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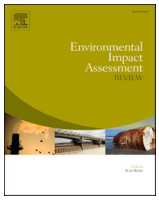

Conceptualising the characteristics of the indicators of a neighbourhood sustainability assessment framework in a developing country context

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ABSTRACT

Sustainability Indicators (SIs) emerged to monitor progress towards sustainable development which has led to the development of large quantity of indicators locally at the various scales of spatial development. This paper utilizes 23 SIs that were distilled in engagement with both residents and institutional stakeholders responsible for neighbourhood delivery in metropolitan Lagos. The aim is to conceptualise how these indicators can be characterised in terms of their attributes in a way they can be compared with indicators developed in other contexts. Drawing extensively from literature on how indicators can be described, the 23 indicators were characterised based on their typology in an assessment framework, weight, and ranking, and balance (i.e. contextual, procedural, and integrational). Findings showed that while there are some similarities in the characteristics of the indicators when compared to existing Neighbourhood Sustainability Assessment Frameworks (NSAFs), there are areas of differences which are primarily driven by contextual factors. As major area of contribution, this article could serve as a starting point, and basis for comparison with indicators developed in other African cities with similar contextual factors and sustainability challenges. This paper contributes significantly to the argument that SIs are context-specific and transference of sustainability solutions may be quite challenging.

1. Introduction

SIs are traceable to the Rio Summit of 1992 because of the need to develop indicators which will be helpful to monitor progress towards sustainable development (Bell and Morse, 2008). It is against this backdrop that a large quantity of indicators has been developed locally at the various scales of spatial development (Bell and Morse, 2008; Science for Environment Policy, 2015; Wu, 2014; Huedo et al., 2016).

Indicators perform various complimentary functions as a decision-making strategy for sustainability at the neighbourhood level. One, indicators help to express and communicate information in a structured manner in the decision-making process (Dahl, 2012; Moldan and Dahl, 2007; Hezri and Dovers, 2006; Munier, 2011). In this regard, indicators make the concept of sustainability observable and demonstrable. For example, the term 'sustainable neighbourhood' can best be observable when there are indicators that express what the concept means and what should be aimed at in an attempt to deliver one. Two, in addition to demonstrating what a sustainable neighbourhood is, indicators help to put to practice the concept (Bell and Morse, 2005; Malkina-Pykh, 2002; Halla et al., 2022). That is, it pulls the discussion of sustainability from the abstract formulation and encourages explicit discussions as regards how indicators address sustainability dimensions (Braulio-Gonzalo et al., 2022). To this end, it helps to benchmark sustainable neighbourhood in a context. Three, because the development of indicators involves stakeholders' engagement, it therefore helps to facilitate social learning (Bell and Morse, 2004; Coelho et al., 2022) as advocated in Agenda 21. Four, the uptake of SIs in the decision-making process may change the way in which a society measures progress towards sustainability which serves as a leverage point to tackle the root causes of unsustainable development (Pinter et al., 2012).

Besides these complimentary functions, indicators are important for an assessment to achieve some requirements of the Bellagio Sustainability Assessment and Measurement Principles (STAMP) as reported in Sala et al. (2015). For instance, indicators can enhance the transparency of the decision-making process if they are developed in a clear and simple language with no ambiguity that can easily be understood and

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interpreted (Pinter et al., 2012). The general outlook of an indicator set can also be useful to determine the guiding vision for sustainability in a particular context. For example, if the indicators are more towards environmental aspects may suggests that such context is more environmentally driven in quest for sustainable future. The benefits of indicator set can also be explored from its role in an assessment framework. According to Shen et al. (2011) and Joss et al. (2013), indicators can serve as an explanatory tools, pilot tools, performance assessment, or as a planning tool.

With this, Cowley et al. (2013) noted the following six benefits of indicators: incentivising schemes by providing a platform for city authorities to pledge and define their strategies, plans and agenda for sustainability; strategic visioning as a tool to define city-level strategies for urban sustainability most typically those initiated at the local level; part of planning toolkit as a guide for planners and developers to analyse when designing and implementing sustainable urban projects; for assessing performance against baseline measures and future targets; to enhance community engagement by facilitating the involvement of stakeholders and community members in knowledge sharing and social learning, and finally; for certification scheme as it offers standardisation and accreditation to developers, based on prescribed, step-by-step design and assessment methods.

To this end, the significant role of context in the development of indicators has continually been recognised in sustainability assessment framework (Joss et al., 2015; Gazzola et al., 2011; Gazzola, 2008; Fischer, 2005; Fischer and Gazzola, 2006; Fischer and Onyango, 2012; Braulio-Gonzalo et al., 2015). According to Conte and Monno (2012), context influences the development and implementation phases in sustainability assessment, including the indicators, and how they are used for decision-making. The development phase for instance which involves the understanding and interpretation of sustainability is a function of context. That is, how sustainability is perceived in one context may be different in another context. This perception is mostly based on values, needs, aspirations, cultural inclination, and climatic conditions amongst others. Gazzola (2008) draws attention to the various planning paradigms influenced by cultures, while Fischer (2002) and Hilden et al. (2004) emphasises the significance of distinct legal and administrative aspects which have important procedural and methodological implications for environmental assessments. Knieling and Othengrafen (2015) amongst other scholars have provided an authoritative theoretical framework that established the pivotal role of context in shaping planning frameworks and consequent outcomes, based on empirical analysis of European planning frameworks.

Moreover, there is also a difference in terminology which can vary across context as documented in Du Plessis (2005). For instance, the term 'social wellbeing' which is a global sustainability agenda may have different meanings and interpretations in different countries. Context also plays a further role in the development phase during the process of transferring the interpretation of sustainability into measurable values known as indicators. For example, the indicators for 'integrated transport' or 'support for the local economy' in a developed country may be quite different from that of a developing country.

Although some relevant studies can be found in literature addressing sustainability in both developed and developing country context, they nevertheless do not provide a comprehensive treatment of the issue.

At the transnational scale, it is noteworthy the development of Sustainable MED cities in the Mediterranean countries through which a new sustainable approach to spatial planning and management will "provide municipalities with a system of innovative tools and methodologies to develop effective policies, strategies and action plans in relation to the Mediterranean strategy for sustainable development 2016-2025" (ENI CBCMED, 2023b). Expectedly, the Sustainable MED would combine the capitalisation of the Common European Sustainable Built Environment Assessment for Mediterranean Cities (CESBA MED) method with the European Neighbourhood Instrument (ENI) Cross-Border Cooperation (CBC) MED project "Green building". The CESBA MED according to Balaras et al. (2019) and Balaras et al. (2020) emerged as a collaboration between seven European organizations from seven countries which was structured around the UN 17 Sustainable Development Goals (SDGs). Although it was initially developed to aid decision-making process at the building scale, it has now been expanded to the neighbourhood scale. On the other hand, ENI CBC MED Green Building project is with the goal of promoting the use of renewable energy measures in public buildings to maximise its potential in the Mediterranean (ENI CBCMED, 2023a) which has been adopted in Greece, Spain, Lebanon, Tunisia, and Jordan.

Also, although there is a wide body of knowledge in Neighbourhood Sustainability Assessment (NSA) literature, there appears to be none that explores how the indicators for a sustainable neighbourhood in a developing country can be characterised in terms of their attributes. The reoccurring themes in these studies are: most of the NSA tools could do betters in terms of broad coverage of sustainability issues (Sharifi and Murayama, 2013); provision of no mechanism for local adaptability and engagement (Sharifi and Murayama, 2013; Sharifi et al., 2021); limited consultation of local stakeholders (Adewumi et al., 2019; Sharifi et al., 2021); potentials of NSA tools in contribution to the transition towards sustainable urban development (Sharifi et al., 2021b). Kamble and Bahadure (2020) who reviewed NSA tool in both developed and developing countries noted that the former focused on social issues whilst latter emphasised more on energy, water and wastewater, and transportation.

