Original Article: CART Survey Application in Assessing Community Resilience towards Hazard-Induced Urban Community

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ABSTRACT

Communities Advancing Resilience Toolkit (CART) is a comprehensive surveying tool for assessing the community's resilience and identifying the strength and challenges of the community towards resilience capacity. The study assessed the community resilience of the hazard-induced urban community in Nigeria. The version of CART adopted enlisted 27 items of core community resilience and community attributes which represented critical components in an urban community and were randomly administered among urban dwellers. Survey outcome deduced that the domain "connection and caring" was deduced as the community resilience strength domain (mean= 3.18, SD= 0.38). In contrast, the item deduced as the strength of the community was "people feeling of belonging in the community", with the highest agreement of 63.3% (mean= 3.63, SD= 1.35). The domain "disaster management" was deduced as the community resilience challenge (mean= 3.06, SD= 0.63), while the item deduced as the challenge of the community was "community has services and programs to help people after a disaster", which recorded the lowest agreement and highest disagreement of 69.3% (mean= 2.13, SD= 1.13). The community attribute assessment items indicated that "necessary healthcare services availability" has the highest agreement (61.3%, Mean= 3.48, SD= 1.25) while the item "availability of leadership opportunities in the community" has the lowest agreement (42.7%, Mean= 3.32, SD= 1.24). Expanding the surveying process of the CART application can provide key information in a resilient building; hence, the need for continuous improvement on such application to further improve the study of community resilience.

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Introduction

Communities Advancing Resilience Toolkit (CART) is a comprehensive exercise for assessing the community's resilience and involving the community to explorein exploring andencouraging activities that improve resilience [1,2]. Recovery from disaster can be hindered by inadequate community resilience capacity, impoverishment, and destitute facilities [3, 4]. Therefore, crucial attention is presently given to acquiring the mental ability of disaster-impacted communities to recuperate from the consequence of the event in the present or absent of foreign support [4]. According to the " "Weather, Climate & and Catastrophe Insight 2020 Annual Report" report, world direct economic deprivation and destruction from natural disasters in 2020 were estimated at USD268 billion. This figure was lesser when compared with the economic deprivation and damage worth of 2011 (USD557 billion) and 2017 (USD485 billion) [5].

Urban areas are interdependent systems, extremely vulnerable to threats from natural hazards. A resilient city is a sustainable system of physical and human communities [6]. Researchers of Hazards and system theorists identified characteristics in complex, resilient systems, like cities, where interaction between technological and social components occurs. They showed that resilience entails a combination of strength and flexibility, redundancy and efficiency, planning and adaptability, diversity and interdependence, and autonomy and partnership [7-9]. Hazards caused by humanss and nature can lead to significant damage and community disruption to buildings, distributed infrastructure systems, the economy, and social services [10].

Urban disasters include natural and human-induced disasters such as public health events, technology-related and terrorist attacksnatural and human-induced disasters such as public health events, technology-related and terrorist attacks, which can destroy development archived over the years. The resulting consequences of the urban disaster are enormous, considering the extent of the population and infrastructures therein. Urban disaster management is embedded in the general concept of "disaster-resilient" and "sustainable development" which are interrelated [5, 11, 12]. The central focus of the 11th goal of the "17th Sustainable Development Goals (SDGs) of 2030 Agenda" is to "ensure cities inclusive, safe, resilient and sustainable"; hence, urban disaster resilient is highly significant in the advancement of urban sustainability which eventually ensures the sustainable development of the urban community.

Community resilience involves the capability of community members to intentionally take calculated, goal-oriented, and cooperative actions to assuage from destructive impacts of unwanted events such as disasters. Similarly to personal resilience, community resilience entails the desire, attitude, beliefs, mindset, hope, and resources [1]. Community resilience depicts the corporative capacity of a group or an area to come together to handle their adversity and recover from it without necessarily affecting their way of life in the aftermath of the adversity [13, 14]. Many disciplines have considered resilient from various perspectives [15-18]. Masten, 2001, not excluding disaster research [1, 2, 5, 10, 13, 19-25] which were based on the conceptualization of community resilience. The concepts of resilience and resilience to hazard events has wide application in psychology, public health and environmental sciences, engineering, and the economic, social, and behavioral sciences discipline [26-30]. The resilience concept impacts how Federal, State, and local government agencies respond to natural disasters

