, and the ability to make ongoing changes by continually adjusting, learning and innovating. The concept has, therefore, helped in the accumulation of new knowledge and the active development of disaster management plans (Henly-Shepard *et al.,* 2015; Sandanam *et al.,* 2018). Adaptive capacity, just like coping capacity, is characterised by socio-economic and environmental systems that through specific actions, support communities to respond to an event (Gupta *et al.,* 2010). Also, it depends on the scale of influence, whether geographical, national, regional, community, household or individual conditions (Tolentino-Arevalo *et al.,* 2019).

Community resilience was also defined by linking coping and adaptive capacity, as identified by four experts. One of such definitions was *'the way communities tend to guide against further disaster or coping and adaptive strategies of communities to deal with a disaster. A feedback*

mechanism of the community to get back to itself after a climate event' (D). This was also defined as *'the ability of a community to adapt and cope during a disaster and to return to its previous state'* (Q). The experts understood community resilience as both sudden and long-term community changes with these different approaches requiring different solutions which are equally important. Understanding community resilience by the expert group is therefore underpinned by the idea of coping capacity, adaptive capacity and the combination of both. However, what was lacking from the expert group's definitions was community resilience based on transformative capacity. Transformative capacity gives the concept a direction and provides a long-term structure for preparedness for communities to reach a sustainable future. There is a need to move towards transformative capacity that involves robust reflective learning in the face of climate change.

Overall, the experts defined community resilience by placing the scale of influence at the community level. This level was also identified in most of the published literature assessed within the systematic review. Defining community resilience in the context of community-level is significant to help understand risk and changes in communities. Nonetheless, when communities are researched as a stand-alone unit at a single spatial scale, the importance of the cross-scale relationship is neglected (Frankenberger *et al.,* 2013). Hence, it is crucial to base the scale of influence linking the communities from each spatial scale together to get a complete result.

Table 5.2. Interviewees' definitions of community resilience

Category	Scale of influence	Direct quote of community resilience definition	Experts
Coping capacity	Community	The ability of the community to bounce back after undergoing some climate-induced disaster.	A
		The ability of a community to withstand shock or bounce back from a climate change disaster that have occurred over a period of time.	C
		The ability of the community to withstand shock or disaster or negative impact of climate change and to withstand such disaster.	H

		The ability of a community to bounce back to its original state after a climate change event.	N
	Unspecific	The concerted efforts to get results during an environment issue.	F
Adaptive capacity	Community	The capacity of community to cope or resist the risk to climate change. Capacity to adapt to the impact of climate change.	E
		The ability of an area or community to work against a particular problem. To put in place measures of combating a particular problem which may be affecting their communities.	G
		The ability of the community to withstand the impact of climate change. How equipped the communities are to adapt to the impact of climate change.	I
		The ability of the community to understand and be able to guard themselves on the impact of climate change.	J
		The ability of a particular community to withstand the severity of the adverse impact of climate change. The capacity of the society to adjust and readjust to the adverse impact of climate change.	K
		The ability of the community to put up adaptive measures in place against climate change.	L
		The ability of the community to adjust and adapt to the impact of climate change.	M
		How the community can resist the impact of climate change? It just to make them take precautions, prepared and to plan for the impact of climate change.	O
		The ability of a community to apply the available resources to adapt, respond to, withstand, and recover from adverse situations.	R
		It means the ability of the community to utilise the available resources to respond to and respond to negative situations and disaster.	S
		Community resilience is the ability of communities to prepare for anticipated hazards, adapt to changing conditions and withstand and recover rapidly from disruption as a result of climate change.	T
		Community resilience is the sustained ability of a community to utilise the available resources to respond to and recover from adverse situations.	U
Coping and adaptive capacity	People-centred	How people are able to adapt or cope with climate change.	B
	Community	The way communities tend to guide against further disaster or coping and adaptive strategies of communities to deal with disaster. a feedback mechanism of the community to get back to itself after a climate event. The ability of a community to adjust or readjust themselves from prevailing situations or the environmental problems they face.	D
		The ability of the community to adapt to the impact of climate change. Putting things in place to reduce the effect of climate change on communities. How communities are able to cope with the impact.	P
		The ability of a community to adapt and cope during a disaster and to return to its previous state.	Q

5.3.2 Elements of Community Resilience

Indicators which are relevant to measuring community resilience and reducing the impact of climate change were identified by the expert group. These were categorised into eight elements such as infrastructural, training and awareness, environmental, social, economic, demographic, institutional, and health and fatality (Table 5.2). The most identified elements for measurement

were the infrastructural and training and awareness elements (Table 5.3). These elements and their indicators were described by the expert panel as indicated below [5.3.2.1 – 5.3.2.8].

Table 5.3. Elements and their indicators for measuring community resilience identified by the experts

Elements	**Indicators**	**No. of experts**
Infrastructure	Resilient infrastructure and maintenance	15
	Adequate domestic and industrial waste facilities	2
	Disaster management centre	21
Training and awareness	Learning and awareness	18
	Adequate resource monitoring and feedback mechanism	5
Environment	Renewable energy	6
	Sustainable agricultural practices	17
Social	Community engagement and empowerment	10
	Inter-community relationships	2
Economic	Adequate livelihood	9
	Access to credit	1
	Ecological fund	5
Demographic	Education	9
Institutions	Enforcement of good land use planning	3
	Equal distribution of responsibility	7
	Synergy and harmonisation of policy	3
Health and fatality	Access to health assistance and facilities	4

Table 5.4. Elements and their indicators identified by the experts

Elements	**No. of indicators**	**No. of experts**
Infrastructural	3	21
Training and awareness	2	18
Environmental	2	17
Social	2	10
Economic	3	9
Demographic	1	9
Institutional	3	7
Health and fatality	1	4

5.3.2.1 Infrastructural Element

Under the infrastructure element, the indicators identified can be analysed from a wide range of perspectives, such as their efficiency in decreasing the impact of climate change events. Resilient infrastructure and maintenance as an indicator focus on infrastructures that needs to be developed to withstand the repercussions of climate change. This indicator is analysed by looking at the development of resilient infrastructure and techniques that could reduce the impact of climate change effects upon the community, such as barriers built for floods. In the literature, this indicator is linked to infrastructural barriers such as seawalls that are used to protect communities from flood or sea-level rise (Ahmed *et al.,* 2016; Irwin *et al.,* 2016). Expert group gave their views on this: *'to combat flooding, attention has been towards drainage drenching to channel water away from buildings and farms'* (R); and *'people are more knowledgeable now about the climate change impact and are involved in preventing flooding from damaging their houses and farms, by using sandbags, irrigation and building on highland area'* (U). However, *'infrastructure to build roads, repair old ones, and build shelters should be increased'* (N).

As part of the climate change resilient infrastructure, it is important to provide communities with appropriate drainage and waste removal facilities to ensure good health and wellbeing of the community members. Besides hygiene and infection control, maintaining drainage systems improves drain capacity, thereby, reducing flood impacts within the community (Irwin *et al.,* 2016). According to one of the experts, *'waste disposal, open defecation and sanitation is poor in most communities, and should be dealt with as it will increase resilience in the communities and the use of polythene bags in the country should be eradicated' (P)*. Likewise, *'waste management in terms of solid and general waste in the community are severe problems faced by the communities and government'* (B). Climate change impacts can create waste which can

have distinct effects on lives and properties (Pathirage *et al.,* 2010). Therefore, as the drainage system has more than one objective, it is necessary to measure the frequency of clogging and overflow along with number and capacity of waste facilities available to assess the efficiency of these systems at an integrated level.

Regional and local governments are responsible for disaster management (Singh-Peterson *et al.,* 2015). They maintain and monitor disaster bases and are involved in identifying ways to mitigate the impacts, and by drafting and spending budgets for these disaster base services to reduce the effects of climate change (Ainuddin and Routray, 2012). The expert group mentioned that '*some places in Nigeria like Abuja and Lagos have National Emergency Management Agency (NEMA) and Federal Capital Territory Emergency Management Agency (FCTEMA) which are established to support the community, but none exist at the rural level due to funding'* (B). Another stated that *'we have a NEMA that is responsible for responding to emergencies like flooding, but they are easily overwhelmed by issues from the emergency no matter how much effort they put in'* (E). These agencies are said to also give health counselling and training programs for disaster victims and provide hazard mitigation programmes at residential and regional levels. This indicator is measured by the number of recovery centres relative to community size. It is necessary to have infrastructure that can withstand or reduce the effect of climate change events (Perera and Emmanuel, 2018).

5.3.2.2 Training and Awareness Element

Training and awareness element provide various techniques that are effective in coping with, and adapting to, vulnerabilities (Norris *et al.,* 2008). Training and awareness indicators are classified into two: Learning and training; and Resource monitoring and feedback mechanism. Learning and training indicator aims at the compatible procedures, techniques and proper technical support that various stakeholders need in educating multiple aspects of community

attributes, climate change, policy actions and their responsibilities. Relevant people need to be trained to build resilience in communities (Reams *et al.,* 2017). Sovacool *et al.* (2012) mentioned that both government officials and local leaders should be given appropriate training. Training and awareness indicator were also shown to be very important in the systematic review publications (Joerin *et al.,* 2012; Cutter *et al.,* 2014; Cinderby *et al.,* 2015; Ahmed *et al.,* 2016). This was reflected by the experts who stated that; *'awareness has been improved as people are now aware of the dangers that come with the changes in weather and people are told the time and where not to build, farm, fish and not to block water channels'* (O). K stated that *'awareness has helped in improving compliance and policy has enhanced innovation in using boreholes, solar panels and rain harvesting'*. Similarly, *'community members are able to pass down the knowledge they have gotten from awareness on climate change impact and also let others know the damages in doing some things'* (I). Nevertheless, J stated that *'some of the awareness documents should be translated into local languages and also, picture form (photographic) documents should be introduced which can be easily understood by the community members. Also, policy documents should take into consideration how to communicate their strategies to the local community members'*. In order to measure the importance of these indicators, the number of awareness and training programmes available in communities is assessed.

To sustain the livelihood of a community, its resources and activities must be maintained, distributed and monitored. This process seeks an institutionalisation of resource monitoring and implementation management. Also, it mandates an active information transfer on the status of resource availability and quality to regulate community activities and resource consumption (Singh-Peterson et al., 2015; Dobson, 2017; Islam and Walkerden, 2017). According to the experts, *'The communities need to own the process, be part of the process and create feedback*

mechanism back to their people' (D). However, '*For proper monitoring, there must be a capacity, funding, and available stakeholders and feedback mechanism put in place'* (F). Furthermore, P stated that *'The monitoring is done through a framework which is coordinated by the budgeting team and the monitoring and evaluation team from the ministries by conducting surveys, visiting sites, checking reports and giving feedback'*. This information can then be focused on relevant and concrete impacts that are specific and prominent to the communities. This indicator measures the percentage of members of the community that provides feedback to government on issues that need improvement in their communities and the number of the resources, adaptation and mitigation projects being monitored.

5.3.2.3 Environmental Element

The environmental indicators identified by the expert groups are focussed on two areas: Renewable energy; and Sustainable agricultural practices. Renewable energy use is important in planning, emission reduction and executing clean energy projects for the community needs. Renewable technologies such as hydroelectric, wind and solar energy plants provide a source of livelihood for people in engineering and management to marketing and sales, which offer safety nets to the community members (Dobson, 2017). The experts indicated that '*Efficient renewable energy and improve clean technologies is necessary for helping communities increase their resilience'* (P). Nonetheless, *'The promotion of renewable energy comes with the creation of NEED (National economic empowerment development) and the state economic empowerment development (SEED), which promote the use of alternative sources of energy other than wood and coal for cooking, which increase greenhouse gas'* (Q). However, G stated that *'the focus is on developing the capacities of rural dwellers on climate free product development and look more generally on clean cook technologies for the rural community,*

which is a major issue in the rural community'. This indicator is measured using the percentage of households using renewable energy and clean products.

Lack of agricultural produce can lead to socioeconomic instability; however, with new, improved agricultural practices, it can yield more product to sustain the communities (Mishra *et al.,* 2017). From the systematic review, the most cost-effective agricultural practices that were cited in most of the publications were better irrigation control, improved fertilisation use, conservation of biodiversity and land management which includes the removal of contamination from lands meant for building, farming and afforestation (Sovacool *et al.,* 2012; Qin *et al.,* 2017). The experts mentioned that, *'Now farmers get information now through their mobile on agricultural practices, and when to farm and when not to, and on different techniques which has improved their yields'* (J). Similarly, *'Engagement of community members through awareness creation and training to adapt to good agricultural practices like the use of agroforestry by combining different farming practices on a single piece of land, plant arable crops, rearing of animals was introduced in most communities. These diversifications of farming help prevent flooding and reduce soil quality loss'* (Q). Also, K stated that *'communities have been trying to adapt through crop rotation which helps the soil to regenerate over the years, storing of grains for the future, tree planting has been encouraged greatly, re-afforestation of the forest with government collaboration with the community member, which a project was introduced by the government called the 'great green wall' and introducing law enforcement to arrest anyone poaching'*. Sustainable agricultural practices are measured by the percentage of people involved in good agricultural practices. This indicator helps communities to create and implement plans to maintain the population along with the protection of natural resources of the communities (Henly-Shepard *et al.,* 2015).

The environmental element was profoundly ignored in the mainstream studies of community resilience (Singh-Peterson *et al.,* 2014; Sharifi, 2016; Whitney *et al.,* 2017). Nevertheless, this element was identified as very important by the expert groups.

5.3.2.4 Social Element

The main applications of the social element are in terms of establishing social networks and utilising them before, during and after the climate change event, to achieve fast and reliable communications and engagement towards lessening the loss and improving the community's self-reliability. The firm establishment of community engagement and empowerment can help create, plan and organise policy actions and their respective implementation procedures (Cinderby *et al.,* 2015). On an overall scale, community engagement and empowerment comprise of the activities that could improve the community's trust, livelihood and the individual's ability to overcome stress caused by a disturbance. The experts mentioned that *'There is a need for community engagement and empowerment across all board. Communities need to be part of the process as it is only on this basis, they will know the government have their interest at heart; and community engagement and community participation like in awareness campaign, festivals, support system, are key to community resilience*' (D). Likewise, *'In a village we had a project in, community members work together to prevent flooding in their community. They made sure each household cleared their waste and put sand in bags to divert the flood. Organise meetings to put their heads together to get solutions to their problems and clear drainages in the community'* (H). *'The government help in the empowerment of the community members in learning and training of community members on how to deal with climate change, technical capacity, human capacity in planting trees and growing greens, and helping them with an alternative source of income which can increase resilience'* (P). However, N stated that *'more focus should be given to gender and vulnerable people who are not*

supported really at the moment'. This indicator can be measured through the percentage of people involved in community activities. Community engagement and participation is vital for local policy strategy and actions to be successful in improving their resilience (Markantoni *et al.,* 2019). This statement was supported by Shortall (2008), who highlighted that there is a need for inclusive engagement to ensure that the participation of community members does not only favour well-resourced and affluent communities. Furthermore, the marginalised communities are less likely to participate in local policy development process, unless more attention is given to their inclusion (Shucksmith, 2010).

Intercommunity relationships help the community before, during and after the climate change event by creating various opportunities such as trading and volunteering. Intercommunity trading could improve the demand for local products, thus improving the sourcing opportunities for those who are working in their production within the community. Amundsen (2012) highlighted the contribution and importance of volunteers from other communities into building economic opportunity in the targeted community as a policy action. During a climate change event, other communities can help the affected community by providing resources and volunteers to ensure the safety of the community members (Mavhura, 2017). Some experts mention the intercommunity relationship as an indicator; they stated that *'Most communities resort to self-help, it's like a communal thing. If such disaster happens, members of the community and other communities that are not very affected can afford to make contributions for donations for food items, clothing and medications and they can do that even before the government do anything'* (C). Also, *'Communities now check soil texture and soil exchange with other communities that have better soil and grass planting'* (L). However, from the systematic review, Mavhura (2017) suggested that policy activities to improve intercommunity

relationships should be improved. This factor can be measured by the number of relationships between two or more communities.

5.3.2.5 Economic Element

The analysis of community resilience from an economic perspective has been researched in numerous studies (Cutter *et al.,* 2014; Abenayake *et al.,* 2016; Ahmed *et al.,* 2016). The economic element is analysed to check the status of economic indicators in a community efficiently. The indicators identified by the experts are adequate livelihood, access to credit and ecological fund. There are however more indicators identified in the systematic review such as homeownership, household assets and insurance coverage (Joerin *et al.,* 2012; Kim and Marcouiller, 2015) that were not identified by the expert group.