In Sub-Saharan Africa (SSA), there is no evidence of a comprehensive and systematic study investigating the characteristics of a context-specific indicator set of a sustainability assessment framework for decision-making that could steer urban sustainability at the neighbourhood scale. For example, Okpoechi (2014) and Ihuah and Eaton (2014) identified the functional requirements and sustainability factors for public housing neighbourhoods in Nigeria. Jiboye (2010, 2009), Clement (2012) and Ibem and Azuh (2011) examined residents' perception and satisfaction with urban neighbourhood. Ibem et al. (2015), Jambol et al. (2013), and Ibem and Amole (2010) examined the urban challenges in Nigeria and concluded that critical to the success of housing delivery at the neighbourhood is the consideration for sustainability parameters. Momoh et al. (2022) developed the Sustainable Composite Cities Environmental Evaluation and Design (SUCCEED-ND) tool within the Nigerian context with no specificity to the neighbourhood scale or exploration about how the indicators can be described. Onyango and Adewumi (2021) appears to be the closest in literature which distilled 23 sustainability indicators for neighbourhood development for metropolitan Lagos after consultation with stakeholders. However, the study did not proceed to explore the characteristics of these indicators.

Using an analytical framework, this paper aims to address the knowledge gap by exploring the characteristics of the indicators developed by Onyango and Adewumi (2021) for assessing neighbourhood sustainability at the neighbourhood level. Amongst other attributes, it attempts to address the following questions about the indicator set: what dimensions of sustainability does the indicator set address? what types of relationship(s) exist between the sustainability indicators? how well does the indicator set provides a balanced assessment of sustainability issues? This is with a broader question of to what extent does the context of metropolitan Lagos influence the characteristics of the indicators.

"The contribution of this paper to wider academic debates in urban studies and planning is quite clear. It provides a better understanding of how indicator set can be characterised using various approaches. Most importantly whilst Fischer and Onyango (2012), Conte and Monno (2012) have argued for the critical role of context to achieve progress in planning for sustainability, this paper takes that notion forward by demonstrating empirically the significance of context using a case of Lagos, Nigeria".

The SSA has grown rapidly in urban population size from 15% in 1960 to 40% in 2010 with cities such as Lagos, Kinshasa, Addis Ababa metamorphosing into megacities with over 10 million inhabitants each

(UN-Habitat, 2015). According to UNDESA (2019), the population growth in SSA will continue despite a decline expected in other parts of the world especially in Europe. For example, Nigeria with an urbanisation rate of 5.5% is one of the highest in the world (Federal Ministry of Lands Housing and Urban Development FMLHUD, 2014). Whilst this growth continues, the need to focus on systematic approaches and methods that would guarantee sustainability of urban places becomes apparent. The choice of metropolitan Lagos located Southwest Nigeria is quite strategic due to the current sustainability challenges that confront the city neighbourhoods. The projection by UN-Habitat (2015) that metropolitan Lagos will be the 9th most populous country in the world by 2030 with an estimated population of 24 million suggests the need to begin to characterise the sustainability indicators for effective utilisation and uptake in the decision-making process.

The remainder of this paper is structured in this manner. Section 2 presents the framework for characterising the indicators. Section 3 captures the methodology adopted for the paper. Section 4 focuses on the results and findings looking into details the characteristics of the indicators. Section 5 and 6 presents the discussion and conclusion respectively.

2. Framework for characterising indicators

The role of indicator set as the main aspect of a NSAF is to communicate the meaning (or standard) of a sustainable neighbourhood in a context where it has been developed. NSAF have grown in popularity over the past decades with flagship tools being developed to measure, implement, and reward sustainable practices (Ameen et al., 2015), whilst also helping to achieve sustainable developing goals (Saiu et al., 2022). These tools or frameworks operate under indicators sets, which are used locally in country of development and also exported to other regions. These tools include Building Research Establishment Assessment Methods (BREEAM) UK (BRE, 2017); Leadership in Energy and Environmental Design (LEED) US (USGBC, 2018); Pearl Community Rating System (PCRS) UAE (AUPC, 2010); and Green STAR Communities Australia (GBCA, 2012). However, the indicator set has some characteristics worth investigating and can be explored using two perspectives. One has to do with the content of the indicator set. That is, what areas and aspects of sustainability does it cover, and how can each of the indicator in the set can be described in terms of function. Two has to do with the relationship of the indicators with one another. For example, in the decision-making progress, how are the indicators prioritised with respect to one another. This section presents four various ways of characterising the indicator set of a NSAF under the two main perspectives as illustrated in Fig. 1.

2.1. Typologies

The typology of indicators can be characterised in three ways. One is based on the summary of the vast literature which describes the ideal set of indicators as fully functional: ideally, capturing all the elements of sustainability, from the drivers, status, impacts and responses. This comprehensive information set type is found in very few sets, e.g., the Driving Pressure State Impact Response (DPSIR) framework which has been widely used as an extension of the Pressure State Response (PSR) developed by the Organisation for Economic Cooperation and Development (OECD). Its values lie in presenting a comprehensive spectrum of indicators that inform about the dynamics that capture sustainability: linking the built and natural with human interface, as well as linking the flows (forces causing) and status (results of) aspects. Using the DPSIR, indicators can be transformed to a causal network thereby eliciting meaning and making it easier to communicate to stakeholders how the indicators are linked to one another (Opon and Henry, 2019; Pakzad and Osmond, 2016). The DPISR framework has the advantage over other indicator frameworks because it helps to better understand how the indicators address the various components of the interaction between human activities and environment. Kirstensen (2004), Bell and Morse (2008), Dong and Hauschild (2017), and Ramos-Quintana (2018) have adopted the DPSIR in explaining how the characteristics of different indicators can be helpful in the decision-making process.

In this paper, the driving force indicators attempt to address the need and demand of a typical neighbourhood; pressure indicators aim to reduce the demand on the environment and its resources by enhancing sustainable production and consumption pattern; state indicators assess a proposed neighbourhood development in terms of its contribution to enhance the quality or state (S) of the environment; impact indicators assess a proposed neighbourhood development in terms of its consideration to reduce its likely impact (I) on human health; response (R) indicators are response measures to ensure environment-friendly development and that mitigation interventions are taken to prevent

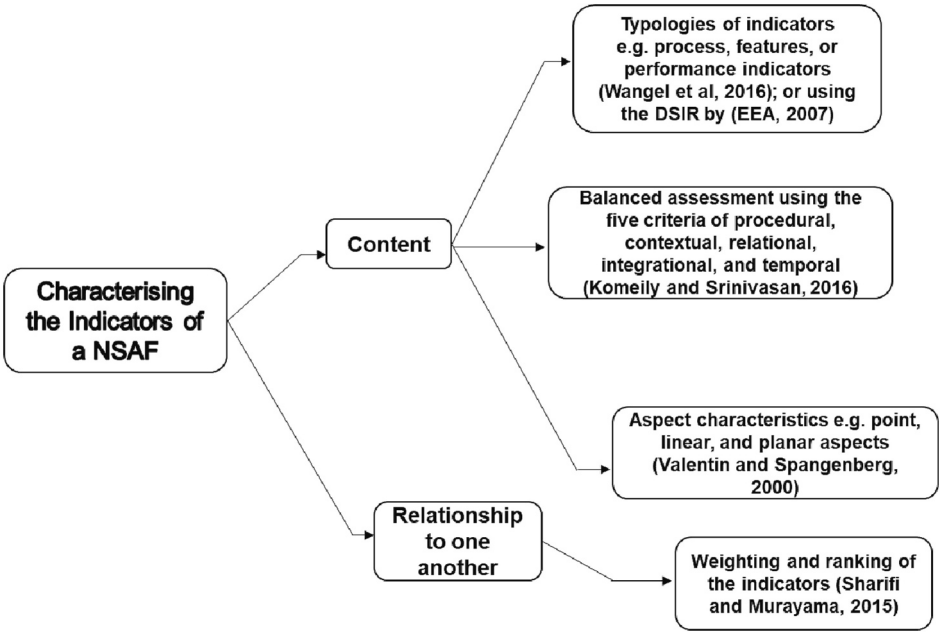

Fig. 1. Conceptualising the approaches for characterising the indicators of a NSAF.

the likely adverse effects of the development on the environment. This approach has the potential to provide a compelling framework for understanding the characteristics of an indicator set by creating a window for facilitating the communication and understanding of the various inter-linked and inter-dependent factors at play when considering a sustainable neighbourhood.