In recent decades, scholars have linked community resilience tocertain attributes/features using various methodologies and instruments. Madsen and O'Mullan (2016) linked community resilience to attributes such as social connectedness, optimistic acceptance, learning tolerance and patience, and learning from the past for the future [23]. Shim and Kim (2015) established three-dimensional resilience factors; biophysical, built-environment, and socioeconomic conditions [31]. Alshehri et al. (2013) indicated that factors such as age,

education level, economic, risk perception, access to sources and willingness, responsibility, and faith are essential to building community resilience to disaster [4]. There are literature on quantifying community resilience. However, the gap exists in the integration of risk analysis with resilience at the community level. Moreover, a number of frameworks support the management of infrastructure into working tools, yet they have not been fully exploited. Examples are the Communities Advancing Resilience Toolkit (CART), Department for International Development (DFID), San Francisco Planning and Urban Research Association framework (SPUR), and the Conjoint Community Resiliency Assessment Measure (CCRAM).

Cai et al., (2016) assessed community resilience through "Resilience Inference Measurement (RIM) model," which was based on twenty-five capacity indicators [32]. Cutter et al. (2008), through "Disaster Resilience of Place (DROP) model" which identified ecological, social, economic, institutional, infrastructure, and community competence as the indicator for the assessment of community resilience [33]. Pfefferbaum *et al.*, (2015) engaged the CART assessment survey through four interrelated domains; connection and caring, resources, transformative potential, and disaster management [2]. Knowledge of various attributes/features that promote resilience among groups or communities can enhance their capacity to cope with and recover from a disastrous event. This paper presents a perspective on community resilience to natural hazards through a review of the CART resilience framework.

Materials and Methods

Research Instrument- The Communities Advancing Resilience Toolkit (CART)

The CART is a comprehensive exercise for assessing the community's resilience and involving the community to explorein exploring and encouraging activities that improve resilience [1]. The CART process encourages public engagement in problem-solving and the development and use of local assets to address community needs. With CART, four spheres build the foundation for resilience and capacity building of a community; these are connection and caring, resources, transformative potential, and disaster management. The version of CART survey adopted for this study enlisted 20 items of core community resilience based on the four spheres of building community resilience. Also, the survey assessed the community attributes, which contained 7 items concerning infrastructures and opportunities, representing a crucial component in an urban community. Aside from the questions added by the researcher, the rest of the CART surveyed items are readily available online [2].

Study Area

The study was carried out within the urban area of Port Harcourt, Rivers State, Nigeria. Port Harcourt is the capital of Rivers State, a southern zone of Nigeria. Port Harcourt is located within the Sub-Equatorial region located on latitude 4° 42' N and 4° 47' N and longitude 6° 55'E, 7° 08' E (Figure 1). Port Harcourt is also a Local Government Area and a major city in the state. Port Harcourt, part of Obio-Akpor and Ikwere, made up the metropolis. Port Harcourt has situated a tropical climate. The mean temperature is about 30ºC (86 °F), relative humidity of 80 - 100% (Ogionwo, 1979), and rainfall all through the year reaches about 480mm (the maximum) between July-September. The annual rainfall mean is about 2,3000mm. The urban community has a litany of environmental problems across its length and breadth. It is yet occupied by many people and various state facilities that are exposed to different forms of environmental/ecological problems [36].