The adequate livelihood of an individual as an intrinsic part of the community would influence the community resilience as its sufficiency would absorb the consequences of climate change and accelerate the adoption process (Qin *et al.,* 2017). The temporal consistency of an individual's income is dependent upon the type of sourcing community members have. If the sourcing is weather dependent, such as farming and fishing, the recipients may not be able to obtain income consistently throughout the year (Bergstrand *et al.,* 2014; Mavhura, 2017). The experts stated that *'Most women in the community engage in different activities to generate a source of income for their family to improve their livelihood'* (I). Also, *'Having wealth can help people adapt very well to the impact of climate change while poor people find it very difficult to cope as they will even burn wood which is called 'survival emissions'* (K). Hence, it is crucial to collect data on annual income to assess the average yearly income of a household and the percentage of people with more than one source of income. This data is important for the government and community to check how much improvement is needed in the livelihood of the community members and what kinds of actions are to be taken in doing so (Ahmed *et al.,*

2016). The data can be further extrapolated into calculating the percentage of households that are below the poverty line. This can be used by governments to check if the community members are in need of any financial support or improvement techniques in their income and money management.

In circumstances where the community members could not avail funds either from the sourcing or from household wealth, other options such as credit loans will help the community members to re-establish their livelihoods. These credit loans were availed by a variety of means such as microfinance institutions, local government, NGOs, banking systems, and local money lenders (Ahmed *et al.,* 2016, Bene *et al.,* 2017). Bene *et al.* (2017) raised concern over abusive interest rates for the cash grants by the local money lenders. This expresses the need for established institutions for credit loans organised by a reliable governing system as part of the policy. An expert stated that '*government introduced schemes which gives out loans to farmers in the community'* (O). This can be measured using the percentage of people with access to credit facilities.

Alongside household, economic resilience towards climate change is important to maintain public properties such as transportation, communication, and other infrastructural indicators against fluctuations in climate. Ecological fund as an indicator has been proposed by the experts, who stated that *'Introducing ecological fund help reduce the effects of climate change'* (I). Also, T said that '*Because of the policies introducing ecological fund, people were able to move to shelters during a flood event and move back to their communities and homes afterwards, without incurring a lot of costs'*. According to Alshehri *et al.* (2015), community disaster fund is the most important economic indicator. Despite being claimed to be the most important, it is essential to understand the ways of obtaining plausible resources such as national and international donor to create this funding and using available knowledge and

resources to reduce the need of excessive amount of funding (Ahmed *et al.,* 2016). Nevertheless, Qin *et al.* (2017) suggested that the ecological fund should be given particular preference during budget allocation. This can be measured by the percentage of annual spending on mitigation and adaptation projects.

5.3.2.6 Demographic Element

This element focuses on demographic characteristics such as age, sex and education for its measurement (Akamani, 2012; Bene *et al.,* 2017; Qin *et al.,* 2017). It relies on how individual lives are connected and their behaviours in response to an event, and the number of people in a geographical scale (Cutter *et al.,* 2008; Engle *et al.,* 2013). The expert group proposed one indicator (educational status) in this element. To combat climate change repercussions, it is important to find out the educational levels of residents to get an idea of their awareness for knowledge transfer and skills that could be useful during an emergency (Ainuddin and Routray, 2012). This would aid policymakers to design suitable training sessions to educate the people on climate change actions and shared responsibilities. The experts mentioned that *'Government is beginning to see that these rural communities are at the receiving end of climate change impact and are trying to increase education and advocacy in the communities'* (G). K stated that *'education is also a factor, the more educated we are, the more we are able to accept and deal with changes'*. Also, O said *'education is also a very important component which enables people to have the knowledge to deal with climate change impact, and lack of education is a serious problem in the community'*. According to Cutter *et al.* (2004), vulnerability to climate change is related to people who are limited in education as they are often less resilient than others. This indicator is mostly used to collect the attributes of the community, which would be used further in measuring the effective implementation of other indicators. For example,

this indicator is measured by collecting data on the number of people who have attained a school leaving certificate.

5.3.2.7 Institutional Element

The institutional element is essential for establishing organisational networks to plan and execute various mitigation actions, training programmes and distributing responsibilities (Cutter *et al.,* 2014; Khalili *et al.,* 2015). Every community needs inclusive governance involving government, business, organisations and communities in decision making, coordinating activities and integrated development planning. From the interview, the experts proposed three indicators as the enforcement of land use planning; distribution of responsibilities; and synergy and harmonisation in policies.

Enforcement of proper land use planning helps in comprehensive town monitoring and management. For example, land used for building, farming and forestry is mapped out in communities. This has helped in making these areas visible to government planners with the information provided on essential services, land tenure, and income and risk, all of which are necessary for assessing and mitigating risk in development planning (Dobson, 2017; Mavhura, 2017). The experts mentioned that *'Area like the land use planning needs to be improved as it is important for communities'* (H). Likewise, L said *'with the increasing urbanisation, population growth, land use is affected as lands meant for wildlife and parks are being taken over by housing and industries which, need to be looked at as it is very important'*. This indicator is measured by the number of development and implementation plans on land use.

Responsibility distribution plays a role in community resilience as a policy strategy by looking at the processes, structures and mechanisms that enable preparedness and coping with climate change. Responsibilities are to be distributed among the stakeholders from various levels of

the policy implementation process to help build resilience in communities (Sovacool *et al.,* 2012; Gawith *et al.,* 2016). Responsibilities such as legislation, funding, provision of health services, organising training sessions, controlling illegal exploitation of forests and transportation, are taken from the federal to the local government (Cutter *et al.,* 2014; Fox-Lent *et al.,* 2015). In case of deficiency of government stakeholders, the gap can be filled through establishing partnerships between organisations, and the responsibilities could be distributed among the stakeholders (Amundsen, 2012). In the literature, the partnership between sectors helped to enhance community resilience as it provided an array of adapting and mitigating measures (Sovacool *et al.,* 2012). From the expert groups, it was stated that *'all the ministries and sectors are coming together to work on one goal and not as separate issues'* (E). Likewise, *'Collaboration with sectoral ministries and NGOs help to improve awareness in this regard'* (M). *'The Department for Climate Change has the responsibility to coordinate all climate change programs in the country and other sectoral ministries and bodies report back to them'* (G). Equally, K mentioned that *'groups like the women leaders, youth leaders, community leaders are involved in driving climate idea in their communities like enforcing environmental laws'*. These can be measured from the number of strategies for responsibility distribution and partnerships amongst sectors and stakeholders on policy process.

Synergy and harmonisation of policy is the interaction between various institutional arrangements or strategies in the planning and implementation of adaptation and mitigation policies. This helps in promoting joint efforts in building capacity, avoiding duplication, broadening knowledge base, encouraging cooperation, providing opportunities and sharing experience (UNFCCC, 2015). Although this indicator was not mentioned in the systematic review publications, the expert groups identified its importance and stated that *'Climate change problem is a global issue and as such everyone and every country should be involved to ensure*

sustainability and corporate responsibility should be strengthened' (L). However, H said *'there is the lack of coordination, no synergy among the stakeholder groups which affect their roles in combating climate change issues, but synergy is very important and should be looked at. These bodies do not collaborate well enough. For example, land and survey ministry do not wait or consult town planners or get environment impact assessment on an area before they give out lands, which is a huge issue. If this can be dealt with, it will help facilitate policy implementation'.* Also, S explained that *'there is the issues of the inconsistency of some policies due to lack of synergy around government officials in different ministerial sectors and this has to be dealt with for any meaningful progress to be made. Policies to regulate forest management, valuation of ecosystem services, propagation of seedlings, gender mainstreaming and harmonisation of policies are key factors to be prioritised'*. The synergy and harmonisation of policy are measured by creating a common standard in regulations within the sectors in the policy process.

5.3.2.8 Health and Fatality Element

Any policy action that can influence the wellbeing and longevity of the community members in terms of their health before, during and after the climate change disaster is under this element (Orencio and Fujii, 2013; Cutter *et al.,* 2014; Alshehri *et al.,* 2015; Cinderby *et al.,* 2015; Ahmed *et al.,* 2016; Dobson, 2017; Alam *et al.,* 2018). From the expert group, only one indicator was proposed, which is the access to healthcare assistance and facilities. They stated that *'Health issues relating to the environmental impact should be looked at and improved'* (H). Also, *'Community members should live a healthy lifestyle and learn skills to manage stress. People should be able to access hospitals and doctors when they are ill, which is lacking in most local communities'* (S). This can be measured by the percentage of community members with access to clinics, hospitals, doctors and nurses. In terms of access to healthcare

services and assistants, Ahmed *et al.* (2016) stated the importance of having nearby local hospitals where community members can be checked for earlier detection of illness prior to visiting more prominent hospitals, which helps to saves some cost for not always visiting bigger or private hospitals. This also shows that community members are knowledgeable about treatment options at a reduced price.

5.4 Discussion

This Delphi round one identified how community resilience is defined by experts, relative to the literature, and a clear set of elements and their indicators to measure community resilience to climate change. While the concept of community resilience is complex (Bergstrand *et al.,* 2014; Patel *et al.,* 2017), the current findings indicate that the expert group had a clear understanding of the concept. The definitions were around two generic terms: coping capacity and adaptive capacity. Importantly, community resilience as adaptive capacity was defined by most of the expert group. The conceptualisation of community resilience as adaptability is in agreement with other studies (Norris *et al.,* 2008; Levin *et al.,* 2013; Baggio *et al.,* 2015; Baggio and Calderon-Contreras, 2017; Ferro-Azcona *et al.,* 2019). The critical aspect of community resilience as adaptive capacity is accepting that change is ongoing and, consequently, highly unpredictable. As a result, adaptive capacity is about flexibility and the ability to make constant changes through the continuous process of adjusting, learning and innovation (Henly-Shepard *et al.,* 2015; Sandanam *et al.,* 2018). This finding is slightly different from the systematic review finding as most of the analysed publications defined community resilience as the combination of coping and adaptive capacity. Understanding the linkages between 'coping capacity' and 'adaptive capacity' of community resilience is critical to furthering community capacity to respond to both short- and long-term change. Both approaches are equally important considerations for community resilience and a joined holistic approach with the definition of community resilience is more likely to be functional in practice. Critically, as identified during

this research, a definition of community resilience focusing on stability could be described as 'coping capacity' and would demand broader, bottom-up processes of response, not the 'top-down, command and control' that focuses on continued changes, and is described as 'adaptive capacity'.

One of the finding of the research is that community resilience was not defined in terms of transformative capacity by the experts. The understanding of community resilience in terms of transformative capacity as a concept is very important as it would give direction and provide a long-term structure for preparedness for communities to reach a sustainable future (Chung, 2017; Choko *et al*., 2019). Society needs to move towards transformative capacity that involves robust reflective learning in the face of climate change (Otoara-Ha'apio *et al*., 2018). Transformative understandings of community resilience offer more significant potential for creating shared action and 'future-proofing' communities, through providing a long-term structure for community preparedness and reaching their goal. Due to continued risk arising from climate change, communities can benefit from a more sustainable planning which will lead to transformative changes by increasing resilience in communities.

The experts at the regional level mentioned that community engagement and participation was not sufficient due to lack of capacity building, as people are not really aware of the impact of climate change and policies to be implemented in their communities while some are not concerned about what is actually happening. However, the national level experts felt that community members need to own the process before the policy impact can be felt. One of them mentioned '*when plans are put in place, community members do not follow it through'*. This is also a significant problem with implementation of activities where community members do not cooperate with government officials if they do not see any financial gains from the required work. According to Markantoni *et al*. (2019), community engagement and participation is vital

for policy strategy to be successful to improve resilience in communities. In order to encourage community participation by supporting their empowerment, the government needs to understand the status of local needs and level of awareness before designing and implementing policies. This statement was supported by Shortall (2008) who highlighted that there is a need for inclusive engagement that ensures the participation of communities.

The extent to which communities can offer resistance, or recover and adapt to changes, is based on the different capacities which are part of that specific community that is stressed (Twigger-Ross *et al.,* 2016). Respective communities need to understand their capacities and vulnerabilities for the development of community resilience to climate change. In this research, the expert group identified 17 indicators that are categorised into eight community resilience elements (infrastructure, training and awareness, environmental, social, economic, institutional, demographic and health and fatality). These measurable indicators are necessary precursors in their process of becoming resilient in the face of climate change.

This research identified an indicator that was not recognised in the published literature from the systematic review. Synergy and harmonisation of policy helps in the interaction between various institutional arrangements or strategies in the planning and implementation of adaptation and mitigation policies. This indicator promotes joint efforts in building capacity, avoiding duplication, broadening knowledge base, encouraging cooperation, providing opportunities and sharing experiences (UNFCCC, 2015). Also, the most mentioned elements were infrastructural and training and awareness. This is different from the systematic review, where the social and economic elements were mostly addressed (Table 5.4). In the context of developing countries like Nigeria, these elements (infrastructural and training and awareness) are given more priority as they are the core area where resilience needs to be built in developing countries. This is due to their geographical area, land characteristics, coastal locations, high

temperature level, high population and limited financial, technology and adaptation capacity to adapt to climate change (Yohe and Tol, 2002; IPCC, 2014; Ogbuabor and Egwuchukwu, 2017). Likewise, the health and fatality element were identified the least from both the systematic review and the expert group. According to Plough *et al*. (2013), healthcare is an integral part of community resilience and the backbone of medical responses to an event. Health and fatality deals with access to healthcare services at the time and after a climate change event. It does not only focus on the hospital setup but on staff, services and facilities that are to be used by general members of the public, including those with a variety of disabilities and special needs (Ahmed *et al*., 2016; Alshehri *et al*., 2015). Besides, this element encompasses the activities related to the preventive measures for various epidemics that are common after climate change events, mostly in developing countries. The poor in developing countries who have limited access to healthcare and poor resistance (Ludwig et al., 2007) feel climate change impact on health more. Encouraging activities to improve this element can enhance the health status of the community members, reassure their lives and increase the number of participants that are fit to take part in climate change activities.

Table 5.5. Elements and number of indicators identified in the systematic review and expert group

Systematic review elements	No. of indicators	Expert group elements	No. of indicators
Social	6	Infrastructural	3
Economic	8	Training and awareness	2
Demographic	5	Environmental	2
Infrastructural	8	Social	2
Institutional	7	Economic	3
Training and awareness	4	Demographic	1
Environmental	5	Institutional	3
Health and fatality	6	Health and fatality	1

Due to the increased number of participants as a result of improved wellbeing, the cost of community resilience activities can be potentially reduced. Some of the activities to support this element would involve seeking help from the surrounding communities, which would lead to inter-community bonding. This would improve their relationship further, including business activities, and contribute positively to other elements. As a result of these deep interlinkages among the elements, a priority order cannot be assumed without understanding the needs of the communities. Hence it is more appropriate to use the phrase, 'relative prioritisation with respect to the targeted community'. Generally, the prioritisation needs two criteria to be looked at before analysing: the importance; and the need. While the measurement of community resilience is challenging and potentially constraining (Sharifi, 2016), the community resilience elements and indicators identified here are grounded and coherent for the broader application of community resilience within policy planning processes. Likewise, this could form a basis for the development of policy prioritisation guidance around community resilience applications for developing countries.

5.5 Conclusion

This research contributes to the body of knowledge in exploring how the expert group in Nigeria, as an example of developing nations, operationalise community resilience. This was addressed using the application of Grounded Delphi Method, where data was collected using semi-structured interview (Delphi round one) providing valued indicators by tapping into expert's knowledge and experience regarding community resilience to climate change. Community resilience was defined by the expert group in terms of coping capacity, adaptive capacity and a combination of both. Also, 17 indicators that are relevant to reducing the effect of climate change were identified. Hence, a survey was designed in this research to find out how significant each of the community resilience indicators is. Since funding for the

implementation of policies is generally inadequate, the indicators identified need to be prioritised to have the most impact in the context of developing countries, and to achieve a consensus, this research conducted two more Delphi rounds (survey) to establish community resilience elements and indicators.