Two is by the classification of indicators in typical assessment framework as documented by Wallhagen et al. (2013) and Wangel et al. (2016). In this typology, the character of an indicator could be process, features, or performance indicators. The process indicators describe the important procedures or activities that contribute to the achievement of sustainability outcomes in planning a new neighbourhood. For example, this may involve stakeholder engagement which could take place at any of the phases of the proposed neighbourhood. Most times, it could be key strategic planning like scenario analysis; forecast etc. The features indicators describe certain solutions, provisions, technologies, and components that would contribute to a sustainable neighbourhood. These are most times tangible. They serve primarily to maintain the sustainability of the neighbourhood. Lastly, are the performance indicators which are the expected result following the execution of the process and feature indicators. It suggests in a way how the neighbourhood would perform. This typology has the advantage of comprehensively capturing the key factors in describing the implementation and delivery of a sustainable neighbourhood.

Three is the classification as either qualitative, quantitative indicators or both. According to Waas et al. (2014), quantitative indicators rely on quantitative data providing information numerical data, which are more objective parameters for calibrating positions and status of performance. However, qualitative indicators provide information in a non-numerical manner and have the advantage of being rich in nuanced and contextual descriptions which are amenable to easy or reliable quantification (e.g., direction of travel or perspective). While indicators traditionally are known as quantification tools, there are some aspects such as human experiences that also requires a qualitative approach (Bell and Morse, 2008).

2.2. Balanced assessment

The characteristics of an indicator set can further be explored from the perspective of the degree at which they enhance a balanced assessment. That is, how it enhances a holistic and comprehensive approach to measuring sustainability. Komeily and Srinivasan (2016) suggested five types of balance. One is the contextual balance which is how the indicators enhance the specificities and peculiarities of each region. That is, how does the indicator set addresses local issues, challenges, values, and aspirations of the context where it is going to be implemented for decision-making. Two is the procedural which focuses on the engagement of all relevant stakeholders in the development, revision, and subsequent uptake of the indicators. Three is the integrational which addresses the comprehensiveness of the indicator set in addressing holistically sustainability aspects. That is, consideration for sustainability in a manner that cuts across the relevant dimensions. Four is relational which focuses on indicators that address spatial and social relationships within the neighbourhood and between existing neighbourhoods in terms of infrastructures and amenities. Five is temporal which examines how the indicator set addresses the needs of the present and future generation in terms of intergenerational and intragenerational aspects. For example, the provision of infrastructure and amenities can help to meet current needs, while future needs can be assured by providing a strategy to maintain the infrastructure. The advantage with this typology is that it attempts to intervene in areas where there is contestation and are easily subject to bias, to avoid missing out on a crucial factor that may define sustainability. For example, it is easy to consider sustainability of a neighbourhood by referring to the present generation whilst not associating it to the future or past generations.

2.3. Aspects

The Sustainability Pathway (SP) as conceptualised by Valentin and Spangenberg (2000) could also serve as a framework to explore the characteristics of the indicator set of a NSAF. The SP helps to understand the inter-relationship between the dimensions of a sustainable neighbourhood. Dawodu et al. (2017) elaborating this model, suggested the following four aspects: One is Point Aspect where an indicator concentrates mainly on one dimension of sustainability. Two is Linear Aspect where an indicator could be indexed to establish a link between any two dimensions e.g., environmental and economic; economic and socio-cultural etc. Three is the Planar Aspect whereby an indicator cuts across the three dimensions. Four is summative or aggregate which links four dimensions together. However, since sustainable neighbourhood in this paper is discussed under three dimensions of environmental, economic, and socio-cultural dimensions, the characteristics of the indicators would be explored in terms of their Point, Linear, and Planar Aspects. The strength in this approach lies in the fact that it helps to better appreciate the multi-dimensional nature of an indicator in the decision-making process. That is, how the uptake of an indicator can deliver more than one dimension (e.g., both environmental and economic) of a sustainable neighbourhood.

2.4. Weight and ranking

Another perspective to explore the characteristics of the indicator set of a NSAF is by examining which of the indicators are highly ranked by the value of their weights. The weight of an indicator gives information about its relative importance to other indicators in contributing to a specific output or a desired state (Kondyli, 2010). This approach of characterising can be helpful in the following ways.

- Indications of rank and weight can be reliably used to prioritise the indicators in the decision-making process of a new neighbourhood.
- The weights and ranks can help create a platform for comparison with similar indicators in other NSAF. This would further help to know if such weight and ranking are only context-based or applicable more universally.

3. Methodology

This paper adopts the 23 sustainability indicators developed by Onyango and Adewumi (2021) following a survey with both residents and institutional stakeholders involved in neighbourhood delivery in metropolitan Lagos. The novelty of this paper is the idea of taking the indicators further (as illustrated in Fig. 2) by exploring how they can be characterised using the analytical framework from diverse literature for understanding indicators. This is the first of its kind in a developing country context. Adopting the critical realism philosophical position, it seeks to investigate the extent in which the context (i.e., underlying reality) of metropolitan Lagos would shape the characteristics of the indicators. This was conducted using the analytical framework for characterising indicators presented in Section 2. These include the typologies; balanced assessment; aspects; weighting and ranking of indicators. Similar approach for describing indicators was observed in Komeily and Srinivasan (2015); and Wangel et al. (2016).

As a background, the 23 SIs by Onyango and Adewumi (2021) were developed following these methodological steps:

- Identifying 25 generic indicators from wider literature and prominent reports including the: New Urban Agenda which provided eight key commitments that define a sustainable urban area (UN-Habitat, 2016); Sustainable Development Goal (SDG) 11 aimed at delivering sustainable communities, which adopts ten targets and twenty indicators; Africa Union Agenda 2063 proposed in 2014 with 7 key aspirations to enhance sustainable development; Nigerian National

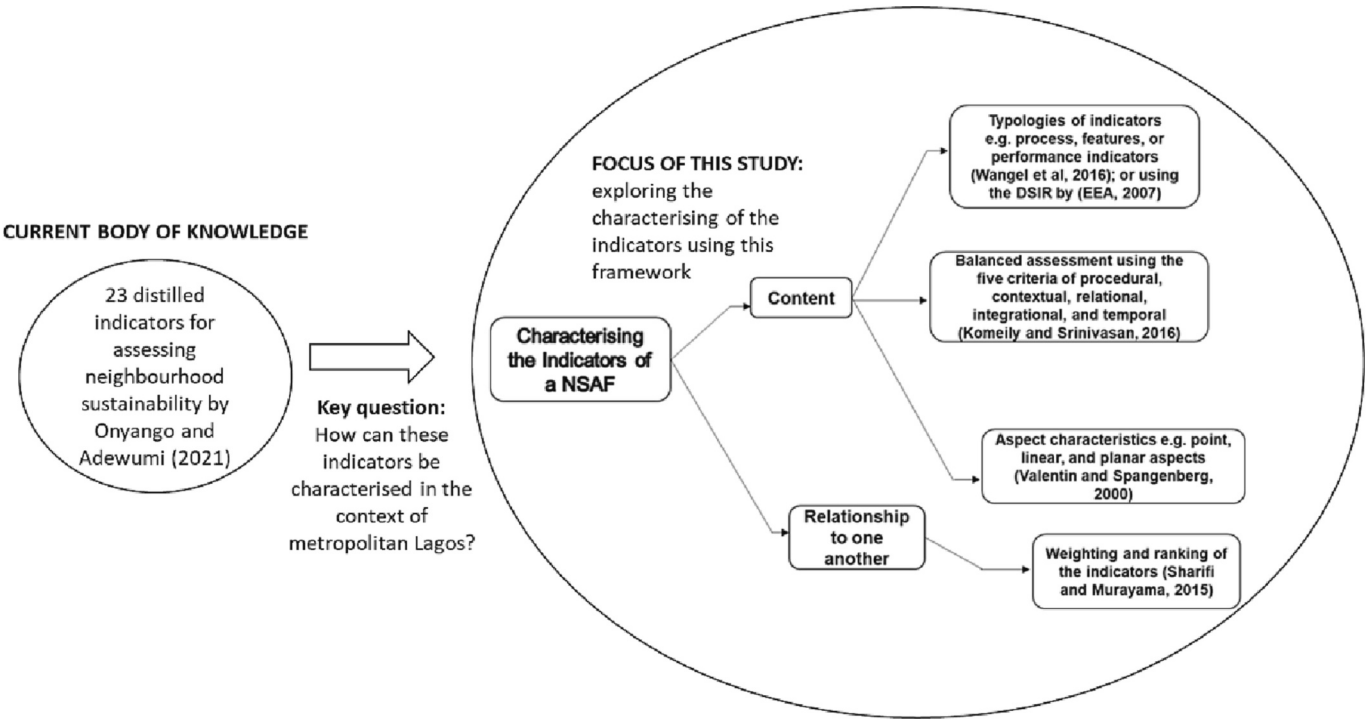

Fig. 2. Flowchart of a connection with existing body of knowledge and novelty of sudy.