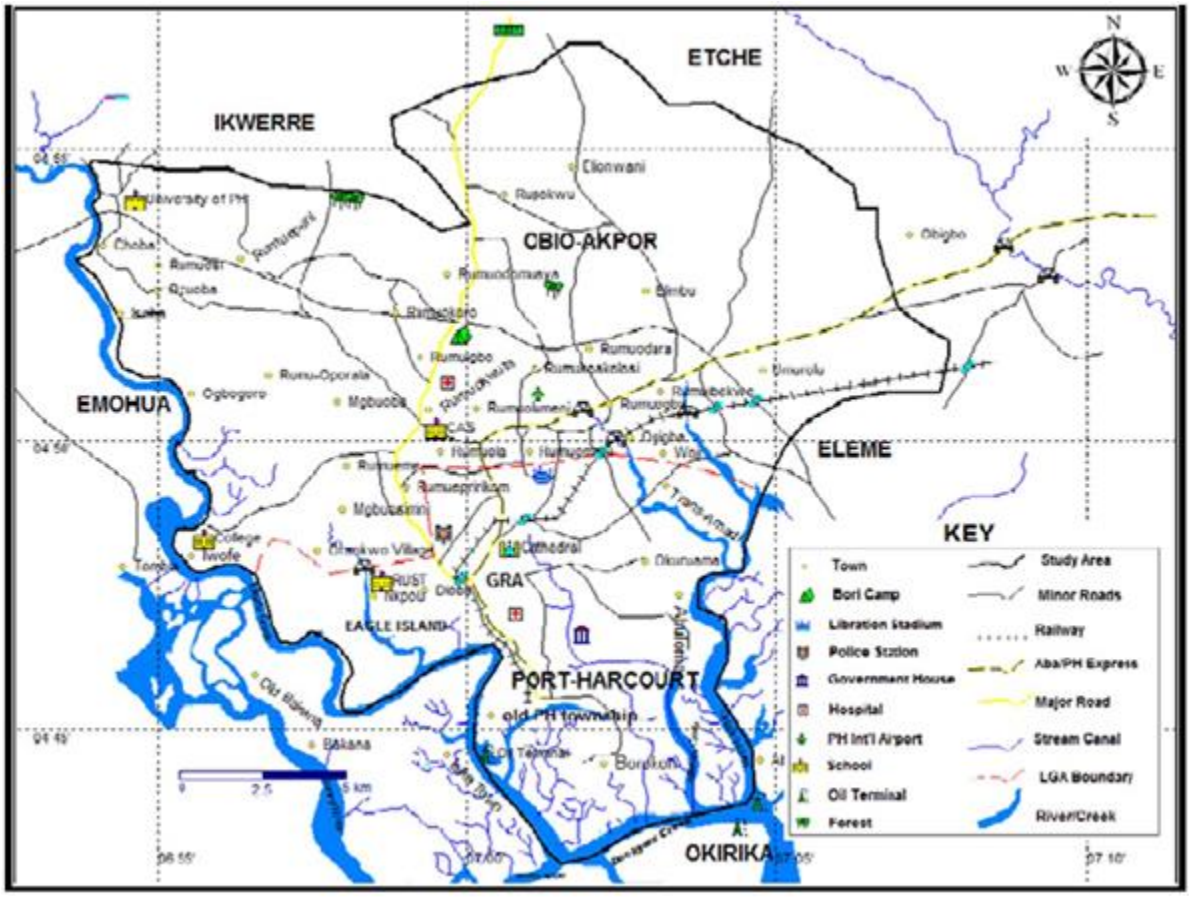

Figure 1: Urban Communities of Port Harcourt, Rivers State

Sample Size

The survey engaged volunteers from various works of life to gain their perception ofcommunity resilience. The sample size was estimated using the Cochrane formula (Cochran, 1963) in Equation (1):

$$N = \frac{Z^2 \cdot P \cdot q}{e^2} \qquad (1)$$

Where;

N= Sample Size

Z= Standard normal deviation corresponding to the level of significance

p= Prevalence of the study population (p =0.90) from a similar study conducted by Pfefferbaum *et al.*, (2015) [2].

q = 1-p

e = Minimum error @95% confidence interval

Given that e= 0.05, p= 0.90, z= 1.96, q= 1-0.90 =0.1

$$N = \frac{1.96^2 \cdot 0.90 \cdot 0.1}{0.05^2}$$

$$N = \frac{3.8416 \cdot 0.90 \cdot 0.1}{0.0025}$$

$$N = \frac{0.345}{0.0025}$$

$$N = 138$$

For non-response increase by 10%

= 138 + 14

=152

Therefore, a sample size of 150 (of community inhabitants) was used for the study.

Purposive sampling was adopted in selecting 150 respondents for the study. The inbuilt response options of the CART survey were adapted for the 27 items (that is 20 items: core community resilience and 7 items: community attributes assessment). The response options ranged from 1-"Strongly disagree" to 5- "Strong Agree" while the non-CART bound questions use a closed-ended format. High and low percentages of agreement scores for the 27 community resilience items were used to identify the primary community resilience strength and the primary community resilience challenge, respectively.

Data Analysis

The retrieved questionnaire coding was done with MS Excel before being transferred to the Data entry of Statistical Package for Social Sciences (SPSS). Using the SPSS window (Version 22), the analyze tool from the tool menu bar containing the descriptive statistics tools (Frequencies- was used in analyzing descriptive statistics such as frequencies, percentages, mean and standard deviation, and Crosstabs- was used in testing the association between demographic characteristics and core community resilience) were adopted for the analysis.