6 Establishing Community Resilience Elements and Indicators

6.1 Introduction

The objective of this chapter is to implement stage four of the research programme and establish a methodology by which consensus between Nigerian experts on how competing issues can be prioritised to improve community resilience in Nigeria. In Chapter 5, a Grounded Delphi Method was used to determine how 21 Nigerian experts operationalise community resilience. The expert group was drawn from Nigerian government officials at the national and regional levels who are involved in the climate change policy process (design to implementation). They identified 17 indicators that were categorised under eight elements: infrastructural; training and awareness, health and fatality, environmental, infrastructural, social, economic and demographic. Therefore, the current chapter uses Delphi two to examine how significant each of the 17 indicators was perceived to be and applies Delphi three to achieve a consensus from the expert panel on each of the indicators. Feedback from the first and second round was sent out to the experts to review and to then give their final rating for each of the 17 community resilience indicators. As a result, this research chapter spells out appropriate indicators that were significant and achieved consensus to support community resilience to climate change in Nigeria and other developing countries. Overall, the categorisation of indicators under the general community resilience elements was derived from both the systematic review analysis (Chapter 4) and expert group interviews (Delphi one; Chapter 5).

6.2 Result and Analysis

The survey was designed to rate the importance of each of the indicators to measure community resilience to climate change, and check for consensus on each of these indicators among the different experts. The survey data were analysed using Excel. Delphi round one of this research identified 17 indicators to measure community resilience to climate change with three more indicators identified during Delphi two. These 20 indicators are categorised under community resilience elements of infrastructural, training and awareness, environmental, social, economic, demographic, institutional, and health and fatality, as shown in the sections below. These have been compared to other approaches in the literature for categorising and measuring indicators supporting community resilience (Jordan and Javernick-Will, 2013; Cutter *et al.,* 2014; Alshehri *et al.,* 2015; Sharifi, 2016; Qin *et al.,* 2017).

6.2.1 Delphi Two (Survey)

In the Delphi two, 17 community resilience indicators were sent to 21 experts to get their opinions on the importance of each indicator, and to suggest other relevant indicators. However, only 20 experts completed this round, as one of the experts dropped out. The 5-point Likert scale was used with 1 representing unimportant; 2 for slightly important; 3 for moderately important; 4 indicating important; and 5 for very important (Appendix 8.4.1, Delphi two). The indicators were analysed based on the resulting Weighted Average (WA), Standard Deviation (SD) and Interquartile Range (IQR) as presented in Table 6.1. These different methods can be used to measure the importance of each indicator and achieve consensus (Murphy *et al.,* 1998; Bailie, 2011; Von der Gracht, 2012). Furthermore, this method of weighting is considered acceptable for consensus (Hasson *et al.,* 2000).

The weighted average was used as a method for understanding the expert's opinions on the significance of the indicators (Greatorex and Dexter, 2000). Hence, their range from 3.75 to 4.65 shows that all the indicators were significant. In addition, these indicators were significant since more than 70% of experts were in agreement (Diamond *et al*., 2014; Slade *et al*., 2014; Musa *et al.,* 2015). The 17 indicators to measure community resilience to climate change were measured and prioritised by the expert group, and as funding for climate change activities is limited, these indicators can be deemed relevant where stretched finances need to be focused on while having the most impact.

Standard deviation and interquartile range are complimentary resulting in their combined use in previous studies (Musa *et al.,* 2015). Standard deviation is used in measuring consensus (Holey *et al*., 2007) as it determines how far each response is from the weighted average (Rayens and Hahn, 2000). Standard deviation, which uses all the data in the survey, helps to measure outliers and how far each observation is from the mean (Murphy *et al.,* 1998; Rayens and Hahn, 2000). Furthermore, the standard deviation of the individual response to each indicator (≤ 1) was calculated in this research. A standard deviation between 0 and 1 is considered a strong consensus while standard deviation more than one reflects a weak consensus (Goldman *et al.,* 2008). The standard deviation analysis in this research shows that only 59% of the experts agreed. This shows that consensus was not reached among the expert group on the 17 indicators within Delphi two. As indicated in Table 6.1, the standard deviation analysis identified seven indicators for which there was no consensus as follows: Adequate domestic and industrial waste facilities (SD = 1.10 > 1); Access to credit (SD = 1.23 > 1); Renewable energy (SD = 1.33 > 1); Enforcement of good land use planning (SD = 1.14 > 1); Ecological funding (SD = 1.06 > 1); Inter-community relationships (SD = 1.27 > 1); and Access to healthcare assistance and facilities (SD = 1.19 > 1).

According to Murphy *et al.* (1998), the Interquartile range less than or equal to one (≤ 1 or = 1) is considered as strong consensus whereas an IQR more than one (≥1) is considered a weak consensus. The IQR is very important as it is computed by using data lying along the first quartile (25%) and the third quartile (75%) and measures the mid-spread or the middle 50% of responses (Musa *et al.,* 2015). Similar to the findings of the standard deviation, the IQR shows that there was no consensus for three indicators out of the 17 community resilience indicators. These were adequate domestic and industrial waste facilities (IQR = 2 > 1); Access to credit (IQR = 1.25 > 1); and Renewable energy (IQR 2.25 > 1) (Table 6.1). The main purpose of using a Delphi method is achieving a significant level of consensus from the expert panel on each of the community resilience indicators, which this Delphi round failed to achieve.

Some researchers have recommended the use of interquartile range to measure consensus (Alshehri *et al.,* 2015; Musa *et al.,* 2015), the results of this research suggest not to rely on the technique wholly. The IQR gives a clear view of the overall data by removing the outlying values and by measuring the dispersion based on two values from the dataset (Giannarou and Zervas, 2014). However, the standard deviation is a more substantial measure of distribution as it considers every value in the data (Goula, 2013). Therefore, the use of the standard deviation method in this research helps in investigating further the range of indicators where consensus is weak since the interquartile range technique may overlook those indicators.

Table 6.1. Rating result by 20 experts of the importance of community resilience indicators round two

Indicators	WA	SD	IQR	Rank
Resilient infrastructure and maintenance	4.65	0.93	0	1
Learning and awareness	4.6	0.83	1	2
Educational status	4.45	0.83	1	3
Adequate resource monitoring and feedback mechanisms	4.45	0.69	1	3
Enforcement of good land use planning	4.4	1.14	1	5

Community engagement and empowerment	4.35	0.75	1	6
Sustainable agricultural practices	4.35	0.75	1	6
Synergy and harmonisation of policy	4.3	0.98	1	8
Adequate livelihood	4.25	0.91	1	9
Ecological funding	4.2	1.06	1	10
Inter-community relationships	4.15	1.27	1	11
Adequate domestic and industrial waste facilities	4.05	1.10	2	12
Disaster management centres	4.05	1.00	1	12
Access to healthcare assistance and facilities	4.05	1.19	1	12
Equal distribution of the responsibility	4.05	0.95	1	12
Access to credit	3.95	1.23	1.25	16
Renewable energy	3.75	1.33	2.25	17

6.2.2 Delphi Three (Survey)

Apart from the 17 community resilience indicators identified, the expert panel identified three more indicators as significant in round two, and these include communicating information in local languages; the role of faith-based organisations; and exhibition programmes to showcase local produce. As a result, the final round (Delphi three) consisted of a rating of the 20 indicators by the 20-member expert group using a 5-point Likert scale (Appendix 8.3, Delphi three). In the analysis, the weighted average was between 4.10 to 4.70, which shows that they were all important. Likewise, the standard deviation ranged from 0.47 to 0.99, and the inter-quantile range was all equal to one (≤ 1) indicating that consensus was reached on all 20 indicators (Table 6.2 and 6.3).

6.2.2.1 Training and Awareness Element

The weighted average indicators in the training and awareness element are in the range of 4.50 and 4.90. The standard deviation for the indicators in the training and awareness elements is less than 1, ranging from 0.31 to 0.88, and the IQR range from 0 to 1. Accordingly, there is a

consensus on the significance of three indicators in the training and awareness element, and this element ranked the topmost to other elements.

6.2.2.2 Health and Fatality Element

The standard deviation for the indicators in the health and fatality element is less than 1, which is 0.59, and the IQR is ≤ 1. The weighted average of the indicator in the health and fatality element is 4.65. Consequently, there is a consensus on the significance of the indicators in the health and fatality element, and this element ranked second.

6.2.2.3 Environmental Element

Table 6.4 illustrates that the standard deviation for the indicators in the environment elements is less than 1, ranging from 0.47 to 0.94, and the IQR is ≤ 1. Also, the weighted average of the indicators in the environment element is in the range of 4.45 and 4.70. Thus, there is a consensus on the significance of the two indicators in the environment element and this element ranked third.

6.2.2.4 Infrastructural Element

The standard deviation for the indicators in the infrastructure elements is less than 1, ranging from 0.69 to 0.99, and the IQR is equal to one. The weighted average indicators in the infrastructure element are in the range of 4.30 and 4.50. Therefore, there is a consensus on the significance of three indicators in the infrastructure element, which ranked fourth.

6.2.2.5 Institutional Element

The weighted average for the institutional element is 4.15 and 4.55. Similarly, the standard deviation for the indicators in the institutional element is less than 1, which is 0.60 to 0.8, and

an IQR equal to one. So, there is a consensus on the significance of the four indicators in the institutional element, and this element ranked fifth.

6.2.2.6 Social Element

The standard deviation for the indicators in the social element is less than 1, ranging from 0.67 to 0.75, and IQR equal to one. Equally, the weighted average is in the range of 4.35 and 4.35. Thus, there is a consensus on the significance of two indicators in the social element, and this element ranked sixth.

6.2.2.7 Infrastructural Element

Table 6.4 illustrates the standard deviation for the indicators in the economic elements is less than 1, ranging from 0.75 to 0.88, with IQR equal to one. The weighted average of the indicators in the economic element is in the range of 4.10 and 4.50. Hence, there is a consensus on the significance of the four indicators in the social element, and this element ranked seventh.

6.2.2.8 Demographic Element

The weighted average for the demographic indicator is 4.20. In addition, the standard deviation for the indicator is 0.77, and the IQR is equal to one. Therefore, there is a consensus on the significance of the one indicator in the demographic element, and this element ranked least to other elements.

Table 6.2. Rating result by 20 experts of the importance of community resilience indicators round three

Community Resilience Indicators	WA	SD	IQR	RANK
Learning and awareness	4.9	0.31	0	1
Communicating information in local languages	4.85	0.37	0	2
Sustainable agricultural practices	4.7	0.47	1	3
Access to healthcare assistance and facilities	4.65	0.59	1	4

Synergy and harmonisation of policy	4.55	0.6	1	5
Adequate resource monitoring and feedback mechanisms	4.5	0.51	1	6
Ecological funding	4.5	0.76	1	7
Adequate domestic and industrial waste facilities	4.5	0.69	1	8
Enforcement of good land use planning	4.5	0.69	1	9
Renewable energy	4.45	0.94	1	10
Resilient infrastructure and maintenance	4.4	0.99	1	11
Adequate livelihood	4.4	0.88	1	12
Community engagement and empowerment	4.35	0.75	1	13
Inter-community relationships	4.35	0.67	1	14
Disaster management centres	4.3	0.86	1	15
Equal distribution of the responsibility	4.3	0.8	1	16
Educational status	4.2	0.77	1	17
Exhibition programmes	4.15	0.75	1	18
Role of faith-based organisation	4.15	0.75	1	19
Access to credit	4.1	0.79	1	20

Table 6.3. Total community resilience indicators reaching consensus in Delphi two and three

Elements	Delphi two			Delphi three		
	Total indicators	Consensus of indicators	%	Total indicators	Consensus of indicators	%
Training and awareness	2	2	100	3	3	100
Health and fatality	1	0	0	1	1	100
Environmental	2	1	50	2	2	100
Infrastructural	3	2	67	3	3	100
Institutional	3	2	67	4	4	100
Social	2	1	50	2	2	100
Economic	3	1	33	4	4	100
Demographic	1	1	100	1	1	100
	17	**10**	**57**	**20**		**100**

6.2.3 Overall Ranking of all the Community Resilience Elements and their Indicators

As shown from the Delphi results, the consensus among the experts on the indicators to measure community resilience to climate change has been established (Table 6.3). Table 6.4 shows the consensus from the third and final round of Delphi, with a weighted average ranging from 4.1 to 4.85. Also, the grouped weighted average based on categorising the indicators under the elements were 4.2 to 4.75. The standard deviation is less than one on each of the

indicators ranging from 0.31 to 0.99. Likewise, the IQR was less and equal to 1 on all the community resilience indicators. The final ranking of the community resilience elements and their indicators is shown below, with training and awareness as the first and demographic as the least.

The presence of community resilience indicators can actively enhance climate change preparedness and recovery (Plough *et al*., 2013; Steiner *et al*., 2016). Also, strengthening community resilience to climate change is critical in the face of uncertainty and the expected increase of climate change impact in the future (Ziyath *et al*., 2013). The measurement of community resilience indicators is not meant to be used to compare one community against another. Preferably, it should be used as a relative measure within each community to identify better where investments and resources could be effectively applied to address their challenges. As such this research identified elements and indicators relevant to developing countries that can be prioritised for measuring the effectiveness of current policies designed to support community resilience to climate change.

Table 6.4. Community resilience elements and indicators rating results

Elements	Community Resilience Indicators	WA	SD	IQR	Grouped WA	Rank
Training and awareness	Learning and awareness	4.9	0.31	0	4.75	1
	Communicating information in local languages	4.85	0.37	0		
	Adequate resource monitoring and feedback mechanisms	4.15	0.88	1		
Health and fatality	Access to healthcare assistance and facilities	4.65	0.59	1	4.65	2
Environmental	Sustainable agricultural practices	4.7	0.47	1	4.57	3
	Renewable energy	4.45	0.94	1		
Infrastructural	Resilient infrastructure and maintenance	4.4	0.99	1	4.4	4
	Disaster management centres	4.3	0.86	1		
	Adequate domestic and industrial waste facilities	4.5	0.69	1		
Institutional	Equal distribution of the responsibility	4.3	0.8	1	4.37	5
	Synergy and harmonisation of policy	4.55	0.6	1		
	Enforcement of good land use planning	4.5	0.69	1		

	Role of faith-based organisation	4.15	0.75	1		
	Community engagement and empowerment	4.35	0.75	1		
Social	Inter-community relationships	4.35	0.67	1	4.35	6
	Adequate livelihood	4.4	0.88	1		
	Exhibition programmes	4.15	0.75	1		
	Access to credit	4.1	0.79	1		
Economic	Ecological funding	4.5	0.76	1	4.28	7
Demographic	Educational status	4.2	0.77	1	4.2	8

6.3 Discussion

Figure 6.1 shows the final elements and indicators as developed in the current research for measuring community resilience to climate change, with indicators categorised under eight elements. Community resilience elements have several similarities and differences, including their indicators between the current research and previous ones. This research community resilience element is in-line with other related studies (Cutter *et al.,* 2014; Alshehri *et al.,* 2015; Qin *et al.,* 2017) (Table 6.5).