Urban Development Policy which has five sustainability agenda as a vision for sustainable urban planning and design; and Lagos State Development Plan (2012–2025) which identifies four key issues of the plan (economic growth; infrastructure development; social development and security; and sustainable environment) (LASG, 2013).

- Distilling appropriate indicators for metropolitan Lagos from the generic indicators sought from residents and experts (including institutions) of urban neighbourhoods. The relevant institutions were approached and asked to nominate single experts to participate. Where more than one participant was required, the snowballing technique was used. With this, 21 questionnaires were retrieved from 27 administered to the institutional stakeholders. Also, 309 questionnaires were retrieved from 409 administered to residents selected from three neighbourhoods.
- In the questionnaires administered, participants were asked to consider the 25 indicators and delete, revise or add others as they felt necessary. Participants were asked to indicate their perceptions on the importance of an indicator for urban sustainability using a 5-point Likert scale (1- Not important and dispensable; 2- Little importance but contribute insignificantly; 3- Important but only contributes slightly; 4- Important and contributes significantly; 5- Highly important and indispensable).
- The result was analysed using Microsoft Excel function's descriptive statistics which helped to calculate the weighting average (WA) value showing the level of importance attached to an indicator by the stakeholders, the co-efficient of variation (CV) showing the extent of variability to the mean, and; the content validity ratio (CVR) which helps to determine the degree to which the items on the measurement instrument represent the entire content domain: providing a numeric value indicating the degree of validity determined from expert's ratings.
- The AHP analysis was done using the BPMSG (Business Performance Management Singapore) AHP Online system, to elicit relative weights to the indicators, acting as a support tool for decision-making on the indicators.
- In all 23 indicators were distilled and ranked as presented in Tables 1 and 2

Details on the content of questionnaire and sampling techniques are reported in Onyango and Adewumi (2021).

4. Results and findings

This section presents the characteristics of the indicator set as

Table 1
The sustainability index showing the aggregate values of the indicator.

Dimensions	Indicators	Weight	Rank
Environmental (0.379)	Environmental Impact Assessment	0.064	4
	Efficient use of resources	0.060	5
	Pollution control	0.051	6
	Waste collection and management	0.049	7
	Strategy to maintain infrastructure	0.044	8
	Effective land usage	0.040	9
	Use of renewable energy	0.037	10
	Greenfield preservation	0.034	11
Social-cultural (0.310)	Access to potable water	0.036	12
	Availability of infrastructure and amenities	0.035	13
	Quality of construction material	0.034	14
	Security	0.031	15
	Nearness to basic amenities	0.029	16
	Use of locally made material	0.025	17
	Outdoor spaces	0.022	18
	Diverse mobility option	0.022	18
	Inclusive design	0.020	20
	Use of public arts and landscape elements (Aesthetics)	0.019	21
	Good pedestrian lane	0.019	21
	Neighbourhood squares	0.018	23
Economic (0.311)	Cost of construction, operation, & maintenance	0.124	1
	Home affordability	0.100	2
	Support for home-based business	0.087	3

Source: Adapted after Onyango and Adewumi (2021).

Table 2
The assessment criteria for the headline indicators.

Headline indicators	Assessment criteria
Social amenities and infrastructure e.g. clinics, schools etc	- Evidence of survey of existing neighbourhoods to know which facilities will be required for the proposed neighbourhood - Site plan of neighbourhood showing amenities based on the survey - Infrastructural plan of the proposed neighbourhood - A detailed spatial analysis of the amenities to be provided showing the capacity
Access to potable water	- Each dwelling connected to a water source - A water treatment plan for the proposed neighbourhood
Diverse mobility options	- A mobility plan showing the layout and design of streets which promotes sustainable modes of transportation such as walking and cycling - A transit-oriented development - Connection to existing road and routes in the neighbourhood area
Nearness to social amenities and infrastructure	- A considerate travel time to access neighbourhood amenities - Site plan showing that amenities are within walking distance from dwelling units through safe pedestrian routes.
Strategy to maintain infrastructure	- A detailed management plan for facilities such as road, drainage, waste treatment plan, and for amenities like schools, health centres, and other public buildings
Inclusive planning and design	- Evidence of consultation with necessary stakeholders (e.g. local authority; residents or community representative of an existing neighbourhood) in the design of the neighbourhood - Design consideration for the aged, young, and physically-challenged
Friendly pedestrian lane	- Design of streets that are secured by natural surveillance - Design of streets that are appealing e.g. using landscape elements - Use of pedestrian crossing to ensure the safety of users - A clear and appropriate sign for vehicular, cycling, and pedestrian routes
Quality of construction material	- A specification note showing the quality of material to be used for construction to ensure that it meets the required standard
Pollution control strategy	Noise pollution Noise impact assessment showing: - The sources of noise to the site and how they can be addressed - Means to reduce on-site noise in order not to affect noise-sensitive areas near the site e.g. hospitals, schools, places of worship etc. - Design decisions to minimise noise e.g. use of landscape elements; acoustic in congregational buildings - Policies to reduce noise from congregational buildings, and music vendors - A commitment to achieving a reasonable rating noise level - Site plan showing expected noise areas (on and off-site) and mechanisms to address it. - Plan to mitigate potential vehicle noise disturbance through road layout, building orientation and creation of buffer zones For water pollution: - A detailed drainage plan for the proposed neighbourhood - Measures to avoid pollution of existing watercourse during construction and operation of the neighbourhood (e.g. treatment of run-offs from hard surfaces; and water pollutants)
Environmental Impact Assessment	A detailed EIA report
Waste collection and management	Waste management strategy showing amongst others: - An estimate of the amount of excavation waste (soil and stones) that would be generated and how the waste will be maximally reused during construction - An estimate of other construction waste to be recycled - Strategy for household waste collection e.g. method and frequency - Strategy for household waste management e.g. estimate of household wastes to be recycled
Use of renewable energy systems	Consideration for the possible use of renewable sources for power generation e.g. solar or wind
Provision of outdoor spaces	- Site plan of neighbourhood showing spaces for outdoor activities located close to each dwelling, block or streets
Security of lives and properties	- Evidence of how the security of the neighbourhood is considered and addressed through design - Security plan and strategies for the neighbourhood when in operation
Neighbourhood square	Site plan of proposed neighbourhood showing a centrally located neighbourhood square
Support for a home-based business	- Economy study of how the proposed neighbourhood will contribute to the surrounding economy - Number of jobs that will be created locally during the neighbourhood construction - How proposed facilities and infrastructure such as transport, communication, and power amongst others will enhance home-based business in the neighbourhood.
Cost of construction, operation, and maintenance	An estimated breakdown of the total cost of construction; operation; and maintenance of the neighbourhood including the infrastructure and amenities of the proposed neighbourhood
Home affordability	- Integrated distribution of various dwelling types to accommodate diverse income groups and users with no segregation - Friendly tenure housing systems e.g. rent, mortgage, or outright purchase
Efficient use of resources	Water efficiency: an estimate of overall water consumption target for construction and daily use in a household Actions to minimise or not exceed consumption target e.g. landscape design options, water metering, and rainwater collection amongst others Energy efficiency: An energy strategy plan showing: - An estimate of the total energy demand of the neighbourhood - Design measures to reduce energy demand e.g. site layout and orientation, shading devices and solar orientation, daylighting and natural ventilation - Possibility of importing or exporting energy to existing or new neighbourhoods
Greenfield preservation	- Possibility of re-use of existing land to preserve greenfield areas - Site plan of proposed neighbourhood showing land use analysis in terms of buildable areas and green areas preserved
Effective land usage	- A detailed site plan showing how the site has been maximised and percentage of land for circulation - Design strategies to ensure effective land usage e.g. densification

(*continued on next page*)

Table 2 (*continued*)

Headline indicators	Assessment criteria
Active frontages for commercial activities	- Provision of sales outlets attached to building units to encourage commercial activities
Use of locally made material	- Percentage of construction that will be sourced locally
Aesthetics (public arts and landscape etc)	- Neighbourhood design and elements such as colour, architectural style, building form to reflect the local context - Continuity of neighbourhood with existing development - Use of landscape elements for beautification
Home garden for food	- Site plan of neighbourhood showing part of dwelling unit earmarked for food production

Source: Adapted after Onyango and Adewumi (2021).

summarised in Fig. 3 using the various approaches that the indicators can be described as previously reviewed in Section 2.