Result

As estimated, most residents captured in the study were male (81, 54.0%) between the age range of 30-40years (61, 40.7%). Furthermore, the captured residents indicated having been married (66, 44.0%), having the most minor primary education (61, 40.7%), and engaged in various forms of occupations (113, 75.3%), as indicated in **Table 1**. While profiling the hazard associated with the urban community, 66 (44.0%) of the residents identify natural hazards such as flood and erosion as common hazards in the urban area. In comparison, 84 (56.0%) indicated anthropogenically influenced hazards such as social disturbance, deforestation, transportation accidents, environmental contamination, pollution and waste, fire outbreak, and oil spillage as common hazards associated with the urban community. Among these identified hazards, the frequency of their occurrence in the city indicated "Not Always (78, 52%)", "Quarterly (19, 12.7%)" and "Throughout the Year (53, 35.3%) while the severity of their impact demonstrated "Severity (94, 62.7%)", "Moderate (33, 22.0%)" and "Mild (23, 15.3%)". Most residents captured in the study indicated "Highly Aware" of the hazards associated with the city (63, 42.0%) as shown in **Table 2**.

The urban community resilience was measured based on four (4) domains and twenty (20) items, indicating the community strength and challengeas indicated in **Table 3**. The domain "Connection and Caring" was deduced as the community resilience strength domain (Mean= 3.18, SD= 0.38). In contrast, the item deduced as the strength of the community was "People feeling of belonging in the community," with the highest agreement of 63.3% (Mean= 3.63, SD= 1.35). The domain "Disaster Management" was deduced as the community resilience challenge (Mean= 3.06, SD= 0.63) while the item deduced as the challenge of the community was "Community has services and programs to help people after a disaster," which recorded the lowest agreement and highest disagreement of 69.3% (Mean= 2.13, SD= 1.13).

The community attribute assessment items indicated that "necessary healthcare services availability" has the highest agreement (61.3%, Mean= 3.48, SD= 1.25) followed by "community is a safe place to live and work" (57.3%, Mean= 3.40, SD= 1.37) while the items such as "friendships between community people and their neighbors" (44.7%, Mean= 3.28, SD= 1.35) and "availability of leadership opportunities in the community" has the lowest agreement (42.7%, Mean= 3.32, SD= 1.24) as shown in **Table 4** and **Figure 2**. The association of various community resilience domains and various socio-demographic attributes of the community was analyzed in **Table 5**. The options of the socio-demographics attributes were collapsed into two such sex (male and female), age (18-40 and 41-70), marital status (unmarried and married), education (uneducated and educated), and occupation (employed and unemployed). The association outcome showed no association between the community resilience domains and

socio-demographic attributes (where p-value > 0.05)

Table 1. Socio-Demographic Details of the Respondents

Variable	Frequency (n=150)	Percentage (%)
Sex of Respondents		
Male	81	54.0
Female	69	46.0
Age (years)		
18-29 years	40	26.7
30-40 years	61	40.7
41-50 years	30	20.0
51-60 years	10	6.7
61 and above	9	6.0
Marital Status		
Single	53	35.3
Married	66	44.0
Divorced	10	6.7
Widowed	11	7.3
Separated	10	6.7
Educational Qualification		
No Formal Education	43	28.7
Primary	61	40.7
Secondary	29	19.3
Tertiary	17	11.3
Primary Occupation		
Unemployed	23	15.3
Professional Occupation	43	28.7
Skilled/Managerial Occupation	31	20.7
Manual/Partly Skilled	29	19.3
Self-employed/Trading/Commerce	10	6.7
Student	10	6.7
Others	4	2.7

Table 2. Hazard Profile of the Urban Community

Variable	Frequency (n=150)	Percentage (%)
Common hazard associated with the city		
Social Disturbance	18	12.0
Flood	49	32.7
Erosion	17	11.3
Deforestation	12	8.0
Transportation Accident	17	11.3

Environmental Contamination/Pollution/Waste	15	10.0
Fire Outbreak	14	9.3
Oil Spillage	8	5.3
Frequency of Hazard in the City		
Not always	78	52.0
Quarterly	19	12.7
Throughout the Year	53	35.3
Severity of Hazard Impact		
Severe	94	62.7
Moderate	33	22.0
Mild	23	15.3
Awareness about the City Hazards		
Highly aware	63	42.0
Fairly aware	26	17.3
Little awareness	32	21.3
Not aware	29	19.3