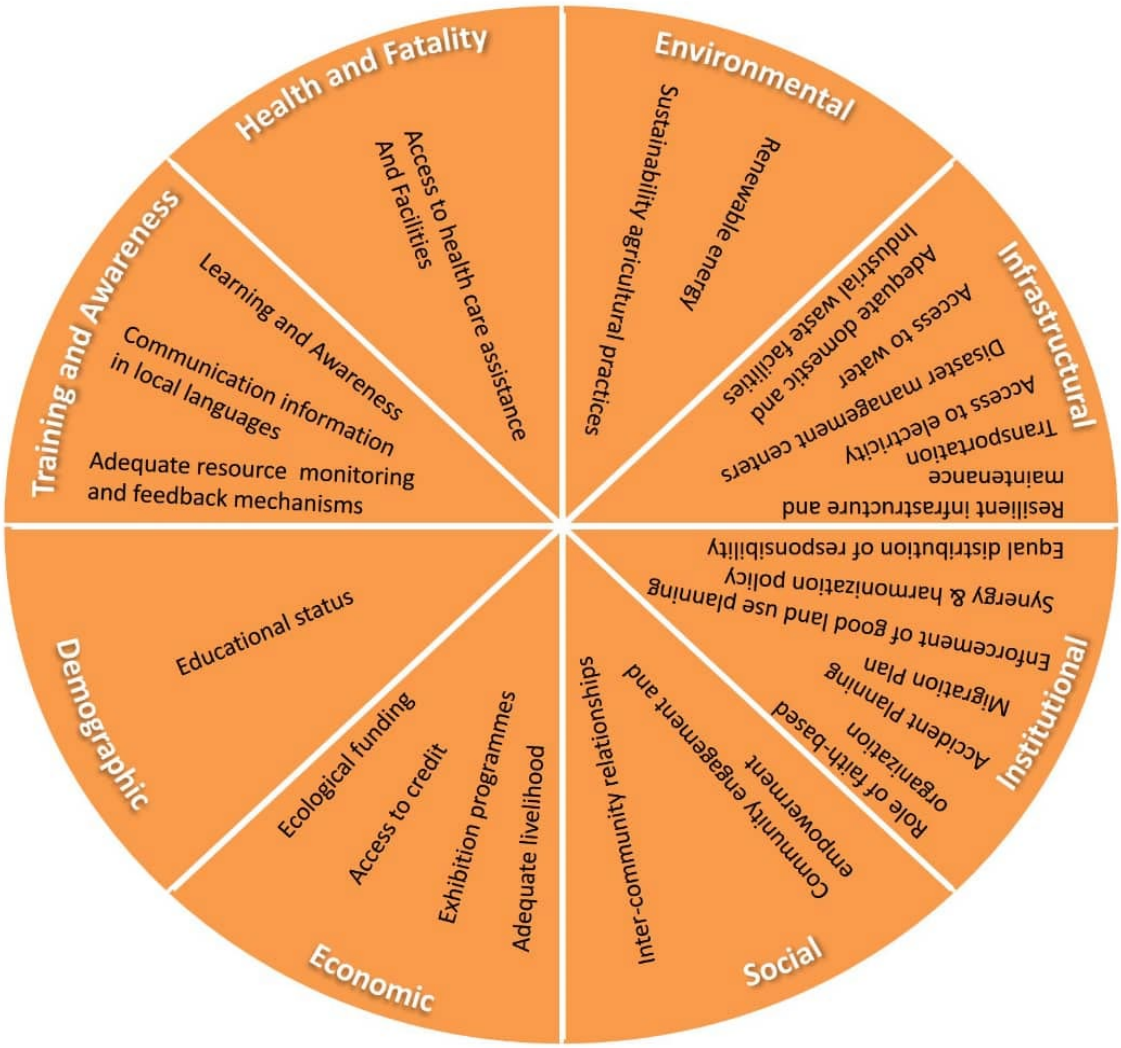

Figure 6.1. Proposed community resilience elements and indicators

Table 6.5. Comparison between the current research and other studies

CDRI	BRIC	CRDSA	RIM	CRI	
Joerin et al., 2012	Cutter et al., 2014	Alshehri et al., 2015	Cai et al., 2016	Qin et al., 2017	Current research
Social	Social	Health and well-being	Social	Social	Training and awareness
Economic	Community	Social	Economic	Economic	Health and fatality
Physical	Infrastructural	Physical and environmental	Infrastructural	Institutional	Environmental

Institutional	Economic	Governance Economic	Community	Infrastructural	Infrastructural
Natural	Institutional	Information and communication	Environmental		Institutional
					Social
					Economic
					demographic

CDRI: Climate Disaster Resilience Index; BRIC: Baseline Resilience Indicators for Communities; CRDSA: Community Resilience Framework to Disaster in Saudi Arabia; RIM: Resilience Inference Measurement; CRI: Community Resilience Index

However, for this research, community resilience elements differ in terms of training and awareness, which is not mentioned in other studies (Joerin *et al.,* 2012; Cutter *et al.,* 2014; Alshehri et al., 2015; Cai *et al.,* 2016). Training and awareness are a new element along with its associated indicators and have been identified to cover climate change challenges in general. Other differences are highlighted when compared to other studies such as by Alshehri *et al.* (2015) who argued that the use of the indicator 'risk training and awareness' is related to the social element; however, the current study elaborated this indicator as an element in 'training and awareness' element. Hence, this element ranked topmost given the consensus of the expert group in this research and the weighted average of 4.74 (see Table 6.4). This research is consistent with other studies on various community resilience elements and their indicators which are considered important and where stretched finances need to be focused in developing countries. Nevertheless, some of the identified indicators were not used in previous studies, and examples include 'exhibition programmes', 'synergy and harmonisation of policy', and 'communicating. Thereby making this work more diverse, inclusive and applicable for various needs of the community, especially in developing countries. The identified community resilience elements and their indicators can be used to measure or assess community resilience levels in different communities in developing countries.

Coping capacity consist of seven elements (social, economic, infrastructural, institutional, demographic, environmental and health and fatality) that drives the resources, the capacity to

prepare, absorb and recover from an event (Table 6.6). The coping capacity indicators focuses on short term strategies after a climate event. However, to improve community resilience, it is not simply about the short-term response strategies but the nurturing and fostering stakeholders to engage in positive and sustainable strategies that builds on the three capacities. Adaptive capacity consists of six elements (Training and awareness, social, economic, institutional, infrastructural, and environmental) that drives the processes that aid changes through learning, reorganise and adaptation of communities to plan and respond to climate event. Transformative capacity includes two elements (institutional and infrastructural) that involves changes in the deep structures that causes vulnerability and risk. Transformative capacity also includes the institutional mechanism, regulations, infrastructure and social protective mechanism that creates enabling environment for change.

The main difference between the systematic review indicators and the indicators identified by the experts is that the indicators from the systematic review are more generalised as identified from different publications, context and scale, whereas the experts, identified the indicators that are needed for the communities in developing countries and indicators that should be prioritised due to inadequate funding in the implementation of policies.

Table 6.6. Elements and indicators of community resilience capacities

Capacities	Elements	Systematic review Indicators	Expert indicators
		Attachment to place	Inter-community relationships
		Collective knowledge and experience	
	Social	Inter-community relationship	
		Annual income	
	Economic	Home ownership	
		Age	Educational attainment
		Sex	
		Educational attainment	
		Household size	
	Demographic	Religious adherence	
		High speed communication	
	Infrastructural	Existence of evacuation route	
	Institutional	Volunteerism	Role of faith base organisation
		Mutual communication	
	Environmental	Improve green space and tree planting	
		Access to health care assistance a facility	Access to health assistance and facilities
		Sanitation and infection control	
		Nutritional status	
		Access to special needs and psychological support	
Coping capacity	Health and fatality	Date rate	
		Social trust	Community engagement
		Community engagement	
	Social	Relationship with other stakeholders	
Adaptive capacity	Economic	More than one source of income	Adequate livelihood

		household asset	Exhibition programmes
		Access to credit	Access to credit
		Insurance coverage	Ecological funding
		Ecological fund	
	Infrastructural	Relocation camps available	Resilient infrastructure and maintenance
		Disaster resilient infrastructure	Adequate domestic and industrial waste facilities
		Disaster management base	Disaster management centre
		Domestic and industrial waste facilities	
	Institutional	Land use planning	Enforcement of good land use planning
		Responsibility distribution	Equal distribution of responsibility
		Partnership between sectors	Synergy and harmonisation of policy
	Training and awareness	Learning and awareness	Learning and awareness
		Information dissemination	Communicating information in local languages
		Resource monitoring and feedback mechanism	Adequate resource monitoring and feedback mechanisms
	Environmental	Renewable energy	Sustainable agricultural practices
		Conservation of biodiversity	Renewable energy
		Agricultural practices	
		Land remediation	
Transformative capacity	Institutional	Mitigation plan	
		Accident planning	
	Infrastructural	Access to water	
		Access to electricity	
		Transportation	

6.3.1 Training and Awareness Element

Training and awareness are one of the most important elements to measure community resilience to climate change which ranked first in this research. Overall, this research emphasised three indicators that contribute to measuring resilience level in the face of climate change. The learning and awareness indicators measure the number of awareness campaigns, training programmes and local skills available in communities. Adequate resource monitoring and feedback mechanisms were measured by the number of resources and projects that are monitored and the number of stakeholders that have access to this information and provide feedback. Furthermore, communicating information in local languages measures, i.e. the number of agencies that give out information in local languages for communities to be able to prepare for and overcome any sudden occurrence, is an essential indicator that measures community resilience in the face of climate change in developing countries. According to Channa and Ahmed (2010), the availability of information and communication during and after an event is said to be very important. The number of awareness campaigns, training programmes and social skills available in communities have positively contributed to developing community resilience in the face of climate change (Norris, 2008). The community as a whole should know about climate change hazards and its effects to which they are exposed, as well as how to plan, prepare, cope and adapt to it. Training and awareness provide various techniques or knowledge aspects that could be applied to actions to deal with any event.

6.3.2 Health and Fatality Element

For communities to be able to meet their needs and achieve better living conditions, the health and fatality indicator is very significant. It is important to improve the safety of the community along with improving the sanitation standards, health assistance and facilities (Orencio and Fuji, 2013; Alshehri *et al.,* 2015; Alam *et al.,* 2018). In this research, the health and fatality

indicators such as access to healthcare assistance and facilities, which is measured by the percentage of community members with access to doctors, nurses, clinics and hospitals, serve as community resilience indicators that help to manage climate change in developing countries. This access helps to improve the well-being of the community members. On the other hand, the lack of access may cause immense fatalities (Ahmed *et al.,* 2016). The overall resilience of a community can rests on the extent to which community members practice healthy lifestyles, have access to hospitals and doctors and are aware of the community's health-related functional needs. Actions such as sanitation, infection control and awareness, nutritional status and awareness, and health insurance, are indicators that help to improve well-being (Cutter *et al.,* 2014; Alshehri *et al.,* 2015; Ahmed *et al.,* 2016). Under extreme conditions, the ability or capacity of the trained health workers and the availability of health centres and resources to effectively respond to these events is vital. Health and fatality element and its related indicators have mostly been incorporated into social indicators in most studies (Cutter *et al.,* 2014). However, in this research, it is a standalone element that is key in measuring community resilience in communities.

6.3.3 Environmental Element

By improving green space, quality of natural resources and protecting biodiversity, environmental indicators activities can have direct implications for local climate change (Mavhura, 2017). The environmental indicators are renewable energy sources and sustainable agricultural practices. These are measured by the percentage of energy demand serviced by renewable energy sources, and the percentage of people involved in agricultural practices that mitigate the impacts of climate change, are useful community resilience indicators to manage climate change in developing countries.

6.3.4 Infrastructural Element

Infrastructure is a crucial area for achieving community resilience (Ainuddin and Routray, 2012; Feldmeyer *et al.,* 2019). The ability of these infrastructures to withstand the shock posed by climate change is a representation for the strength of the physical capital of the community. This research reveals that infrastructures are among the community resilience elements identified by experts to manage climate change. These indicators include resilient infrastructure and maintenance, which is measured by the percentage of buildings with building codes, sewers, and drains to handle excess water to prevent flood, adequate domestic and industrial waste facilities. They are measured by the number and capacity of waste facilities available, and disaster management centres, and the number of recovery centres relative to community size. The availability of physical capital, such as drains, sewers, waste facilities and recovery centres, is necessary for supporting various stages of community resilience starting from climate change mitigation to adaptation (Cutter *et al.,* 2014; Ahmed *et al.,* 2016). These resilient infrastructures help to defend the community from climate change repercussions. From a different perspective, Ahmed *et al.* (2016) stated that the development of resilient infrastructure and techniques such as barriers built for floods, like seawalls and breakwaters, are substantial infrastructural barriers that are used to protect communities from flood or sea-level rise. However, Cai *et al.* (2016) observed that the existence of construction codes solely could not contribute to reducing the impact of climate change effect. It can, therefore, be implied that building codes have to be supported with other resilient infrastructures. They also claimed that high-density buildings and roads on lowlands would make communities more vulnerable to flood. However, infrastructural indicators are expensive to strengthen; therefore, the resilience of the physical capital of the community largely depends on the economic health of that community.

6.3.5 Institutional Element

Institutional elements influence the capacities of a community to adapt to climate change events and are responsible for initiating and facilitating transformational processes to build resilience (Chung, 2017). This covers the arrangements and experience relating to the management of climate change impact that exists in a community (Feldmeyer *et al.,* 2019). It is based on the development and maintenance of structured involvement and various networks that can contribute to the requirements of the community in planning and preparedness (Irwin *et al.,* 2016). It shows that there is a general consensus on the institutional indicators, namely: Enforcement of good land use planning, i.e. implementation of plans on land use that are designed to mitigate the impacts of climate change. Equal distribution of the responsibility for the implementation of policy between the different sectors involved in the policy process. Synergy and harmonisation of policy, i.e. a common standard in regulations in different sectors, constitute of indicators to measure community resilience to manage climate change in developing countries. The role of faith-based organisation i.e. number of faith-based organisations that are involved in supporting the communities. Every community needs inclusive governance such as government, businesses, organisations and communities in making decisions, coordinating activities and integrated development planning.

Equal distribution of responsibility across government and non-governmental agencies helps to create the opportunity for development and fast track policy activities (Bulkeley, 2010). However, the key to this level of partnership for equal distribution of responsibility with other organisations is the level of coordination and organisation within the community itself (United Nations, 2012). Synergy and harmonisation of the policy provide the ability and build capacity to make decisions and implement strategies across a range of responsibilities and services (Tanner *et al.,* 2009). Also, due to the cross-cutting nature of climate change governance, most

government departments and agencies are often not able to implement policies that need to address climate change problems. Thus, a good synergy and harmonisation of policy will help to bolster community resilience.

Furthermore, the role of a faith-based organisations can significantly engage and empower community members to develop resilience (Niaz, 2006). This is important since most developing countries are multi-religious, with a high level of religious faith-based groups. Hence, this plays a significant role in enhancing community resilience. These indicators reflect that top-down to bottom-up approaches should be adopted in creating linkages and planning and preparedness to enable communities to cope and recover from an event (Joerin *et al.,* 2012).

6.3.6 Social Element

The social element is considered as the activities and processes which build collaboration between individuals within and outside the community (Cutter, 2010; 2014; Aldrich and Meyer, 2014; Kim *et al.,* 2017). The social indicators support fast and reliable relationships that constitute a network that can help release their ideas and lessen the loss and improve the community's self-reliability. This research reveals that there is a consensus amongst the experts group that social indicators like community engagement and empowerment are closely linked. That is, the percentage of people involved in community activities and inter-community relationships or working relationships between two or more communities, are among the community resilience indicators that help to manage climate change in the context of Nigeria. Community engagement and empowerment programmes would not only encourage the community members to become responsible but also knowledgeable and aware of their community's socio-economic and ecological status (Cutter *et al.,* 2014; Forest and Milliken, 2018). Therefore, community engagement and empowerment processes are significant acts for

measuring community resilience. Furthermore, the inter-community relationship is generally based upon the relatability among the people living under similar conditions, providing social supports and assistance, especially in case of emergencies (Amundsen, 2012). The more people are involved in community services, the easier it is for the community to adapt to climate change (Khalili *et al.,* 2015). Also, cooperation between two or more communities on climate challenges helps build more robust and broader community resilience and faster recovery following a climate-induced disaster (Amundsen, 2012; Smith, 2012; Islam and Walkerden, 2017). These measures foster bonding, bridging, linkages and connectedness among the community members, which is very important during a climate event (Aldrich and Meyer, 2014). Thus, the larger the membership in the community, the higher the collective action to support community resilience to climate change.

6.3.7 Economic Element

The economic element plays a vital role in the empowerment of communities to become resilient to climate change (Bajayo, 2012; Bach, 2015; Kim and Marcuiller, 2016). This element is assessed from the household level to the entire community and includes community finances for various purposes on different levels that can support the community's goal. Also, there is a consensus on the economic indicators, and they are a significant component of community resilience to manage climate change. These include: (i) Adequate livelihood, i.e. the percentage of people living below the poverty line. (ii) Access to credit, measured by the percentage of people with access to credit facilities. (iii) Ecological funding, i.e. the percentage of annual spending from the government for climate change mitigation and adaptation projects. (iv) Exhibition programmes, i.e. a number of local exhibition programmes to showcase community-based products. One primary reason why people are vulnerable to climate change is related to their economic status (Lo et al., 2015). People who are limited in income or live

below the poverty line will find it challenging to put up adaptive measures in place against climate change (Ahmed *et al.,* 2016; Quasim *et al.,* 2016). Furthermore, Qin *et al.* (2017) claimed that improved livelihood of an individual as an intrinsic part of the community would influence the community resilience as its sufficiency would absorb the climate change-related repercussions and accelerate the adoption process. It is assumed that a diversified community livelihood makes the community more resilient and can improve their stability (Norris *et al.,* 2008; Peacock *et al.,* 2010; Wilson, 2013; Ashkenazy *et al.,* 2017). Hence, the higher the level of finances, the greater the ability of households and community to absorb the impact of climate change.