4.1. Balanced assessment

This assesses the characteristics of the indicator set using the following five criteria of contextual, procedural, integrational, relational, and temporal.

In terms of contextual balance which describes the indicator set from the perspective of consideration for contextual issues, the indicator set reflects consideration for liveability which seems to be a pressing need considering the state of neighbourhoods in metropolitan Lagos. Out of the 23 indicators, the uptake of 5 could contribute directly to the delivery of liveable neighbourhoods. These are: access to potable water; availability of infrastructure and amenities; security; outdoor spaces; and good pedestrian lane.

Also, the indicator set is characterised with procedural balance because there was an engagement with the relevant stakeholders in its development and validation for use. The indicator set as documented by Onyango and Adewumi (2021) was a product of the responses from both institutional stakeholders and residents in selected neighbourhood in metropolitan Lagos. This was important to ensure that values, aspirations, and needs of all stakeholders are captured. This is a distinguishing characteristic when compared with the development process of existing NSAFs which were developed mainly by selected experts with what appears to be no appreciable input from the public. The weighing and ranking of the indicator set show an integrational balance and distribution across the dimensions of sustainability. Environmental was allocated 37.95%; Economic 31.1%; and Socio-cultural 31.0%. It indicates that the indicator set by its formulation enhances a comprehensive and holistic consideration of sustainability.

The relational characteristics of the indicator set can be explained on two fronts. One, within the neighbourhood, the uptake of the "social amenities and infrastructure" indicator, requires a detailed spatial analysis of the amenities to be provided with information of the capacity. Also, "diverse mobility options" requires a mobility plan showing the layout and design of streets which promotes sustainable modes of transportation. Two, the indicator set also addresses the relationship with and consideration for existing neighbourhoods. The "social amenities and infrastructure" indicator requires evidence of a survey of existing neighbourhoods to identify which facilities would be required

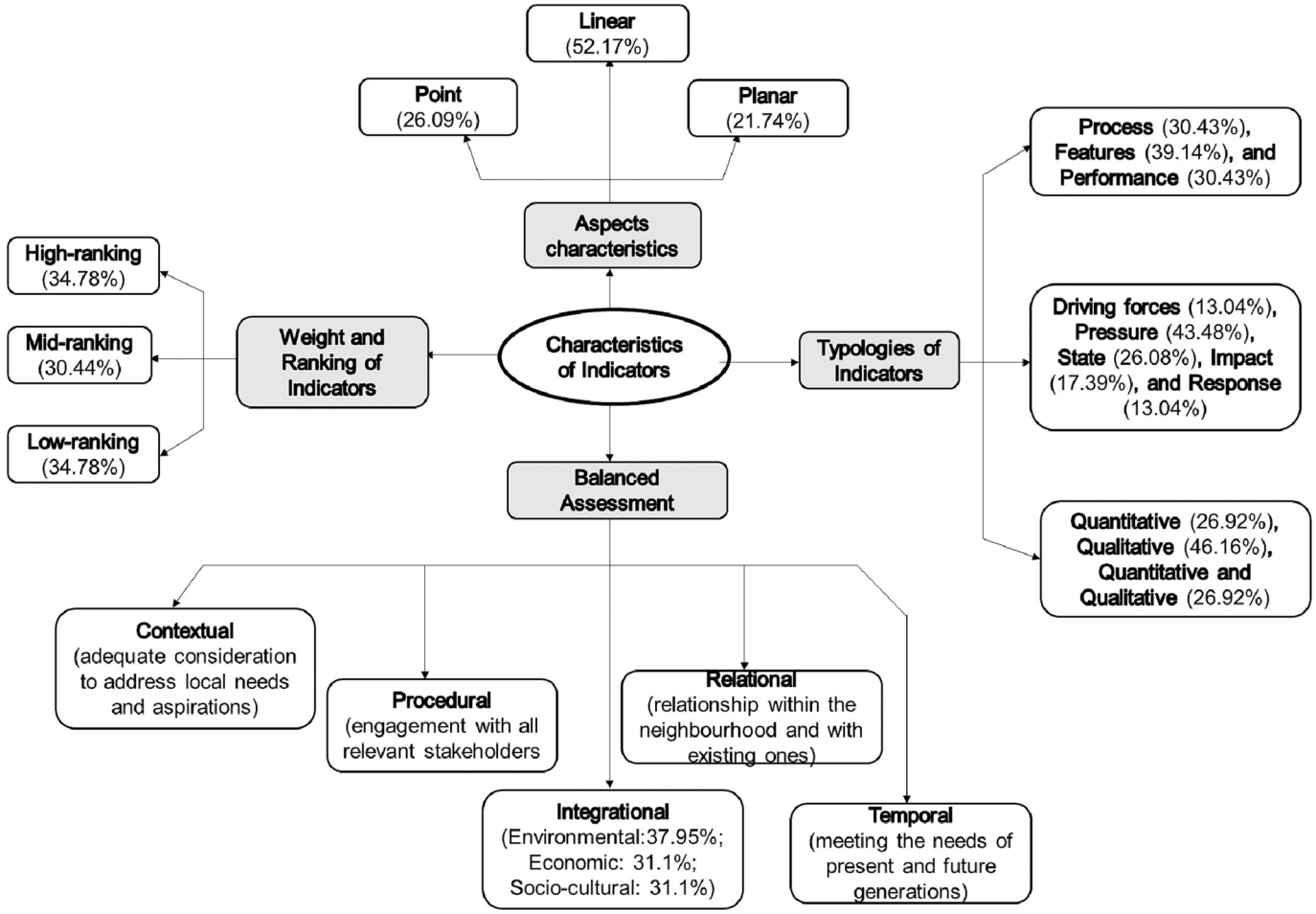

Fig. 3. Characteristics of the indicators for assessing sustainable neighbourhood in metropolitan Lagos.

for the proposed neighbourhood. Besides, one of the assessment criteria for "inclusive planning and design" is the evidence of consultation with necessary stakeholders (e.g. local authorities; residents or community representatives of the existing neighbourhood) in the planning and conceptual stage of the neighbourhood.

For temporal balance which addresses intergenerational and intra-generational equity (that is, consideration for present and future needs), the "access to potable water" indicator can have assessment criteria such as 'water treatment plan' which would ensure that while the needs of the current residents are met, the opportunity for future residents to meet their needs is not compromised. Also, the targets as one of the criteria for "efficient use of resources" could include 'evidence of actions to minimise and not to exceed consumption' as assessment criteria to ensure that the needs of future generations are met. This characteristic helps to ensure the sustenance of the neighbourhood as progress can also be monitored intermittently.

Overall, in terms of a balanced assessment, the indicator set addresses contextual issues that are peculiar to metropolitan Lagos. This is evident with such indicators like access to potable water, good pedestrian lane, and outdoor spaces. Furthermore, the indicator set was also comprehensive in taking a holistic view of sustainability issues thereby attaining integrational balance which would be useful at the decision-making process of a new neighbourhood. Also, it is noteworthy that the indicator set was characterised with consideration for: (i) relationship with the existing neighbourhood; and (ii) needs of both present and future generations.

4.2. Typologies

The characteristics of the indicators were explored by mapping the indicators on the DPSIR framework (Fig. 4).

3 (13.04%) of the indicator set can be described as 'driving forces indicators (D)'. These are to meet the demand for: more eco-friendly means of movement; good living conditions; and to address the current housing deficit in metropolitan Lagos respectively. 10 (43.48%) can be described as 'pressure indicators (P)'. 6 (26.08%) of the indicator set can be described as 'state indicators (S)' to ensure that the state and quality of the environment are not compromised in the decision-making process of a new neighbourhood. For instance, an efficient waste collection and management strategy would contribute significantly to the state of the neighbourhood by ensuring a clean and hygienic neighbourhood with no threat to human health. 4 (17.39%) of the indicator set can be described as 'impact indicators (I)'. For instance, the provision of outdoor spaces and a friendly pedestrian lane is crucial to enhance healthy living. Also, the environmental impact assessment is to minimise the likely impact of the new (or proposed) development on the quality of the environment. However, 3 (13.04%) of the indicator set earlier discussed can still further be described as 'response indicators (R)'. These are environmental impact assessment; waste collection and management; and strategy to maintain infrastructure.