Table 3. Core community resilience

Domain	Items	A (%)	D (%)	Mean (SD)
Connection and Caring [a]	1. People in my community feel like they belong to the community. [c]	63.3	22.0	3.63 (1.35)
	2. People in my community are committed to the wellbeing of the community.	55.3	31.4	3.43 (1.42)
	3. People in my community have hope for the future.	49.4	37.3	3.13 (1.48)
	4. People in my community help each other.	44.7	38.0	3.09 (1.40)
	5. My community treats people fairly no matter what their background is.	28.7	55.4	2.63 (1.32)
				3.18 (0.38)
Resources	6. My community has the resources it needs to take care of community problems.	42.0	38.0	3.06 (1.41)
	7. My community has influential leaders.	48.7	35.3	3.21 (1.44)
	8. People in my community are able to get the services they need.	43.3	45.0	2.98 (1.43)
	9. People in my community know where to go to get things done.	44.6	38.0	3.09 (1.34)
				3.09 (0.10)
Transformative Potential	10. My community works with organizations and agencies outside the community to get things done.	40.6	44.6	2.92 (1.39)

	11. People in my community communicate with leaders who can help improve the community.	53.4	38.0	3.12 (1.46)
	12. People in my community work together to improve the community.	52.7	39.3	3.15 (1.43)
	13. My community looks at its successes and failures, so it can learn from the past.	49.4	32.0	3.21 (1.33)
	14. My community develops skills and finds resources to solve its problems and reach its goals.	45.3	32.0	3.17 (1.35)
	15. My community has priorities and sets goals for the future.	58.0	24.6	3.43 (1.22)
	16. People in my community are aware of community issues that they might address together	46.0	40.0	3.01 (1.45)
				3.14 (0.16)
Disaster Management [b]	17. My community tries to prevent disasters.	51.3	31.4	3.21 (1.31)
	18. My community actively prepares for future disasters.	48.7	13.3	3.50 (1.07)
	19. My community can provide emergency services during a disaster.	46.0	17.3	3.41 (1.02)
	20. My community has services and programs to help people after a disaster. [d]	20.3	69.3	2.13 (1.13)
				3.06 (0.63)
Overall Community Resilience				**3.12 (0.05)**

Key: A- Agreed (Strongly Agreed + Agreed), D-Disagreed (Strongly Disagreed + Disagreed), SD= Standard Deviation

[a] *Domain Community Resilience Strength.*

[b] *Domain Community Resilience Challenge.*

[c] *Item Community Resilience Strength.*

[d] *Item Community Resilience Challenge*

Table 4. Community Attributes Assessment

Community Attribute Assessment Items	A (%)	D (%)	Mean (SD)
1. My community is a safe place to live and work.	57.3	32.0	3.40 (1.37)
2. Good housing is available for people who live in my community.	51.4	28.0	3.39 (1.25)
3. Necessary health care services are available to people who live in my community.	61.3	22.0	3.48 (1.25)
4. Good educational opportunities are available to people who live in my community.	50.6	34.0	3.17 (1.53)
5. Good work opportunities are available to people who live in my community.	48.6	30.0	3.21 (1.17)
6. People in my community have friendships with their neighbors.	44.7	25.3	3.28 (1.35)
7. Leadership opportunities are available to people who live in my community	42.7	24.0	3.32 (1.24)