Access to credit was considered a significant resource for enhancing the financial ability of the communities to adapt (Feldmeyer *et al.,* 2019). Furthermore, funding of ecological projects is necessary for policy activities to succeed, and this responsibility needs to be shared all those who have a stake (United Nations, 2012). Also, many nations do not have sufficient budgets to support policy activities and cannot provide subsidies or incentives for sustainable plans and preparedness. Thus, these indicators are considered necessary in measuring community resilience to climate change. Also, a community can have all the education, training and infrastructural facilities and, if the community's economy is weak and affecting their livelihoods, all other indicators will not succeed (Norris *et al.,* 2008).

6.3.8 Demographic Element

Demographic element is an integral part of community resilience (Akamani, 2012; Bene *et al.,* 2017). It plays a significant role in collecting the attributes of the community, which is further used in measuring efficiency in the implementation of policy actions. In this research, the demographic element focused on educational status, i.e. the percentage of the population with school leaving certificate is an identified factor that supports community resilience to climate

change. There was a consensus among all the experts in this research that a well-informed individual has the ability (knowledge and skills) to put adaptive measures in place to enable community resilience to climate change. According to Ainuddin and Routray (2012), educational status gives an abstract idea of how educated and informed the people are towards the knowledge transfer and skills that could be useful at the time of emergency. Thus, the higher the ratio of the educated to uneducated people in a community, the better placed the community is to cope with climate change. In addition, improving and investing in education will save many lives and enhance community resilience (United Nations, 2012). This element in other studies was incorporated into the social element (Qasim *et al.,* 2016; Qin *et al.,* 2017). However, in this research, demography is a separate element with its respective indicators to measure community resilience to climate change.

6.4 Conclusion

Community resilience indicators are important for any community to become self-sufficient and adaptable towards climate change. Through the Delphi survey process, a set of indicators was established that represent a consensus-based community resilience capability to reduce the impact of climate change. These elements and their indicators for measuring community resilience are necessary precursors in the face of climate change. In this research, eight community resilience elements and 20 indicators were identified which are integral yet versatile in helping decision-makers to plan towards enhancing community resilience to climate change effectively.

This research involves the application of GDM to inform the development and implementation of policy to support community resilience in the face of climate change by tapping experts' experience and knowledge about community resilience. The use of the Delphi technique was

important in reaching consensus around the identified community resilience elements and their indicators (Figure 6-1). The consensus was reached on all 20 community resilience indicators among the expert group, and these indicators were all significant to measure community resilience to climate change. To this end, this research has been able to provide a methodology by which consensus between experts on how competing issues can be prioritised to improve community resilience in developing countries.

Contributions from the experts in the Delphi process identified the critical importance of ensuring that communities are able to identify their needs, aspirations and visions for the future. A well-developed community plan and well-resourced flexible community planning process represents a fundamental basis for future change – and therefore of releasing capacity and building community resilience and inform policy activities to support community resilience at the local, regional and national level.

7 Conclusion

7.1 Introduction

This chapter summarises the significant findings of the research presented in this thesis. In doing so, it illustrates how the research's aims and objectives were addressed, the research's contribution to knowledge and its limitations. The chapter also presents recommendations for future research directions suggested by the research findings. In keeping with constructivist grounded theory this chapter concludes with a reflection on the research process by the researcher.

7.2 Addressing the Research Aim and Objectives

The aim and objectives of this research have been addressed in four stages using different methods which are elaborated in Chapter 3. This section discusses how each of the objectives of the research were met and concludes with a summary of how meeting the research objectives meets the aim of the project. In other words, it summarises how this research informs the development and implementation of policy to support community resilience in the face of climate change in developing countries.

7.2.1 The International Climate Change Policies that are Translated and Implemented in Nigeria's Environmental Regulations and Interventions.

In the first stage of the research, a literature review was conducted to identify the international climate change policies that are translated and implemented in Nigeria's environmental regulations and interventions. This section summarises the key findings from this literature review which are discussed in detail in Chapter 2.

The United Nations is the main forum for international climate change action that led to the Framework Convention on Climate Change (UNFCCC). Over the course of COP conferences,

three policy elements were introduced (mitigation financing, technology transfer and adapting to climate change) into the international structure, on the discourse on climate change (Dieter, 2009; Barau *et al.,* 2014). As a result, countries are increasingly adopting domestic policy strategies to mitigate greenhouse gas emissions and facilitate adaptation to climate change.

The literature review, presented in Chapter 2, found that Nigeria has adopted most of the international climate change policies and has obligations under numerous international treaties and agreements related to the environment (Oladipo, 2010). Climate change policies like mitigation and adaptation, with capacities and resources, were adopted to help reduce the impact of climate change on communities (World Bank, 2012; Oluduro, 2012; Ifeanyi-obi and Nnadi, 2014; Onyeneke *et al.,* 2020).

Some of the climate change policies implemented in Nigeria identified in the literature review are: National Environmental policies; National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN); National Climate Change Policy and Response Strategy (NCCP-RS); National Policy on Climate Change and Respond Strategy (NPCC-RS); and the Intended Nationally Determinant Contribution (INDC). These policies promote low-carbon economic development and aim to build a resilient society (UNFCCC, 2015; Ogbuabor and Egwuchukwu, 2017). However, against the backdrop of low human and financial capacity, a developing country such as Nigeria lacks the resources to implement these policies on its own (UNFCCC, 2007; Choko *et al.,* 2019). This has resulted in most of the policies not being fully implemented. Nigeria has not yet enacted any climate change specific law (Choko *et al.,* 2019) and this remains the case as evidenced by a critical analysis of the literature in 2020. There is no actual legislative process to curtail emissions in Nigeria. While Nigeria is a signatory to all international climate change policies, the adoption of these policies is still at the stage of development.

The literature review conducted in the first stage of the research also found that there is no universal standard for measuring or monitoring the effectiveness of policies designed to mitigate climate change and encourage community resilience. While the literature clearly indicates that the development of mitigation and adaptation strategies has resulted in the need for policies to be monitored and measured (Gianoli *et al.,* 2012; Klostermann *et al.,* 2018). The literature also highlights that these measures need to involve data collection based on pre-defined indicators to help stakeholders identify if a policy process or project is having its desired impact (Lamhauge *et al.,* 2012; Ryakkja *et al.,* 2014; Klostermann *et al.,* 2018).

7.2.2 How Community Resilience is Operationalised within the Academic Literature

The numerous different ways that previous research has sought to measure community resilience lead to a focus on identifying how the concept of community resilience is operationalised (that is defined and measured) in the literature in the second stage of the research. In this phase of the research a systematic literature review was conducted focusing on how previous research has sought to define and measure community resilience. In total the systematic review identified 32 relevant academic papers published out over a ten-year period (2007 -2017). It is interesting to note that only three per cent of the publications contained empirical data which shows a lack of empirical research on community resilience in the face of climate change.

The systematic review revealed that community resilience is defined in the academic literature based on three concepts: coping capacity, adaptive capacity, and transformative capacity (see Chapter 4 esp. Section 4.2.1; Table 4.2). Specifically, 29 of the analysed publications defining community resilience in terms of coping and adaptive capacity, while 3 analysed publications included the concept of transformation.

Coping capacity can be seen as a reactive approach that focuses on shock in the short-term. Coping capacity in terms of community resilience is based on the means that people or a system use (resources, skills, opportunities, *etc*.) to deal with the impact of climate change (IPCC, 2012; Cutter *et al.,* 2008; Tierney, 2014). Practically, coping capacity relates to the things that influence a community's ability to anticipate, prepare, absorb, and recover from an event.

Adaptive capacity in terms of community resilience is the measures and processes that facilitate change through learning, create flexibility in solving problems and adaptation (Birkmann *et al.,* 2013; Keys *et al.,* 2014). Adaptive capacity is characterised by the community's ability to learn and improve the capacity to manage a climate event proactively in light of anticipating future stress or shock (Galopin, 2006). Adaptive capacity is associated with long-term timeframes and implies that some learning, either before or after an event, or change in condition, occurs, i.e. a situation characterised by flexibility.

Transformative capacity is a positive attribute of a resilient system that refers to the ability to promote transformation (Folke *et al.,* 2010) so a new development trajectory can occur. Transformative capacity is associated with changes in the deep structures that cause vulnerability and risk, as well as addressing the structure and root causes of issues, i.e. a situation characterised by structural change.

Fourteen of the analysed publications defined community resilience as the combination of coping and adaptive capacity. Understanding the linkages between 'coping capacity' and 'adaptive capacity' of community resilience is critical to furthering community capacity to respond to both short- and long-term change. Both approaches are equally important considerations for community resilience and a joined holistic approach with the definition of community resilience is more likely to be functional in practice. According to Parsons *et al.* (2016) coping and adaptive capacity facilitates resilience to all kinds of hazards. However, to

really ensure long-term resilience, academics and practitioners need to focus on transformative capacity. Thus, how researchers define community resilience has a huge impact on what it is and what their work is trying to identify. This has significant implications on how current work has informed policy makers to move towards long-term community resilience.

Community resilience as coping, adaptive and transformative capacity should not be viewed as mutually exclusive, as coping capacity in a resilient system should include the dynamics to accommodate trends and co-evolve. In a long-term timescale, adaptive capacity may be insufficiently flexible and hinder improvement (Wardekker *et al.,* 2010). Hence, instead of establishing a generic definition, it could be more appropriate to consider the term community resilience as a process of moving from coping to adaptive to transformative states. Community resilience in this regard is explained in the form of a lifecycle (before, during and after a disaster) which is characterised by the community's ability to strengthen its coping capacity through adaptive capacity during an event. It then requires transformative capacity after a disaster for a more sustainable future (Joerin *et al.,* 2012).

The systematic review identified eight elements of community resilience used in the previous literature: social, economic, demographic, infrastructure, institutional, training and awareness, environmental, and health and fatality. This systematic review also established that there is a deep interlinkage across all the community resilience elements as they are activated in processes and activities in a community to respond to climate disturbance. For example, for a community to be resilient, ideally, resilience has to be achieved from every possible perspective so that there are no gaps left to create new vulnerability (Doorn, 2015; Rus *et al.,* 2018). According to Wilson (2010), communities with all the community resilience elements accounted for are more likely to be resilient than those with one or none of these elements. The community resilience elements cannot stand alone without the support of the rest of the

elements, as every element can potentially contribute to other elements without which these elements can never become self-sufficient and hence stay incomplete. The implication of this is that research focusing on one or two elements will not provide overall resilience in that community as other elements left out might create new vulnerability, which will impact their resilience (Frankenberger *et al.,* 2013; Constas *et al.,* 2014; Quinlan *et al.,* 2015). The systematic review identified 49 indicators, which are used to measure community resilience in the face of climate change.

From the identified publications of the systematic review, elements such as training and awareness, environmental, and health and fatality, have received little attention as they are the least identified (see Table 4.2). The implication of this paucity, in the context of developing countries which includes countries like Nigeria, is that these categories should be given more priority when seeking to measure the impact of policies designed to improve community resilience as they are the core areas where resilience needs to be built. This is due to the geographical area; land characteristics; coastal locations; high natural climate variability; highly vulnerable population; and limited finance and technological capacity to adapt to climate change (Yohe and Tol, 2002; IPCC, 2014).

The findings of the systematic review suggest that the concept of a community becoming resilient is a process moving from a community coping with the impact of climate change to adapting to the impacts of climate change to then transform to the point where they are fully resilient to the impacts of climate change. The next stage of the research sought to determine how community resilience is operationalised within the context of Nigeria.

7.2.3 How Community Resilience is Operationalised within the Context of Nigeria

The next and third stage of the research adopted a Grounded Delphi Method and looked at how community resilience can be operationalised in the context of Nigeria. The first stage of the Delphi involved 21 semi-structured interviews with Nigerian experts (government officials involved in the climate change policy process). While the concept of community resilience is complex (Bergstrand *et al.,* 2014; Patel *et al.,* 2017), the current findings indicate that the expert group had a clear understanding of the concept (see Chapter 5).

The expert definitions of community resilience were around two generic terms: coping capacity, adaptive capacity and the combination of coping and adaptive capacity. Importantly, community resilience as adaptive capacity was defined by most of the expert group members. The conceptualisation of community resilience as adaptability is in agreement with other studies (Norris *et al.,* 2008; Levin *et al.,* 2013; Baggio *et al.,* 2015; Baggio and Calderon-Contreras, 2017; Ferro-Azcona *et al.,* 2019). The critical aspect of community resilience as adaptive capacity is accepting that change is ongoing and, consequently, highly unpredictable. As a result, adaptive capacity is about flexibility and the ability to make constant changes through the continuous process of adjusting, learning and innovation. Hence, the higher a community's experience of an event, the better they would be through learning in enhancing their preparedness for an event (Mishra and Suar, 2007).

One of the findings of the research is that the experts did not define community resilience in terms of transformative capacity. Community resilience to climate change is conceptualised as a process of stages that communities go through to being resilient in the face of climate change. Moving from simply coping and adapting with the impacts of climate change to being resilient to climate change to eventually transforming to the point climate change does not impact on community's wellbeing. This finding shows that Nigeria is not at the stage of transformation

yet and this will result in them missing critical indicators such as those associated with the institutional and infrastructural elements as identified in the literature (see Table 6.6). For example, the experts would not measure indicators such as mitigation and accident planning, access to water and electricity, and transportation and, therefore, be unable to establish how trans-formatively resilient the communities in Nigeria are. The understanding of community resilience in terms of transformative capacity as a concept is very important as it would give direction and provide a long-term structure for preparedness of communities to reach a sustainable future (Chung, 2017; Choko *et al*., 2019). Society needs to move towards transformative capacity that involves robust reflective learning in the face of climate change (Otoara-Ha'apio *et al*., 2018), which was not considered in a developing country such as Nigeria. This can be linked to the low GDP, poverty, lack of finances and technical know-how, that will aid the implementation of policies (World Bank 2017) required for a society to be transformed into a truly resilient community. However, transformative understandings of community resilience offer more significant potential for creating shared action and 'future-proofing' communities, through providing a long-term structure for community preparedness and reaching their goal. Due to continued risk arising from climate change, communities can benefit from a more sustainable planning which will lead to transformative changes by increasing their resilience. By doing this, it will help to fully address long-term policies that will subsequently transform the communities and enable them in their process of becoming resilient in Nigeria. For communities to be resilient long-term, they must have transformative capacity for a more sustainable future.

In this research, the expert group proposed 17 indicators that are categorised into eight community resilience elements (infrastructure, training and awareness, environmental, social, economic, institutional, demographic and health and fatality). These measurable parameters and their associated indicators are necessary precursors for community resilience in the face of

climate change. The expert panel of this research identified an indicator, synergy and harmonisation, that was not recognised in the published literature from the systematic review. The implication is that synergy and harmonisation of policy will help in the interaction between various institutional arrangements or strategies in the planning and implementation of adaptation and mitigation policies. This indicator will promote joint efforts in building capacity, avoiding duplication, broadening knowledge base, encouraging cooperation, providing opportunities and sharing experiences (UNFCCC, 2015).

The experts mostly identified infrastructural and training and awareness which is different from the systematic review, where the social and economic elements were mostly addressed (Table 5.4). These elements (infrastructural and training and awareness) to developing countries are the core area where resilience needs to be built. This is due to developing countries geographical area, land characteristics, coastal locations, high natural climate variability, high population and limited financial and technological capacity to adapt to climate change (Yohe and Tol, 2002; IPCC, 2014). The health and fatality element were identified the least from both the systematic review and the experts. Plough *et al*. (2013), stated that healthcare is an integral part of community resilience and the backbone of medical responses to an event. Health and fatality element encompass the activities related to the preventive measures for various epidemics that are common after climate change events, mostly in developing countries. Encouraging activities to improve this element can enhance the health status of the community members, reassure their lives and increase the number of participants that are fit to take part in climate change activities. While the measurement of community resilience is challenging and potentially constraining (Sharifi, 2016), community resilience elements and indicators identified here are grounded and coherent for the broader application of community resilience within policy planning processes. Likewise, this could form a basis for the development of best

practice guidance around community resilience applications for communities similar to those in the Nigerian context as investigated in the current research.

7.2.4 Prioritising Community Resilience Elements and Indicators in the Context of Nigeria

This stage of the research focused on how we can get consensus between experts on how competing issues can be prioritised to improve community resilience in developing countries. This method helped in establishing consensus among the experts in Nigeria on each of the 20 community resilience indicators (see Chapter 6). Based on this consultation with the experts, this research proposed eight community resilience elements a) training and awareness; b) environmental; c) infrastructural; d) institutional; e) social; f) economic; g) demographic h) health and fatality. It also identified 20 indicators in total which will help measure community's progress within the process of becoming resilient.