In addition to the DPSIR, the characteristics of the indicator set were further explored using the types of indicators in NSAF presented in Wangel et al. (2016). See Fig. 5.

Out of the 23 indicators, 7 (30.43%) are process indicators which represent specific actions, activities, or considerations that could contribute to the delivery of sustainable neighbourhoods. It is noteworthy that the implementation of any of these indicators is not the final product but a phase to lead to the desired outcome. 9 (39.13%) are features indicators which are certain components, or technology that could enhance the delivery of a sustainable neighbourhood. 7 (30.44%) are performance indicators which captures the final output of implementing both process and features indicators.

However, some of these indicators by their assessment criteria can have overlap across the three classifications. For example, "inclusive planning and design" identified as a feature indicator can also be a process indicator because it also involves engagement with key and relevant stakeholders in the design process. Also, diverse mobility option can also be explained as a feature indicator in addition to relaying how a neighbourhood performs in terms of its transportation options.

Overall, the indicator typologies help to understand the linkages in the sustainability index and their interconnected roles in contributing to the planning and delivering of a sustainable neighbourhood. This is because, a sustainable neighbourhood cannot be delivered by feature indicators only because process and performance indicators also play crucial roles in contributing to the sustainability of the neighbourhood.

The characteristics of the indicators as either process, features, or performance indicators help to understand the phase of development that the indicators are to be implemented, and where relevant

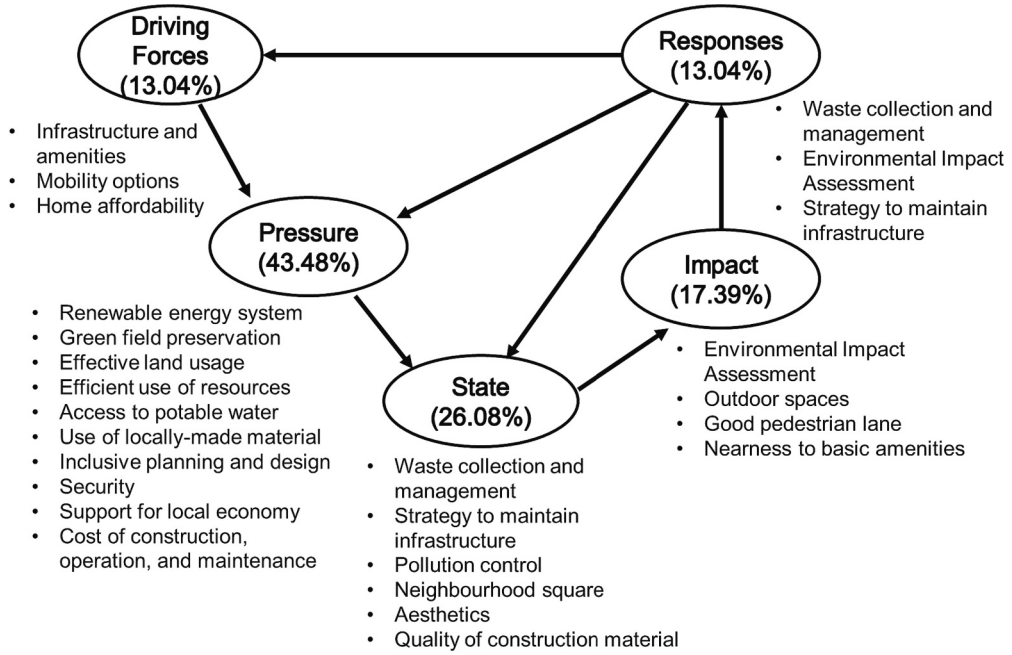

Fig. 4. Description of the indicators using the DPSIR framework.

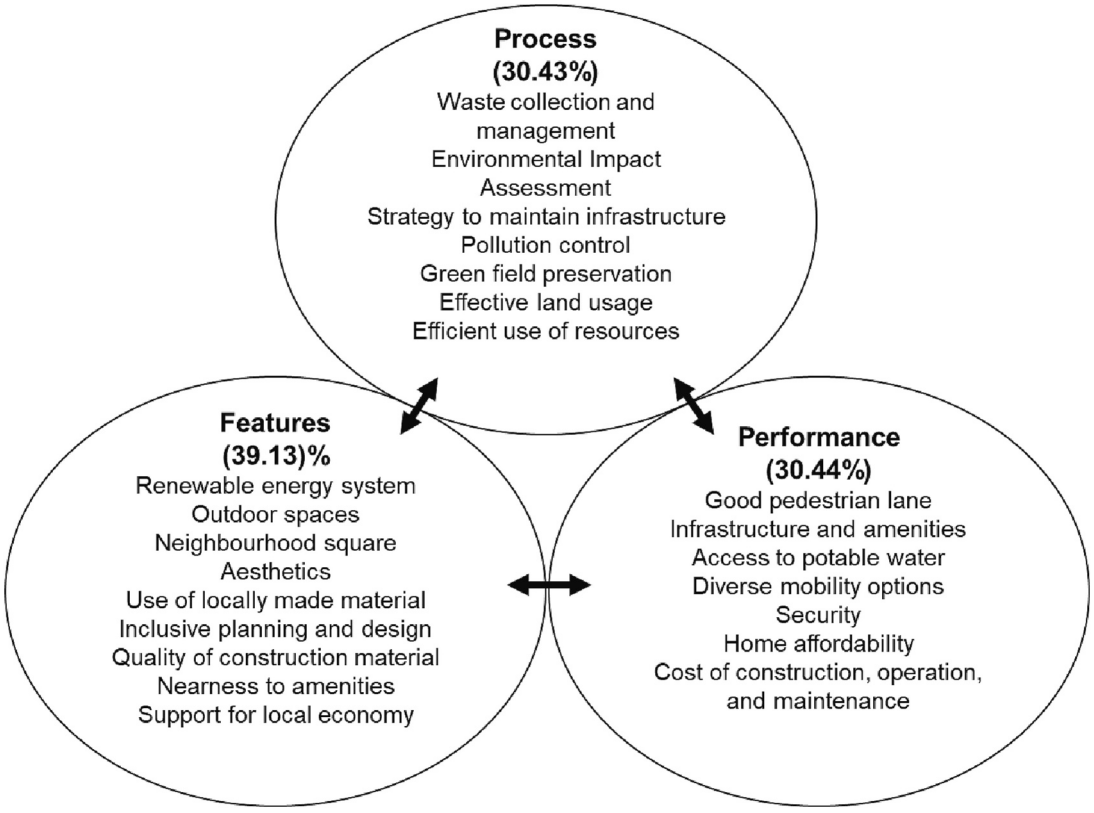

Fig. 5. Description of the indicators using indicator types of an assessment framework.

stakeholders are to be engaged. For example, "strategy to maintain infrastructure" as a process indicator is one of the key procedures which needs to be considered at the various phases of the new development. In addition, it can be observed that the indicators were fairly distributed across the three types.

4.3. Ranking

Out of the 23 indicators, high-ranking indicators with a weight greater than 0.040 are: Cost of construction, operation, and maintenance (0.124); Home affordability (0.100); Support for home-based business (0.087); Environmental Impact Assessment (0.064); Efficient use of resources (0.60); Pollution control (0.051); Waste collection and management (0.049); and Strategy to maintain infrastructure (0.044).

The mid-ranking indicators with weight equal and less than 0.040 but greater than 0.029 are: Effective land usage (0.040); Use of renewable energy (0.037); Greenfield preservation (0.034); Access to potable water (0.036); Availability of infrastructure and amenities (0.035); Quality of construction material (0.034); and Security (0.031).

The low-ranking indicators with weight equal and less than 0.029 are: Nearness to basic amenities (0.029); Use of locally made material (0.025); Outdoor spaces (0.022); Diverse mobility option (0.022); Inclusive design (0.020); Use of public arts and landscape elements (0.019); Good pedestrian lane (0.019); and Neighbourhood Squares (0.018).

Each of the high-ranking and low-ranking indicators represents 34.78% of the indicator set while mid-ranking represents 30.44%.

4.4. Aspect

The aspect characteristics of the indicator were further explored as illustrated in Fig. 6.

6 (26.09%) of the indicators can be described under the point aspect (that is, belonging to one dimension). These are pollution control (Env); greenfield preservation (Env); access to potable water (Sc); security (Sc); inclusive planning and design (Sc); and good pedestrian lane (Sc).