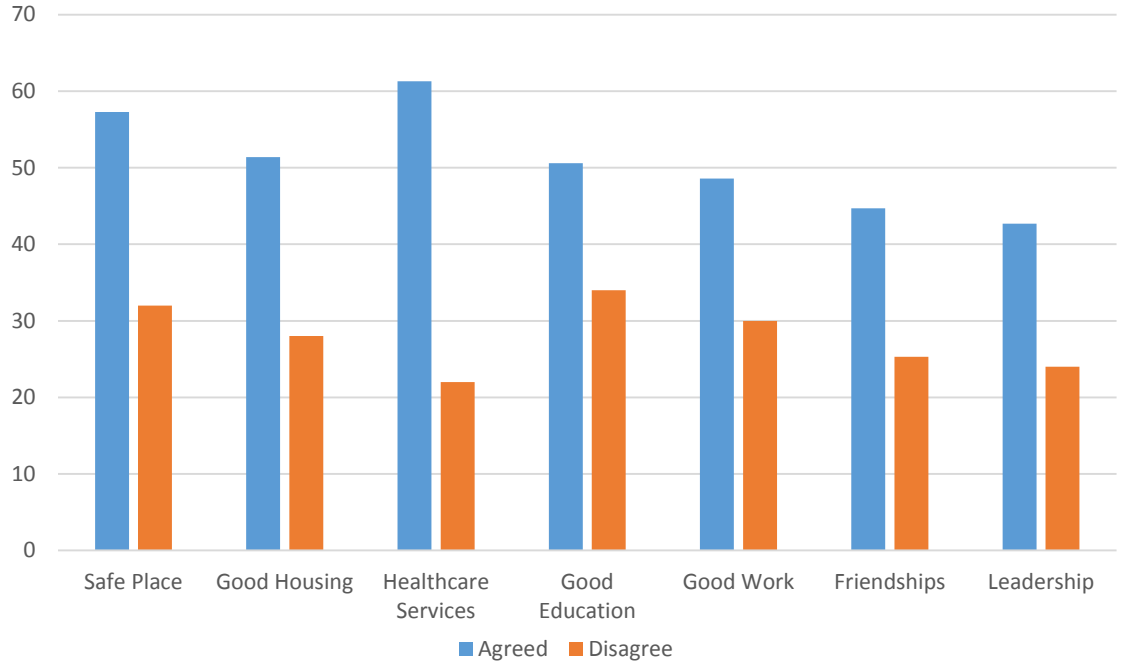

Figure 2. *Community Attributes Assessment*

Table 5. *Correlation Analyses between community resilience domain and various socio-demographic Attributes*

Community Resilience Domain	SEX Male/Female X^2 (p-value)	Age 18-40/41-70 X^2 (p-value)	Marital Status Unmarried/Married X^2 (p-value)	Education Uneducated/Educated X^2 (p-value)	Occupation Employed/Unemployed X^2 (p-value)
Connection and Caring	81 (54.0) / 69 (46.0) 17.992 (0.523)	101 (67.3) / 49 (32.7) 79.571 (0.367)	84 (56.0) / 66 (44.0) 71.552 (0.623)	43 (28.7) / 107 (71.3) 44.385 (0.888)	113 (75.3) / 37 (24.7) 103.367 (0.753)
Resource	81 (54.0) / 69 (46.0) 13.279 (0.581)	101 (67.3) / 49 (32.7) 68.228 (0.218)	84 (56.0) / 66 (44.0) 72.987 (0.121)	43 (28.7) / 107 (71.3) 48.268 (0.342)	113 (75.3) / 37 (24.7) 103.174 (0.162)
Transformative Potential	81 (54.0) / 69 (46.0) 22.509 (0.549)	101 (67.3) / 49 (32.7) 81.092 (0.862)	84 (56.0) / 66 (44.0) 108.420 (0.182)	43 (28.7) / 107 (71.3) 69.312 (0.568)	113 (75.3) / 37 (24.7) 120.407 (0.924)
Disaster Management	81 (54.0) / 69 (46.0) 13.034 (0.600)	101 (67.3) / 49 (32.7) 61.017 (0.439)	84 (56.0) / 66 (44.0) 51.682 (0.769)	43 (28.7) / 107 (71.3) 50.878 (0.253)	113 (75.3) / 37 (24.7) 108.527 (0.089)

Discussion

The study strived to understand the resilience attributes of urban communities based on various hazards that pose challenges to their living, sustainability, and development. Urban disaster have a significant impact on the life and other activities of the area. The identified urban hazards in the studied location are grouped into human-induced hazards such as social disturbance, transportation accidents, fire outbreaks, pollution, and oil spillage. In contrast, natural hazard includes flood and erosion. The outcome was similar to previous studies in the

urban community [34-36]. The urban community is well known for yearly flooding and erosion event, which has been greatly influenced by climate change leading to loss of lives, displacement of individuals, and destruction of properties. The social disturbance in the urban community is majorly influenced by political events and other social events that bring about the destruction of lives and properties. Due to the activities of oil and gas in the urban community, there are oil spillage, fire outbreaks, and pollution incidents. The frequency and severity of hazard in the city is influenced by the kind of hazard and the exposure.