This research found that community resilience elements differ in terms of training and awareness, which is not mentioned in other studies (Joerin *et al.,* 2012; Cutter *et al.,* 2014; Alshehri *et al*., 2015; Cai *et al.,* 2016). Further differences are highlighted when compared to other studies such as by Alshehri *et al.* (2015) who argued that the use of the indicator 'risk training and awareness' is related to the social element; however, the current study elaborated this as 'training and awareness' element and its associated indicators to cover climate change challenges in general. Hence, this element ranked topmost given the consensus of the expert group in this research and the weighted average of 4.74 (see Table 6.4).

In addition, some of the identified indicators by the experts were not found in the identified publications. Examples include 'exhibition programmes', 'synergy and harmonisation of policy', and 'communicating in local languages'. These indicators are diverse, inclusive and applicable for various needs of the community, especially in developing countries. The

identified community resilience elements and their indicators can be used to measure or assess community resilience levels in different communities. This will help build community resilience to climate change in Nigeria. The main difference between the systematic review indicators and the indicators identified by the experts in Nigeria is that the indicators from the systematic review are more generalised as identified from different publications, contexts and scales. In contrast, the experts in the context of Nigeria identified the indicators that are needed for the communities in the country and similar communities in other developing countries, that should be prioritised due to inadequate funding in the implementation of policies to measure the levels of community resilience.

7.2.5 How the Objectives Met the Aim of the Research

By applying the research process, this research objectives were used to achieve the set programme aim by: identifying international policies adopted in Nigeria's environmental regulations; identifying how community resilience is understood or operationalised in the academic literature and by the expert group in Nigeria; and developing a methodology by which consensus can be achieved between experts on how competing issues can be prioritised to improve community resilience in developing countries. As such this research identified elements and indicators relevant to developing countries that can be prioritised for measuring the effectiveness of current policies designed to support community resilience to climate change. These measurable elements and indicators can be prioritised in keeping with inadequate funding in policy implementation to measure community resilience in the face of climate change. Also, they can potentially inform policies on reducing the effects of climate change and supporting community resilience despite limited funding in their process of becoming resilient.

7.3 Key Findings

The key findings from the research are outlined below.

1. There is a lack of empirical research on community resilience in the face of climate change. Only 3% of the 1036 publications published on community resilience between 2008 and 2017 identified in this study contained empirical data.
2. Empirical research on community resilience in the face of climate change tends to focus on the local level detaching the findings from the regional and national context. All of the 32 papers that contained empirical research that were published between 2008 and 2017 focused purely on the local context.
3. Community resilience can only be usefully conceptualised as a process of stages that communities go through moving from simply coping with climate change to being resilient to climate change to eventually transforming into a community that can thrive despite climate change. This is reflected in the literature by the different ways in which community resilience is defined. Some publications focus on the notion of coping capacity, some on the notion of adaptive capacity and some on the notion of transformative capacity or some combination thereof. None of these are incorrect they are merely partial.
4. There are eight key elements to community resilience these include social, economic, demographic, infrastructure, institutional, training and awareness, environmental, and health and fatality. This is a wider set of elements than is considered in earlier work.
5. A community's progress within the process of becoming resilient can be measured using a key set of 49 indicators identified in this research.
6. There are large gaps within policy and practice in Nigeria in relation to training and awareness, the environmental impacts of climate change and improving public health

and mortality rates. These issues are also given little attention in the current academic literature.

7. The Delphi study suggests that key stakeholders in Nigeria define community resilience in terms of adaptive and coping capacity and do not include the idea of transformative capacity and the potential for a community to transform into a one that can thrive despite climate change.
8. The Delphi study revealed that Nigerian policy makers and experts felt that the synergy and harmonisation of policy at the local, regional and national levels, and communicating in local languages, were key to developing resilient communities. These issues are not considered or measured in the academic literature looking at how resilient communities are.
9. The Delphi study found that in the Nigerian context eight elements of community resilience are key to measuring a community's progress in their process of becoming resilient. These are infrastructure, training and awareness, environmental, social, economic, institutional, demographic and health and fatality.
10. There is a mismatch between what Nigerian experts find most significant in terms of understanding how resilient a community is and what the academic literature suggests is most significant. Nigerian experts see having adequate local infrastructures such as hospitals, recovery centres, roads and drainage as key to a community's level of resilience. On the other hand, the academic literature focuses on the existence of funding to provide these infrastructures rather than the existence of these infrastructure. This is important because the provision of funding for these infrastructures does not necessarily lead to their construction and maintenance in the context Nigeria and other developing countries.

11. The grounded Delphi method is an emerging methodology and its successful application in this research lends credence to its ability to move beyond the limitations of Grounded Theory and Delphi when applied individually. It combines the features of Grounded Theory in regard to data analysis with the Delphi Method in reaching consensus and integrates the elements of Grounded Theory which helps in enhancing theory capabilities of the Delphi approach.

7.4 Original Contribution to Knowledge

This research contributes to knowledge in several different areas.

1. The systematic review indicated that only 3% of the 1036 papers reviewed published between 2008 and 2017 include empirical studies that attempt to measure the impact of policies intended to increase community resilience in the face of climate change. Therefore, this work has clearly identified a need for further empirical research into measuring the levels of community resilience in the face of climate change.

2. Most of the publications and experts responsible for the design and implementation of climate change policy in Nigeria focused on coping and adaptive capacity but there is very little work that focus on the notion of transformative capacity. The research has also highlighted the need to include transformative capacity and their relevant indicators when measuring community resilience to climate change. The understanding of community resilience in terms of transformative capacity as a concept is very important especially in the context of Nigeria. Transformative capacity would provide direction and give a long-term structure for preparedness for communities to reach a sustainable future (Chung, 2017; Choko *et al*., 2019). Also, transformative understandings of community resilience offer more significant potential for creating shared action and 'future-proofing' communities,

through providing a long-term structure for community preparedness and reaching their goal.

3. The research identified some indicators such as 'exhibition programmes', 'synergy and harmonisation of policy', and 'communicating information in local languages' that were not used in previous studies (Norris *et al.,* 2008; Twigg, 2009; Sherrieb *et al.,* 2010; NRC, 2012; Cutter *et al.,* 2014) but identified by the participating experts in the current research. These indicators are relevant to help communities be more stable and involved in increasing their resilience. Synergy and harmonisation of policy promotes joint efforts in building capacity, avoiding duplication, broadening knowledge base, encouraging cooperation, providing opportunities and sharing experiences (UNFCCC, 2015). Identification of this indicator by the Nigerian experts in the current study can be seen, potentially, as the beginning of their consideration for a transformative process and capacity. The exhibition programmes can support communities to learn and showcase their products and services that can improve their livelihood. Relevant information and knowledge can be made available to various communities to help plan, prepare and adapt to climate risk (Singh-Peterson and Underhill, 2016). Thereby making this work more diverse, inclusive and applicable for various needs of the community, especially in developing countries. The elements and indicators identified in this research on prioritising specific, measurable indicators can potentially inform policies on reducing the effects of climate change and supporting community resilience despite limited funding.

4. This research developed elements and their indicators as a framework for measuring the effectiveness of policies that supports community resilience to climate change. Also, the application of the GDM to enable the prioritisation of those elements and indicators within policies or context. This will provide the first step towards building community resilience

in the face of climate change in developing countries such as Nigeria. Although international bodies and governments mostly fund policy activities, most of these activities are still not carried out due to inadequate funding. This research focuses on prioritising specific, measurable indicators that would potentially inform policies on reducing the effects of climate change and supporting community resilience despite limited funding in their process of becoming resilient.

7.5 Limitations of the Research

Irrespective of which approach is used, or which philosophical standpoint is taken for research, there are always limitations. This research faced some limitations that are elaborated below.

The systematic review focused only on peer-reviewed publications. Other sources such as grey-literature (including non-peer-reviewed research, policy documents and reports) were excluded. As a result, reports that provide other evidence on community resilience to climate change could have been omitted. Likewise, in including keywords and search strings, some publications might have been excluded from the searched databases used, due to the difference in keywords that may refer to similar events. Some examples include neighbourhood resilience, social resilience, strategies, and disaster (Table 3.2 in Section 3.5). Also, only three scientific databases were used; however, more publications might have been included with the use of other databases such as Google Scholar. Notwithstanding, having more databases does not mean all publications in the field will be included as some will still be left out due to restrictions such as language. In this case, only publications written in the English language were included with relevant resources written in other languages omitted.

Although the Grounded Delphi Method ensured that the research aim and objectives were achieved, the Delphi aspect of the approach has some recognised bias. For example, selection

of the expert group, which was done using a snowball sampling technique, might have led to findings that support the researcher's position. However, this bias was reduced as much as possible by adopting the expert selection processes and criteria as developed by Donohoe (2011), and Okoli and Pawlowski (2004) (see section 3.6.1.1).

Another limitation is focusing on experts at the national and regional level while exempting the local level. Including experts from the local level might have added more value in terms of understanding community resilience at this particular scale, and additional indicators that local experts might have been proposed. The researcher recognises the concerns, but the focus of this research was at the national and state level. However, with the complicated situation surrounding community resilience to climate change, focusing on one scale will result in neglect of some indicators that will determine resilience at other scales, which can also affect the trade-offs and synergies across the scales. Also, identifying less resilient communities across all scales can enable resources to be distributed to these groups to increase their resilience. Consequently, the failure to achieve resilience at the regional, national and global scales will hinder policy activities and programmes at the local level. This shows there is a need to balance the discourse by having a cross scalar study which will help foster interactions and feedback among scales.

The outcome of my research could be widely applied by governments, policymakers and practitioners for monitoring and measuring priority indicators to assess community resilience at the national, regional and local level in developing countries (Table 7.1). The main objective of measuring community resilience is to inform policy planning, build action and assess outcome, where the indicators identified in this research can be considered. According the World Bank, developing countries are grouped into upper-middle, lower-middle and low-income levels. Looking at countries similar to Nigeria, they are classified under lower-middle

income economies (49 countries) with GNI per capital of $1,036 to £4,045. These lower-middle income countries are also characterised by poor healthcare institutions, severe inequality, low education, low infrastructure, high unemployment, heavy reliance on agriculture, and rapid population growth. These classifications allow policymakers to determine suitable policy recommendations (World Bank, 2020). Therefore, the outcome of this research can be applied in these countries.

Table 7.1. Classification of developing countries, their GNI and population

Developing countries (lower-middle income levels)	GNI per capital (US Dollars	Population
Bangladesh	$1,517	166,303,498
Cameroon	$1,447	27,224,265
Egypt	$2,413	104,258,327
Ghana	$1,641	31,732,129
India	$1,940	1,393,409,038
Kenya	$1,508	54,985,698
Nigeria	$1.969	211,400,708
Pakistan	$1,548	225,199,937

7.6 Future Research Directions

From the results and findings of this research, some potential recommendations are outlined below.

1. Since only 3% of the systematic review publications contained empirical research on understanding community resilience to climate, more research is needed in this area.
2. The need for more research is necessary at the national and regional level in measuring community resilience. The systematic review shows that there is currently little work done at the regional and national levels where indicators can help capture trends and thresholds. Consequently, the failure to achieve resilience at the regional, national and global scales will hinder policy activities and programmes at the local level. This shows

there is a need to balance the scale by having a cross scalar study which will help foster interactions and feedback among scales.

3. The Grounded Delphi Method is recommended for governments or decision-makers to design policies and effective regulations to implement the community resilience indicators identified in this research, within Nigeria and other similar countries, to visualise the status of resilience, track improvements over time and identify areas where more focus is needed. For example, this can be done with broadly comparable geography and climate change challenges in terms of prioritisation due to inadequate funding to implement policies that increase community resilience to climate change.
4. Due to the scale of climate change disturbances and the significance of transformative capacity, there is a need for transformative changes. Therefore, it is important that debates on supporting transformative capacity for change be mainstreamed and tailored towards understanding how best to support transformation in communities.

The implications on practice by policymakers and researchers, in terms of how the outcomes of this research will inform the situation in Nigeria, are included below.

1. Government needs to ensure the measurement of community resilience to climate change at the national, regional and local level.
2. Data should be collected across the multiple elements and their indicators and use this research process to prioritise indicators where resources are limited.
3. Measurement techniques should to be framed in terms of coping, adaptive and transformative capacity looking at the elements (social, economic, infrastructural, institutional, health, environmental, demographic, training and awareness), as they are significant resources needed to build resilience at individual and community levels.

4. This research process could promote inter-sectoral collaborations among policymakers, emergency planning, economic development, education sector, healthcare and civil society organisation.
5. Community members should be engaged in assessments and use of the GDM approach to promote collective actions and develop a mutual understanding of community resilience to climate change within vulnerable communities.

7.7 Epilogue: Reflections of the Researcher on the Research

Reflection is needed when carrying out research in constructivist grounded theory and putting into practice the research epistemological standpoint (Charmaz (2014). The research preconceptions are brought to light and the way it affects one's view. Depending on one's philosophical standing, the reflectivity can be understood in different ways. The current research explored the constructivist perspective in terms of the relationship dynamics between the researcher and the expert group (Finlay, 2002). For me, reflection analysis started when the ideas for this work were conceived at the beginning of the research and lasted until the end of the thesis writing up. Memo writing helped me to facilitate the entire reflexivity process of the research. I was able to reflect on the subject and my relationship with the phenomenon of the research. My experience with this cohort was gained from being in a community that was plunged with flood each year and how the government have tried to implement policies to curtail the crisis. However, these policies have not been able to have much impact in the community. Through examining literature, I began to gain intellectual ideals into the development and implementation of policies to support community resilience. It became evident that most of the literature were focused on developed counties. Thus, it became necessary to be able to contextualise the uniqueness of these experiences within a developing country such as Nigeria. From the literature, there was a preconception that the effect of climate

change will be severe in developing countries like Nigeria, due to their socio-economic, cultural, health and environmental characteristics.

From the data collection, using GDM semi-structured interview was useful because it allowed a combination of both Grounded Theory and Delphi techniques. I spoke with experts in this area and heard them explain their understanding of community resilience and what policies they think could be prioritised due to inadequate funding. Similarly, ethics, the process of data collection, the multi-staged and multi-method approach, proved valuable because the research was able to propose community resilience elements and indicators to measure community resilience and reduce the effect of climate change in Nigeria and other similar communities in developing countries. Establishing a presence in the studied area and undertaking data collection with many of the same participants through an iterative process that supported findings to emerge throughout interviews, and on which participants could suggest and verify, supported me to develop rapport and build trust with the participants. This approach was beneficial, as it enabled me to elicit different expert perspectives on issues around policies, community resilience and how it is measured, which may have proved more challenging if I had adopted a different approach such as quantitative method. The design of the research also supported participant commitment, particularly with a phone interview, which is sometimes affected by network issues. My engagement with the participants in the preceding stages of the survey supported participant engagement in the process with trust and rapport already established being highly advantageous.

In addition to gaining an insight into policies that support community resilience to climate change within the contextual setting of this research, I have gained valuable experience in undertaking a mixed method research process through a GDM approach. I have learnt, for example, the tediousness inherent in collecting and analysing data; the difficulty in transcribing

interviews and analysing them while at the same time witnessing a pattern of codes and categories developing during the process. I have also become familiar with indicators used in measuring community resilience proposed in this research and the debate surrounding the different frameworks in community resilience research. This research has also helped to identify some areas of interest that I would want to pursue after this thesis; for example, the application of GDM to enable the prioritisation of those elements and indicators within policies or context in other developing countries and how they can help measure community resilience. The study reveals that much is needed to be done in the application of community resilience indicators in communities. There is no doubt; the research journey has influenced me as a researcher.