12 (52.18%) of the indicators can be described under the linear aspect (that is, belonging to two dimensions). These are efficient use of resources (Env and Ec); waste collection and management (Env and Sc); effective land usage (Env and Ec); quality of construction material (Sc and Env); nearness to basic amenities (Sc and Env); outdoor spaces (Sc and Env); diverse mobility options (Sc and Env); use of public arts and landscape elements (Sc and Env); neighbourhood squares (Sc and Env); cost of construction of operation, and maintenance (Ec and Sc); home affordability (Sc and Ec); and support for home-based business (Sc and Ec).

5 (21.73%) of the indicators can be discussed under the three dimensions (Sc, Env, and Ec) in what is known as the planar aspect. These are environmental impact assessment; a strategy to maintain infrastructure; availability of infrastructure and amenities; use of locally made materials; use of renewable energy.

Overall, the characteristics of the indicator set shows that environment focused indicators (Env) account for 8.69% of the indicator set; 17.39% for Social (Sc); and 0% for Economic focused indicators Environmental and economic (Env-Ec) indicators account for 8.69%; Environmental and social- 30.43%; Social and economic- 13.05%; and Environmental, Economic, and Social (Env-Ec-Sc)- 21.75% (Fig. 7).

Table 3 summarises the characteristics of the indicator which provides a detailed information about the character of an indicator in the indicator set. For example, it shows that 'outdoor spaces' is a 'low-ranking', 'response', and 'feature' indicator with a 'linear aspect characteristics' (Env-Sc). which can be measured in both 'quantitative and qualitative terms'.

5. Discussion

This section discusses the three emerging issues from the characteristics of the indicator set as shaped by the context of metropolitan

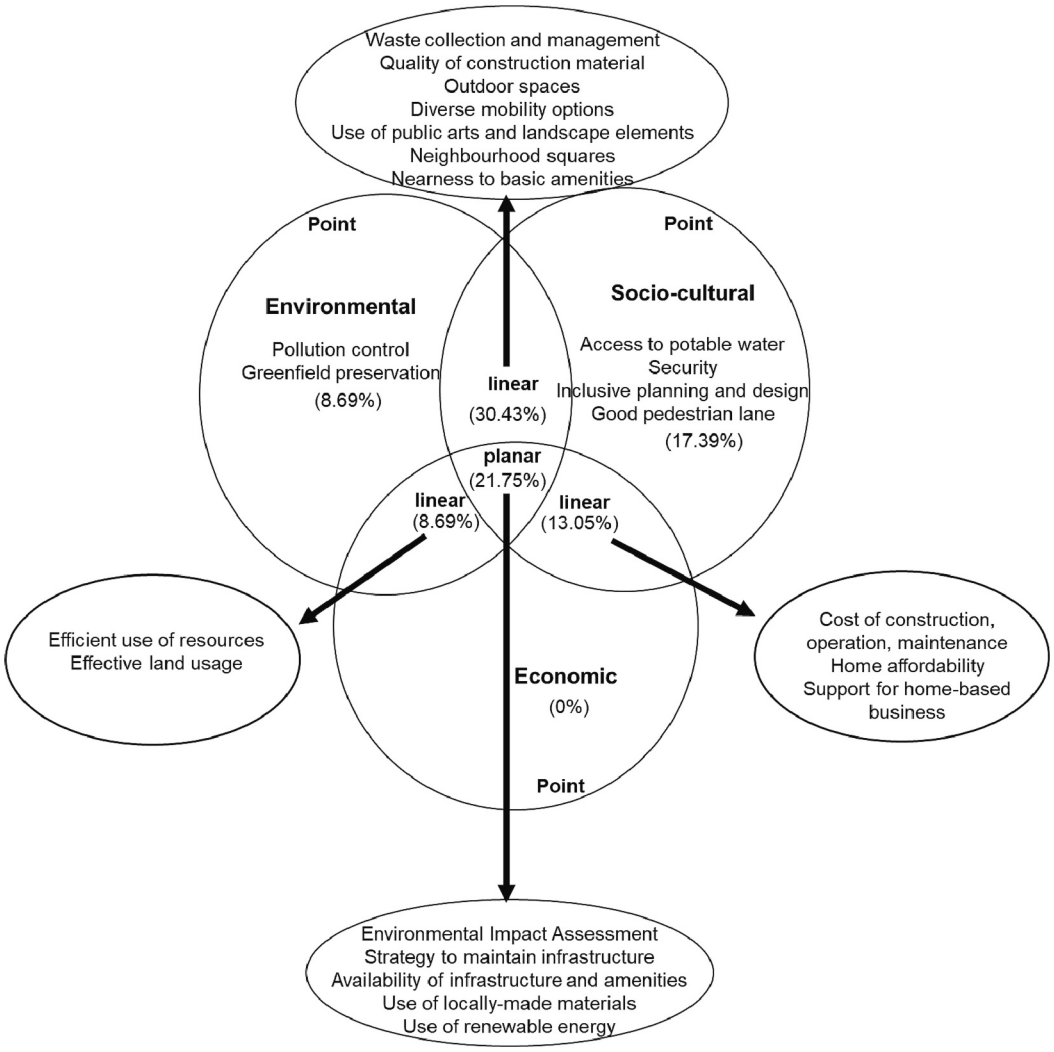

Fig. 6. The aspect characteristics of the indicator set.

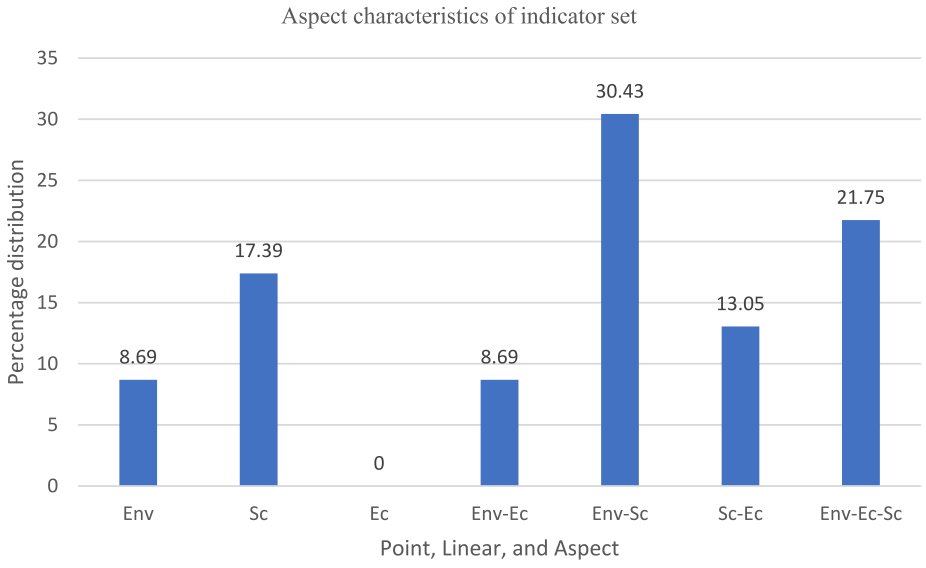

Fig. 7. Aspect characteristics of the indicator set.

Table 3
Characteristics of the indicator set.

Indicators	Typologies								Aspects							Ranking		
	D	P	S	I	R	Perf.	Feat.	Proc.	Env	Sc	Ec	Env-Ec	Env-Sc	Sc-Ec	Ec-En-Sc	High	Mid	Low
Environmental Impact Assessment				●	●			●							●	●		
Efficient use of resources		●						●				●				●		
Pollution control			●					●	●							●		
Waste collection and management			●		●			●					●			●		
Strategy to maintain infrastructure			●		●			●							●	●		
Effective land usage		●						●				●					●	
Use of renewable energy		●					●				●				●		●	
Greenfield preservation		●						●	●								●	
Access to potable water		●				●				●							●	
Infrastructure and amenities	●					●									●		●	
Quality of construction material			●				●						●				●	
Security		●				●				●							●	
Nearness to basic amenities				●			●						●					●
Use of locally made material		●					●								●			●
Outdoor spaces				●			●						●					●
Diverse mobility option	●					●							●					●
Inclusive planning and design		●					●			●								●
Aesthetics			●				●						●					●
Good pedestrian lane				●		●				●								●
Neighbourhood squares			●				●						●					●
Cost of construction operation & maintenance		●				●								●		●		
Home affordability	●					●								●		●		
Support for home-based business		●					●							●		●		

Lagos and the implications in the visioning for a sustainable neighbourhood. One, the comprehensiveness of the indicator set in terms of a holistic approach to addressing sustainability. Two, the peculiarity of the ranking and priority levels of the indicator when compared to other NSAFs. Three, the multidimensional character of the indicators in addressing more than one dimensions and aspects of sustainability.