The essence of CART development and adoption in resilience studies is point out the community's strength and challenges in the face of disturbance. The study identified the domain "connection and caring" as the community resilience strength of the city's people, which is influenced by their sense of belonging to the community. The attachment of individuals to their community or household influences their bounce-back capability. Aside from the sense of belonging, individuals in the urban community linked their resilience to the wellbeing of their community, support, as well as hopes for thetreatment received anda better future. A community is said to be resilient when it is capable of demonstrating the ability to withstand an event, self-manage such an event before, during, and post-event, and able to improve on its capacity and experience [37].

Kirmayer, et al., outline some common features that may contribute to resilience [38]. These include values, beliefs, and behaviors related to spirituality, child-rearing, and extended family. Each of these features has its manifestation at various communal levels. The community of study possesses those features as they are indigenous people in their original/ancestry home, showing connectedness among the people even during a crisis. The community's strength can be connected to the fact that most of them have lived in the community for a long time, living in harmony with other tribes, togetherness effort by the people sharing the same cultural belief and knowledge. It always work together to improve their well-being.

To be able to "bounce back and transform" needs a series of adequate and efficiency in communication, emotion, spirituality, community relationships, and more. When a family can identify themselves with the culture and ethnicity they belong to, it can positively affect such family resilience because culture helps the family in decision making, especially those that bring about changes, therefore "a source of stability and support, a way of dealing with the problems of daily life" [38]. The key component to individual and family resilience is their cultural knowledge and their ability to be flexible and cohesive in their practice of such protective factors [38].

However, while having the strength to withstand the stress urban dwellers go through, they also possess some form of challenge that is more or less capable of bringing them back to the same stress they are trying to avoid. The urban community resilience challenge domain is in the area of "disaster management," which is influenced by the lack of services and programs to help people in the city after a disaster. The respondents claimed that even though it is almost expected that there will be a form of disaster at a particular time, more has not been done to avert or reduce such disaster, especially in the area of flooding in the city. Services and programs were perceived as construction/reconstruction and rehabilitation actions that help their city to withstand the impact of a disaster. In disaster management, construction/reconstruction and rehabilitation are part of disaster recovery programs strategically carried out to ensure inclusive, safe, resilient, and sustainable rebuilding and that more equitable societies are in short supply and in high demand. Inadequacy of such services and programs means that people are likely to suffer the same fate over the same one; hence, the purpose of resilience is challenged. Unfortunately, many cities in Nigeria are inadequately prepared for disaster, whether natural or manufactured. Therefore at it occurrence, there are significant socioeconomic and human-related impacts.

Urban attributes/characterize which individuals are still determined to remain in the environment despite the risk and disaster

associated with the environment and pay less attention to the impact or losses suffered. The finding indicated that many of the respondents agreed with the attributes of their community, such as the community being a safe place to live and work, suitable housing available for people who live in my community, people in the community having friendships with their neighbors, good educational opportunities are available to people who live in the community. According to Ranjana and Abenayakeb (2014) [21], uch research pertaining toabout the concept of resilienchas failed to examine the social attributes that act upon the susceptibility or capability at a community level. The community that is oppressed or dejected by various events or situations surrounding it is likely to be overcome by harmful events. However, resilience is made possible by a community that shows competency and association with various groups (such as a church, family, sporting team, cooperative groups.) that would find a way to protect and propagate what they value and use it for their survival.

The lack of association between various community resilience domains and socio-demographic attributes is an indication that resilience is not based on sex, age, marital status, education, and occupation but instead rooted in peoples' heritage, culture, beliefs, sense of ownership or belongings, connectedness to their source.

Conclusion

The application can provide insight into various aspects of resilient building blocks for communities, hence, the need for continuous improvement on such application to further improve the study of community resilience. Disaster impacts can destroy the long-achieved development and wellness of a nation and beyond; therefore, the place of resilience in social, environmental, and economic cannot be overemphasized. Expanding the surveying process of the CART application can provide essential information in the resilient building.

The contribution of climate change to the increasing disaster event remains a major concern for many world nations. Many urban communities are susceptible to various degrees of human and natural events, which therefore need to develop coping capacity and, most importantly, resilience towards such events. Through the CART application, this studyhas explored various domains and items that could influence resilient building in terms of strength and challenges posed to an urban community. To achieve community resilience, the opinion of the community dwellers must be sourced due to their first-hand information that can help build resilience.

Conflict Interest

The authors have declared that no competing interests exist.

Author contributions

This work was done in collaboration among all three authors. All authors have read and agreed to the published version of the manuscript.

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