8 Appendices

8.1 Systematic Review Supplementary Data

8.1.1 Quality Assessment

Quality assessment	Included	No
Was there a clear 8.1 statement of the aims of the research? Was it related to the systematic review research question?	32	
What is the main method employed? Mixed method	10	
Qualitative (interviews, focus group, observation, workshop)	7	
Quantitative (questionnaire)	6	
Statistic databases	9	
Location/setting		
Data collection from whom?		
Duration of study		
Was the data analysis sufficiently rigorous? Was it sufficiently described, and an appropriate sample analysed? For quantitative and qualitative analysis, are enough data presented for results to be valid and useful?	32	
Is there a clear statement of findings? Whether the studies gave enough depth and detail to give confidence to their findings. And whether the studies assessed the relevance of the findings to the wider population and/or context.	32	
Generalisability		

8.1.2 Community Resilience Elements, their Indicators and Method of Data Collection

Element	Indicators	measurement	Data collection method
Demographic	Age	Percentage of population not over 65 years old	Community members, national government (database)
	Sex	Percentage of population male and female	Community members, national government (database)
	Educational attainment	Percentage with higher and lower education	Community members, national government (database)
	Households size	Percentage of population in a household	Community members, national government (database)
	Religious adherence	Percentage of population who belong to a religion	Community members, national government (database)
Social	Social trust	Percentage of population who have trust in their community	Community members, community leaders, local government
	Attachment to place	Percentage of population who trust and have been in a community for over 10 years	Community members
	Community engagement	Percentage of population who engage in different activities in the communities	Community members
	Collective knowledge and experience	Percentage of population/communities who share knowledge from experience of management of an event	Community members
	Inter-community relationships	Percentage of population with community relationships	Community members
	Relationship with other stakeholders	Percentage level of population that have trust in other stakeholder's knowledge and activities	Community members
Economic	Annual income	Percentage of population with average annual income	Community members
	Below poverty line	Percentage of people with income past federal poverty line	Community members, National government (database)
	More than one source of income	Percentage of population with two or more jobs	Community members, national government (database)
	Homeownership	Percentage of house ownership	Community members, national government (dataset)

	Household assets	Percentage of people who own assets	Community members
	Access to credit	Percentage of population with access to credit	Regional, local government, community members
	Insurance coverage	Percentage of people who have insurance	Community members, regional, local government
	Ecological fund	Percentage of population/communities who have access to ecological funds	National, regional, local government
Infrastructural	Evacuation route	Total length of roads per square kilometre that is good	Construction engineers, local government, Community members
	Relocation camps	Percentage of temporal housing unit available for emergencies	National, regional government, NGOs
	High speed communication	Percentage of communities that have access to internet	Community members
	Access to water	Percentage of communities with access to clean water	Community members, local, regional government
	Access to electricity	Percentage of population who have access to electricity	Community members, local, regional government
	Transportation	Percentage of household without a vehicle and communities who have access to basic transport facilities close by	Community members, national government (database)
	Disaster resilient infrastructure	Availability of disaster infrastructure	National, regional, local government, NGOs, construction engineers, disaster managers
	Domestic and industrial waste facilities	Percentage of population/communities who have functional waste facilities	National, regional government, NGOs, academia
Environmental	Renewable energy	Access to efficient renewable energy	Community members, regional, local government
	Conservation of biodiversity	Percentage of community members that are involved in protecting the biodiversity	National, regional, local government, NGOs, academia
	Agricultural practices	Percentage of population adopting hazard resistant agricultural practices	Community members, NGO, s, regional, local government
	Land remediation	Percentage of land regenerated for use	National, regional, regional, local government, NGO, s
	Improved green space and tree planting	Percentage of land allocated to green space and population involved in tree planting	Regional, local government, NGOs, community members

Institutional	Mitigation plan	Percentage of population who have access to grants to mitigate against an event	National, regional, local government, NGOs, academia, community members
	Disaster management base	Percentage of disaster management bases	National and Regional government
	Accident planning	Number of accident mitigation actions and regulations in placed	National, regional, local government, community members, emergency systems and police services
	Land use planning	Percentage of land allocated recreational land use	National, regional, local government
	Responsibility distribution	Percentage of stakeholders involved in coordinating the community members before, during or after an event	National, regional, local government, NGOs
	Disaster training	Percentage of population trained on disaster related issues	National, regional, local government, NGOs
	Partnership between sectors	Relationships and partnership with different sectors	National, regional, local government, NGOs,
	Volunteerism	Percentage of population who volunteer in time of an event	National, regional, local government, NGOs, community members
Training and awareness	Learning and awareness	Percentage of population trained and who are aware of disaster related issues	National, regional, local government, NGOs, community members
	Information dissemination	Percentage of population that information about their communities is communicated to	Regional, local government, NGOs, construction engineers
	Mutual communication	Percentage of population who communicate frequently with other members of the community about their environment and attend community recovery planning meetings	Community members, local, regional government
	Resource monitoring and feedback mechanism	percentage of population in charge of resource monitoring and feedback mechanism	Regional, local government, community members
Health and fatality	Access to health assistance	Percentage of population with access to health assistance	Community members, emergency services, police services, local and regional government
	Access to health facilities	Percentage of health care facilities per 1,000 population	Community members, health care services, regional government
	Sanitation infection control	Percentage of communities who have access to good sanitation system with infection control centres	Regional, local government, NGOs, health professionals
	Nutritional status	Percentage of population have faced nutrition related health issues	Regional, local government, NGOs, health professionals, dataset

	Access to special needs and psychological support	Percentage of population with special needs and mental health and psychological support	Community members, regional, local, NGOs,
	Death rate	Percentage of population being hospitalised annually, and fatality rate related to climate change impact	Regional, local government, NGOs, health professionals, dataset

8.1.3 Data Extraction Table

Authors	Approach	Data collection	Scale	Measured
Ahmed *et al.,* 2016.	Mixed method	Survey, focus group	Households and community members	They measured household baseline of before and intervention and after an intervention comparison. They tracked changes in community resilience. Focus group data were collected to generalise information and to get ideas on non-monetary and indirect benefits.
Cutter *et al.,* 2014.	Database		Communities county	They measured the inherent resilience at the county level using five indicators.
Lam *et al.,* 2016.	database		County	They measured the damages, exposure and recovery of the county using indicators. They measured the existing capacities that are associated with a community's ability to reduce damages and bounce back from a hazard.
Mavhura (2017)	Mixed method	Interview, focus group, observation, survey	Community members	They measured livelihood capital in the community, experiences of people living the flood prone area, and coping strategies. Also measures absorptive and adaptive capacity
Orencio (2013)	Qualitative	Delphi	Community members	They measured household vulnerability to climate change
Abenayake (2015)	Database and qualitative	Interview	Community members	They measured the consistency and concordance of community resilience levels in local community using statistical measures
Henly-Shepard (2015)	Mixed method	Interview, survey	Households	The indicators were measured through a household survey which facilitates a broad and multi-disciplinary perspective of current community vulnerabilities. They examined household preparedness, coping and adaptive capacity. In addition, they measured through demographics, education and socioeconomic status. The resilience components were also measured through various social capacity indicators.
Qasim (2016)	Quantitative	Survey	Households and directors of CDPM	They measured the socio-economic and demographic characteristics, social, economic, institutional and physical resilience

Singh-Peterson (2015)	Mixed method	Survey, workshop	Government organisations, regional level	They measured house the indicators have been effectively institutionalised at the local scale
Gawith (2016)	Quantitative	Survey	Households and community members	They measured community resilience in terms of skills and knowledge to limit the damages from disasters loss and other indicating actors. They measured the extent to which community resilience mitigate loss and damages
Kotzee (2016)	Database		Communities	They used resilience indicators to measured resilience of a system to flood using principal component analysis. They measured the levels of disaster planning, mitigation, and public awareness capacity.
Qin (2017)	Database		Communities	They measured the ability of the communities to function effectively and recover successfully in the aftermath of disasters. The spatial and temporal variations were also measured along with other indicators. They measure vulnerable areas, overall capacities, emergency rescue and recovery and reconstruction
Bene et al., (2016)	Mixed method	Focus group, survey	Households and community members	They measured household and community levels nature, intensity and characteristics of various shocks and stress experienced. The household characteristic and wellbeing analysis covered demographics and resource base and social-economic status. They mostly measured the quality of life and material wellbeing to see if the communities are resilient or not.
Bergstrand (2014)	Database		Community members	They measured household composition, civic organisations, voting behaviour, religious adherence, migration and crime
Cai *et al.,* (2016)	Database		Communities	They measured the socio-economic and environmental indicators associated with the community's ability to reduce damages and recover from hazards
Cinderby (2015)	Qualitative	Participatory action, survey	Community members	They measured the community experience to enhance community resilience through participatory action approach.
Cohen (2016)	Quantitative	Survey	Community members	They measured socio-demographic variables, gender, age, faith, community type, reported income levels, and previous involvement in emergency situations.
Fox-Lent (2015)	Mixed method	Workshops, interview	Expert panels, regional level	They measure how well a system performs the given critical function. Also, they measured the indicators and benchmark utility. They also assessed the stage of disruptive events that makes up the resilience definition

Joerin (2012)	Mixed method	Survey, interviews, focus group	Households, community leaders	They measured the ability of household to learn from experience and their adaptive capacity
Leykin (2013)	Quantitative	survey,	Community members	They measured demographics and disaster related preparedness, belonging to a local community response team and history of exposure to emergency event.
Amundsen (2012)	Qualitative	Interview, observation,	Local government official, community members	They measured their attachment to place, what they value about the place, the community activities they take part in, their relationship to the natural environment and what makes it a good place to live in. also, what changes they have observed and talked about social, economic and political, weather and climate conditions.
Boon (2014)	Mixed method	Focus group, survey	Community members	They measured changes to the community after the flood and explored their resilience by collecting socio-economic and demographic data and identified factors that residents believed supported their resilience.
Irwin *et al.,* (2016)	Database		Regional level	They measured the adaptive capacity of the urban system. They measured number of structure and length of road inundated by flood. Also socio-economic measures include the economic damages attributed to structural damages and the loss of services. Also the number of people belonging to economic and social group residing in areas susceptible to flooding.
Khalili (2015)	Qualitative	Interviews, focus group	Disaster managers	They measured social resilience indicator through interviews
Kim (2015)	Database		County level	They measured demographic, economic characteristics and social capital
Lo (2015)	Mixed method	Interviews, survey	Community members	They measured demographics, social capital and household preparedness for shock and disaster
Singh-Peterson (2016)	Mixed method	Participatory approach and database	communities	They measure capacities and vulnerabilities within the cities
Sovacool *et al.,* 2012.	Qualitative	Interviews, focus group	Experts	They measured the vulnerability and adaptive efforts related to coastal afforestation.

Connon (2017)	Qualitative	Interviews, fieldwork	Community members	They measured how demographic and social change affects storm coping abilities at the inter-community scale. They looked at observed community members familiarity with the social, economic and cultural dynamics embedded within each of the community
Jacobs (2017)	Quantitative	Survey	Households	They measured social capital on perceptions, belief and value related to climate change and wildlife, demographic characteristics
Islam (2017)	Qualitative	Interviews, workshops	Disaster practitioners, policy makers. Local NGOs	They measured the importance of social networks in recovery
Smith (2012)	Quantitative	Survey	Households	They measured social capital on local issues, trust and place meaning. They measured risk awareness, ability to learn, plan and adapt.

8.2 Research Ethics Consent Form

Consent for Participation in Research
School of Science & Engineering, Teesside University

PARTICIPANTS COPY

Project Title

Climate Change in Nigeria: Assessing Policy and Practice for Community Resilience

Researcher Details

Alima Ogah; a.ogah@tees.ac.uk

Description of Research

Please answer all questions or mark as not appropriate. Ensure you include all information of what you would like the participant to consent to.

What is the purpose of the study?

Why have I been invited?

Do I have to take part?

What will happen if I take part?

What are the potential disadvantages and risks of taking part in this study?

What are the possible benefits of taking part?

What if there is a problem?

Will my taking part in the study be kept confidential?

What will happen to the results of the research study?

Who has reviewed the study?

What is the purpose of the study?

The study aims to inform the development and implementation of policy to support community resilience in the face of climate change in developing countries such as Nigeria. This will help give more insight on the perceived challenges of climate change in Nigeria and the

socioeconomic factors influencing the adoption or implementation of climate change policies in Nigeria. It can then be used to design a framework that will help in implementation of climate change policy in Nigeria. This will benefit the government, policy makers and the public to understand the state of our environment, especially given the increasing impact of climate change on the social, economic and health standards of Nigerians.

Why have I been invited?
You are asked to take part in this research because you are an adult (aged 18 and above) that is associated with climate change policies, responsible for adoption and implementation of policies, well knowledgeable on these issues and have been affected by the impacts of climate change. Therefore, your professional experience, especially of different geographic and socioeconomic contexts can contribute to a better understanding into the issues that will be addressed in this study.

Do I have to take part?
Taking part in the study is completely a matter of choice. The researcher has selected you because you meet the requirement of the study. Although we hope you agree to participate in this study, your refusal will not affect any issue or the study. It has nothing to do with any part of your work. If you decide to participate in the study, you are free to withdraw from the study at any point of the interview.

What will happen if I take part?
The study will involve you having a recorded interview through phone calls that will last approximately 30 to 40 minutes, ensuring your convenience and safety. The interviewer will take notes during the interview to record the information that you share as correctly as possible. The interview will be audio recorded and stored properly in the interviewer personal computer and locked with a strong password. At the end of the interview, you might be contacted to ensure that what is being used for the study is what you said and meant during the interview. You will not be asked to share things you are not comfortable talking about. You are also free to decline to answer any questions. There will also be three rounds of the data collection (one interview and two surveys following Delphi technique).

What are the potential disadvantages and risks of taking part in this study?
To the best of our knowledge, the study poses little or no risk. The study and all the information that is gathered will be handled with confidentiality. However, you do not have to answer any question that you are uncomfortable with. Also, you may choose to discontinue with the interview at any point and do not have to give any reasons if you desire to withdraw from the interview.

What are the possible benefits of taking part?
The information given by you will be compared and analysed to design a framework that will help reduce the impact of climate change in Nigeria and create a more resilient society.

What if there is a problem?
If any problem or discomfort arises during the study, you are free to withdraw your information and thoughts. Also, you will be provided with the contact details of the interviewer, project supervisor and Chair of the SSE Research Ethics Committee should you need to report a complaint.

Will my taking part in the study be kept confidential?

This interview will be treated with confidentiality. The information obtained during the interview will be recorded and then transcribed into a computer. Data collected will be analysed. The computer will have a password to prevent anyone else from gaining access to the data. Only persons associated with the study will have access to the data. Your real name will not be used, and you will have a choice to be identified with any information that you have shared. You can choose a name to be used in the study that is different from your real name. If you agree for one to be chosen for you, you will be informed of what it is. This is to ensure that you are not identified with any information. All recorded tape and paper notes made for the study will be destroyed according to Principle 5 of the Teesside University Research Governance on Policies, Procedures and Guidelines for research ethics. You can request a copy of the interview transcript if you want to have one.

What will happen to the results of the research study?
As the study might be published, the findings will possibly offer great implications opportunities for the government, policy makers and the public to appreciate the state of our environment better. This will be especially useful, given the increasing impact of climate change on the social, economic standing and health standards of Nigerians. This will also help me in completing my doctoral study at the University.

Who has reviewed the study?
This study is supervised and approved under the Teesside University Research Governance on Policies, Procedures and Guidelines for research ethics through the School of Science and Engineering Ethics Committee.

Contact for further information

Interviewer
Alima Ogah
Department of Science & Engineering
Faculty of Technology Future Institute
Teesside University
Email: a.ogah@live.tees.ac.uk

Supervisor
Dr Tracey Crosbie
Department of Science & Engineering
Faculty of Technology Future Institute
Teesside University
Telephone Number: 01642 342406
Email: T.Crosbie@tees.ac.uk

Consent

1. I have read and understood the information sheet for the above project and have had the opportunity to ask questions. ☐
2. I understand my participation is voluntary and that I have the right to withdraw at any time without giving reasons and without any of my rights being affected. ☐
3. I understand that confidentiality will be maintained at all times, that I will not be identified and that my data will be anonymised, unless otherwise explicitly stated. ☐
4. I understand that the data will be accessed only by the research team. Information will be stored in a secure place and destroyed on completion of the research project. ☐
5. I agree to take part in this study ☐

……..	……..	……..
Name of participant	Signature	Date
……..	…….. …	……..
Name of researcher	Signature	Date

Contact details for withdrawal

Dr Tracey Crosbie

Senior Lecturer in Research and Energy Reduction

Teesside University, Middlesbrough, Tees Valley, TS1 3BA, United Kingdom

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+44 (0) 1642 342406

8.2.1 Letter of Participant Invitation to the Federal Ministry

Teesside University
Middlesbrough Tees Valley
TS1 3BX UK
tees.ac.uk

Teesside University

02/Apr/2019

Dear Sir/Ma,

LETTER TO THE PARMANENT SECRETARY OF THE FEDERAL MINISTERY OF ENVIRONMENT

ATTENTION: DIRECTOR OF THE CLIMATE CHANGE DEPARTMENT

LETTER OF INVITATION

My name is Alima Ogah, a Ph.D. research student at Teesside University, Middlesbrough, United Kingdom. I would like to invite staff of the climate change department to participate in my study titled **'Climate Change in Nigeria: Assessing Policy and Practice'.** This study aims to explore the role of international and national policy in shaping community resilience in the face of climate change in developing countries such as Nigeria.

You all have been approached as people who can potentially add significant knowledge to this study in relation to your professional and personal experience on climate change and related policy to support community resilience.

I would like to ask you some questions about community resilience: if current policies support community resilience, how current policies supports community resilience, how climate change policies are implemented and monitored and how the levels of community resilience might be measured. The outcome of the study will provide valuable information for the design of an effective intervention strategy. This will help reduce the impact of climate change on people's everyday lives and increase resilience in multiple communities in developing countries.

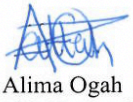
Please find attached a Participant's Information sheet for details of the study, which they will need to read in order to decide whether or not to become a participant. If they are not clear on any issue, please contact (Alima Ogah, A.Ogah@tees.ac.uk) or my Director of Studies (Dr. Tracey Crosbie T.Crosbie@tees.ac.uk, +44 (0) 1642342406) for further details at any stage of the study. Also, they may withdraw from participating in the study at any time without any issues.

If anyone is willing, then kindly provide your full contact details as indicated so that I can contact you directly. The confidentiality of your name and contact details is assured in accordance with principle 5 of the Teesside University Research Governance on Policies, Procedures, and Guidelines for research ethics.

Your decision will not have any impacts on your life or on the study, but I would appreciate your participation.

Yours Sincerely,

Signed:



Alima Ogah
PhD Researcher
Teesside University
a.ogah@tees.ac.uk
+44(0)7448042347

8.2.2 Round One Data Collection

Interview questions

1. Is there a significant risk to local communities in your region from climate change? (If yes) what is that risk? Can you please tell me how your region has tried to address this risk? (If no) why do you think communities are not at risk in your region?

2. What do you understand by the term 'community resilience'? What are the key components of community resilience?

3. Do you think there are policies available for strengthening resilience in your community? (If yes) what are they? (If no) why do you think that policies do not focus on community resilience? If no move to question 5.

4. Do you think these policies are having an impact on people's lives? (If yes) how did they impact on people's lives? What indicators are used to measure the impacts? (If no) why not?

5. Are there criteria used in prioritising the implementation of policy activities? (If yes) Can you explain?

6. Do you think that the implementation of climate change policies is monitored? (If yes) how is it done? (If no) why not?

7. Do you think there is a need for an effective policy strategy that supports community resilience? (If yes) what are those policy actions? (If no) why is that?

8. Is there any other point you would like to raise?

8.3 Round Two and Three Data Collection

8.3.1 Round Two Data Collection

NEXT STAGE OF DATA COLLECTION

COMMUNITY RESILIENCE ELEMENT TO CLIMATE CHANGE IN NIGERIA (stage two)
Feedback and Revision

Dear Expert
I thank you for taking part in my research. A large number of factors were identified as relating to different levels of community resilience in the face of climate change in the interviews I conducted with you and other experts in the field. I am trying to find a consensus on how significant each of these factors are between the different experts that are kind enough to take part in my research.

I would be very grateful if you could complete the survey below which should take no more than 10 minutes of your time.

Kind regards

Please read the list below and indicate how significant each factor is when seeking to increase Nigerian communities' resilience in the face of climate change

	Unimportant	Slightly important	Moderately important	Important	Very important
Educational status i.e. percentage of the population with school leaving certificate					
Community engagement and empowerment i.e. percentage of people involved in community activities					
Collective knowledge and experience i.e. communities' skills and knowledge from past experiences upon the climate change events					
Inter-community relationships i.e. relationship between two or more communities					
Improved livelihood i.e. percentage of people with source of livelihood and more than one job					
Access to credit i.e. percentage of people with access to credit facilities					
Ecological funding i.e. percentage of annual spending for mitigation and adaptation projects					

Resilient infrastructure and maintenance i.e. percentage of buildings with building codes, sewers, and drains to handle excess water to prevent flood

Relocation camps i.e. number of temporary shelters available relative to community size

Domestic and industrial waste facilities i.e. number and capacity of waste facilities available

Policy action plan i.e. number of mitigation and adaptation projects available

Disaster management centres i.e. number of recovery centres relative to community size

Enforcement of good land use planning i.e. development and implementation of plans on land use

Responsibility distribution and partnership amongst sectors and stakeholders on policy process

Synergy and harmonisation of policy by creating common standard in regulations within the sectors in the policy process

Renewable energy uses i.e. percentage of households using renewable energy and clean products.

Sustainable agricultural practices i.e. percentage of people involved in good agricultural practices

Learning and awareness i.e. number of awareness and training programmes available in communities

Resource monitoring and feedback mechanism i.e. number of resources and projects that are being monitored and how many stakeholders are able access the. is information and give feedback

Access to healthcare assistance and facilities i.e. percentage of community members with access to doctors, nurses, clinics and hospitals

Do you think there are other important factors related to community resilience in the face of climate change that we have not included here?

8.3.2 Round Three Data Collection

Community resilience to climate change in Nigeria (third round)

I would like to thank you for the time and effort you took in completing the web-based survey. For your information, I have presented the results based on you and other experts' responses to the survey. The results are presented which reflects the responses given on each factor based on 5-point Likert scale.
I will like to invite you to participate in the final round of the Delphi survey which asks you to review and give the final rating for each of the identified elements and factors of community resilience to climate change in Nigeria that achieved consensus and some that did not achieve consensus during the first round. These also include the factors you or other experts propose to be included.

Thank you.

Feedback and Revision

Thus, please read the list below and indicate how importance you attach to the assessment of each factor when seeking to increase Nigerian communities' resilience in the face of climate change.

	Unimportant	Slightly important	Moderately important	Important	Very important
Resilient infrastructure and maintenance i.e. percentage of buildings with building codes, sewers, and drains to handle excess water to prevent flood					
Learning and awareness i.e. number of awareness campaigns, training programmes and local skills available in communities					
Adequate resource monitoring and feedback mechanisms i.e. number of resources and projects that are monitored and how many stakeholders are able access this information and give feedback					

Educational status i.e. percentage of the population with school leaving certificate

Enforcement of good land use planning i.e. implementation of plans on land use that are designed to mitigate the impacts of climate change

Sustainable agricultural practices i.e. percentage of people involved agricultural practices that mitigate the impacts of climate change

Community engagement and empowerment i.e. percentage of people involved in community activities

Synergy and harmonisation of policy i.e. a common standard in regulations in different sectors

Adequate livelihood i.e. percentage of people living below the poverty line

Ecological funding i.e. percentage of annual spending from government for climate change mitigation and adaptation projects

Inter-community relationships i.e. working relationships between two or more communities

Adequate domestic and industrial waste facilities i.e. number and capacity of waste facilities available

Equal distribution of the responsibility for the implementation of policy between the different sectors involved in the policy process

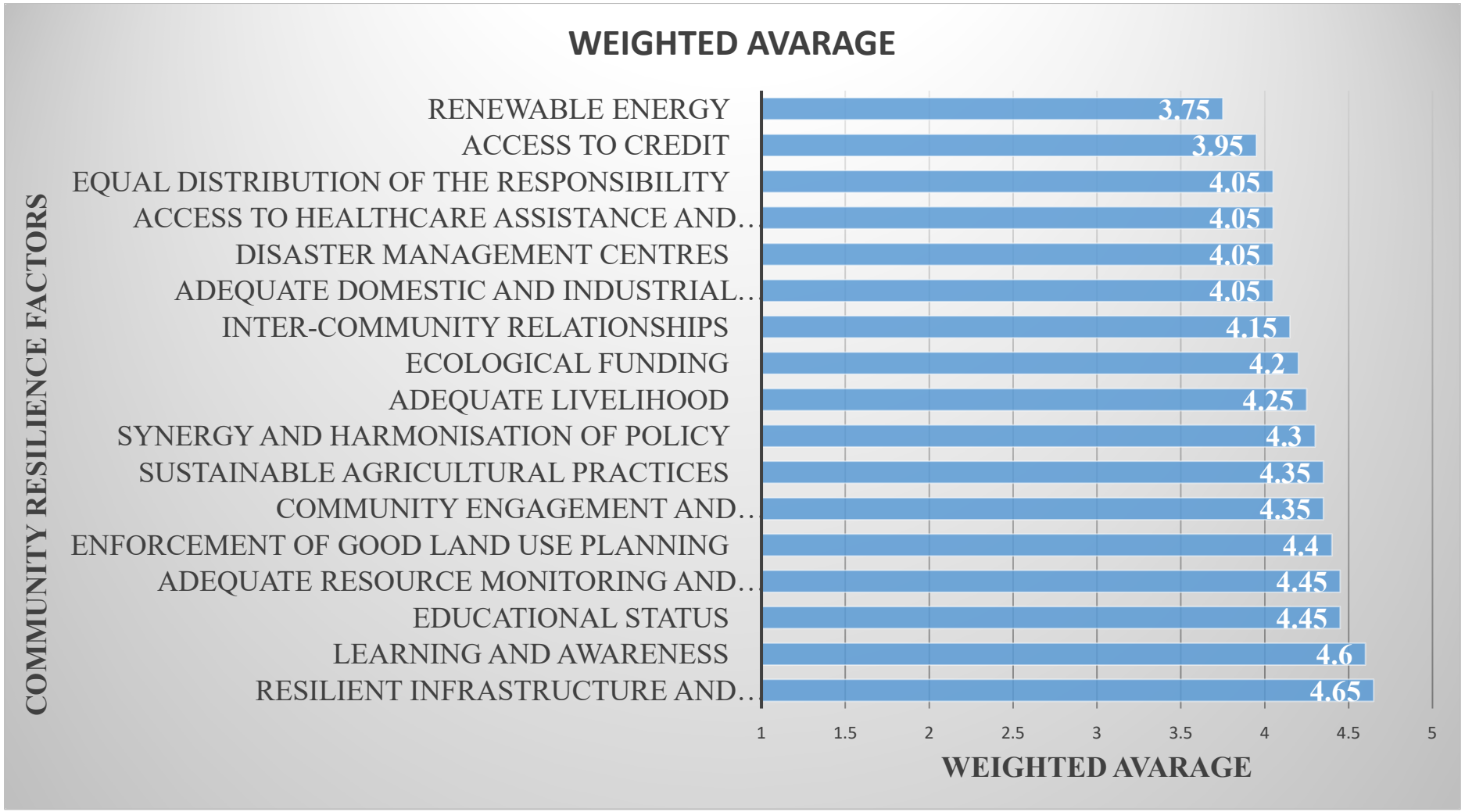
Access to credit i.e. percentage of people with access to credit facilities

Renewable energy i.e. percentage of energy demand serviced by renewable energy sources

The factors below were recommended for inclusion by you or other experts. Please indicate your opinion about these suggested factors.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
Communicating information in local languages i. e number of agencies that give out information's in local languages for communities to be able to prepare for and overcome any sudden occurrence					
Role of faith base organisation i.e. number of faith-based organisation that are involved in supporting the communities					
Exhibition programmes I. e number of local exhibition programmes to showcase community-based products					

COMMENTS


WEIGHTED AVARAGE
COMMUNITY RESILIENCE FACTORS
RENEWABLE ENERGY
ACCESS TO CREDIT
EQUAL DISTRIBUTION OF THE RESPONSIBILITY
ACCESS TO HEALTHCARE ASSISTANCE AND…
DISASTER MANAGEMENT CENTRES
ADEQUATE DOMESTIC AND INDUSTRIAL…
INTER-COMMUNITY RELATIONSHIPS
ECOLOGICAL FUNDING
ADEQUATE LIVELIHOOD
SYNERGY AND HARMONISATION OF POLICY
SUSTAINABLE AGRICULTURAL PRACTICES
COMMUNITY ENGAGEMENT AND…
ENFORCEMENT OF GOOD LAND USE PLANNING
ADEQUATE RESOURCE MONITORING AND…
EDUCATIONAL STATUS
LEARNING AND AWARENESS
RESILIENT INFRASTRUCTURE AND…
3.75
3.95
4.05
4.05
4.05
4.05
4.15
4.2
4.25
4.3
4.35
4.35
4.4
4.45
4.45
4.6
4.65
1
1.5
2
2.5
3
3.5
4
4.5
5
WEIGHTED AVARAGE

8.4 Definition of Terms

A list of definitions used within the context of this research:

Absorptive capacity – Is the ability to ensure stability and cope with shock and stress. It is the capacity to bounce back after a shock (Bene et al., 2012).

Adaptive capacity – Community's ability to learn and improve the capacity to manage an event proactively in light of anticipating future stress or shock (Galopin, 2006). It is associated with long-term timeframes and implies that some learning, either before or after an event, or changes in conditions occurs i.e. a situation characterized by flexibility.

Climate change – Refers to a change in the state of the climate that can be identified by the changes in the mean and the variability of its properties and that persists for an extended period, typically decades or longer (IPCC, 2014).

Community – As a diverse group of people in a shared geographical area, located at the household, local, regional and national level, with a common interest, shared identity, which is connected by dynamic socio-economic ties.

Community resilience – A community's ability to reduce exposure to, prepare for, cope with, recover from, adapt and transform as needed to the direct and indirect effects of climate change, where these can be both shocks and stresses.

Community capacity – The community's ability to engage in collective action and to solve collective problems and improve or maintain their wellbeing through any social, technical, environmental,

geographical or economic resources that can be used by the community to fulfil the needs when required (Magis, 2010).

Coping capacity – Based on the means that people or a system use resources, skills and opportunity to deal with the impact of climate change (IPCC, 2012). It is the short-term ability of a system to manage and cope with external shock and stress. Also referred to as bounce back.

Developing country – Classified using general reference points such as Gross Domestic Product, Gross National Income, the state of development of a country's industrial base compared to that of other countries and its Human Development Index (World Bank 2015).

Delphi method – A communication tool for groups, and a means to reach consensus on a given topic amongst experts (Hsu and Sandford, 2010).

Elements - This research uses elements as an area of measurement which is the preferred term (instead of domain, dimension, category or components). Elements are the highest representation of the data gotten from the systematic review and the GDM. Elements was used to categories the themes from the research when focusing on community resilience to climate change. they are the major forms of capacity that a community can utilise in measuring community resilience. They include social, economic, demographic, infrastructure, institutional, environmental, training and awareness, and health and fatality.

Expert groups – People who have knowledge and experience of the study field, more than five years of working experience in the area of interest, ability and willingness to participate with effective communication skills. Therefore, the expert group for this study was made up of officials from the national and regional level involved in the climate change policy process.

Grounded theory – A logical approach to qualitative analysis for constructing theory (Charmaz, 2017).

Grounded Delphi Method – Used to improve the theory building in the Delphi method by including the features of Grounded Theory in the data collection and analysis phases.

Indicators – This research used indicators as a specific measure which is the preferred term (instead of factors, criteria or variables). They are the sub-themes of the data analysed which are categorised under the elements of community resilience. They are the low level and simpler form of data that give one closer insight to the data. 49 indicators were identified from the systematic review and 20 indicators from the GDM used in measuring community resilience in the face of climate change.

Individual resilience – A personal sense of the ability to deal successfully with ongoing external or internal events and how to bounce back from such events with subsequently positive impact on the community.

Poverty line – An income level that is considered minimally sufficient to sustain a family in terms of food, housing, clothing, medical needs and so on.

Resilient community – An intrinsic part of a multi-layered governmental institution with a well-established and effective policy system that enables a targeted community to plan, prepare for, respond to, recover from, adapt to and transform in the face of climate change disturbance.

Social resilience – The ability of human communities to combat external shocks to social, economic, environmental and political upheaval and take responsibility and control of their development path.

Systematic review – A detailed and comprehensive plan and method used in identifying and appraising relevant studies on a particular topic, with a goal of reducing bias; must be reproducible and transparent.

Transformative capacity – Associated with changes in the deep structures that causes vulnerability and risk, as well as addressing the structures and root causes of issues i.e. a situation characterised by structural change.

Vulnerability – Comprises of various shocks, risks, and stress factors along with their respective contributors that affect people's life and livelihood in an undesirable manner.

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