5.1. Integrational balance

The integrational balance characteristic of the indicator set as demonstrated by the distribution of the weight of the sustainability dimensions (Environmental: 37.95%; Economic: 31.1%; and Socio-cultural: 31.0%) is noteworthy. This aligns with the Bellagio STAMP which advocates for a balanced consideration of sustainability issues (Pinter et al., 2012). This implies that the indicator set by its weighing system takes the position of 'strong sustainability', that social capital and natural capital are not exchangeable by ensuring that environmental aspects are not compromised (Wangel et al., 2016). For example, using the sustainability index in the decision-making process of a new neighbourhood can result in three connected scenarios:

- Satisfying the assessment criteria of all the environmental indicators will result to a score of 0.379 on a scale of 0 to 1 (that is, 37.9%) which is relatively low.
- Consideration for only the assessment criteria in both environmental and economic dimensions would result in a score of 0.690 (that is, 69%) which is not good.
- To achieve a score of 0.80 (that is 80%), it will require adequate consideration across the three dimensions in the sustainability index. As result, the uptake of the indicator set would perhaps leads to the delivery of neighbourhood in metropolitan Lagos which encompasses sustainability aspects. That is, one which is environmental-friendly, socially responsive, and enhance economic prosperity which is currently lacking in metropolitan Lagos.

5.2. Role of context

The high-ranking characteristic of some of the indicators as shaped by the context of metropolitan Lagos is discussed in this section with reference to some existing neighbourhood sustainability assessment frameworks (NSAFs). These are BREEAM-UK (BRE, 2017); LEED-US (USGBC, 2018); PCRS-UAE (AUPC, 2010); and Green STAR-Australia (GBCA, 2012). The 'cost of construction, operation, and maintenance' with a weight of 12.4% reflects its urgency in the light of metropolitan Lagos. Several amenities and infrastructures such as roads and drainages in some neighbourhoods have been left abandoned due to the huge cost that would be needed for their maintenance. Most often, this condition results in environmental challenges such as flood and erosion in cases where drainages have become dilapidated. This supports Ijasan and Ogunro (2014); and Ibem et al. (2015) who advocated for affordable maintenance system for urban neighbourhoods. It calls for a neighbourhood that is affordable to maintain in terms of cost, technology, and manpower due to the increasing scarcity of resources. Similarly, this indicator was also given consideration in the Pearl Community Rating System (PCRS) which allocated 2.5% of its total weighing to life cycle costing (IDP-1).

The ranking of 'home affordability' with a weight of 10% provides support for Ugochukwu and Chioma (2015), and Olotuah and Aiyetan (2006) that emphasise affordability as crucial in delivering sustainable neighbourhood. This is because access to affordable homes has continued to remain a challenge in metropolitan Lagos (Mbali and Okoli, 2002; and Hamiduddin, 2015). This also provides support for Ocholi et al. (2015) and Raschke (2016) who argued for the need to design appropriate platforms and incentives to facilitate homeownership for various income groups. For example, the Lagos State Government needs to intensify and ensure that the rent-to-own policy for low-income earners is sustained irrespective of change in government. In comparison with existing NSAFs which brings out the peculiar character of the indicator, home affordability does not seem to be a pressing challenge because BREEAM communities; PCRS; and Green STAR communities allocated 2.7%; 1.28%; and 4% of their weighing system to home affordability respectively, except for LEED-ND V4 which allocated 7% of its total weight to 'housing types and affordability'.

Furthermore, the characteristic of 'support for home-based business' as a high-ranking indicator with a weight of 8.7% reflects the urgency for its uptake in a megacity like metropolitan Lagos with a growing population. This finding appears to agree with Gibberd (2015), Ilesanmi (2010b), Ibem and Amole (2010) who emphasised the role of home-

based business in ensuring sustainable economic growth at the neighbourhood scale. This would, for example, enhance the ability to work from home reducing the huge road traffic congestion characterised with air pollution at the city corridor while enhancing productivity. This also has the potential to create job opportunities for residents, while enhancing togetherness through local interaction.

Environmental Impact Assessment (EIA) which had a weight of 6.4% is crucial for a growing urban population as that of metropolitan Lagos when new developments need to be assessed to ensure that they pose no threat to the environment and how certain mitigation measures can be taken. This importance has been stressed by several scholars have canvassed for a review of the EIA in Nigeria due to some identified shortcomings affecting the realisation of its full potential in metropolitan Lagos (Ogunba, 2004). In comparison with existing NSAFs, the EIA is compulsory for development to be submitted for the BREEAM Communities assessment process. Besides, 3.2% of its total weighing is allocated to transport assessment, and 1.8% allocated to flood risk assessment (BRE, 2012). What is like the EIA was also noticed in the PCRS where the natural system assessment (NS-R1); natural system protection (NS-R2); and natural systems design and management strategy (NS-R3) are made mandatory for a proposed development (AUPC, 2010).

The high-ranking of 'resource efficiency' with attracts a weight of 6% agrees with Ibem and Aduwo (2015) who advocated for resource efficiency in planning public housing neighbourhoods in metropolitan Lagos. The uptake would ensure that the ability of future generations to meet their needs is not compromised thereby helping to achieve intergenerational equity. The ranking of the indicator seems to agree with LEED-ND V4 used in the United States which also had a higher weighing for resource efficiency with an allocation of 11% (indoor water use reduction- 1%; outdoor water use reduction- 2%; building re-use-1%; rainwater management- 4%; infrastructure energy efficiency- 1%; wastewater management- 1%). This further aligns with the Pearl Community Rating System (PCRS) used in Abu Dhabi that considers resource efficiency, especially on water and energy allocating about 50% of its total weighing to this (AUPC, 2010). This perhaps is because of its geographical location, where water is a scarce commodity. However, the indicator has a lower weight of 2.7% in BREEAM Communities.

Pollution control which attracts a weight of 5.1% reflects the picture in metropolitan Lagos where noise, air, and water pollution has been a major source of concern in its neighbourhoods (Komolafe et al., 2014). This agrees with the BREEAM communities which for instance allocated 3.8% of its total weighing to indicators addressing pollution (SE 04 noise pollution-1.8%; SE 16 light pollution- 0.9%; and SE 03 water pollution-1.1%). PCRS has no indicator for pollution control while LEED-ND V4 and Green star communities allocated 0.9% and 1% only for light pollution reduction respectively.

The ranking of 'waste collection and management' with a weight of 4.9% reflects its urgency to enhance sustainability at the neighbourhood level and at a larger scale in a growing urban population like that of metropolitan Lagos where waste management has been a challenge. In recent times, there has been a decline in environmental quality in metropolitan Lagos due to inadequate waste collection and management strategy (Ozabor and Henrietta, 2016). The uptake of this indicator would, therefore, serve as a preventive measure to outbreak of diseases associated with poor waste management (Oghenekohwo and Akporehwe, 2015) whilst also preventing the emission of greenhouse gasses and subsequently ozone layer depletion, and pollution associated with indiscriminate refuse dumping (Komolafe et al., 2014). In addition, the recycling of household wastes perhaps may reduce the high demand for raw materials in the urban space at large (Jiboye, 2010). In relation to other contexts, Green Star communities used in Australia allocated 2% to encourage projects that reduce the environmental impacts of waste (GBCA, 2012). Waste management in BREEAM Communities, was discussed under resource efficiency (RE 06) allocating 2.7% of total weighing. Pearl Community Rating System made provisions for construction (SM-5), operational (SM-6), organic (SM-7), and hazardous wastes (SM-8) accounting for 4.4% of its total weighing (AUPC, 2010). LEED-ND has two credits for waste management which are: recycled and reused infrastructure and solid waste management both accounting for 1.81% (USBGC, 2018).

Lastly is 'strategy to maintain infrastructure' which attracted a weight of 4.4%. This has not been given much consideration in term of the policy and regulatory frameworks in metropolitan Lagos and other Sub Sahara Africa cities. This is important because it involves a facility management plan to enhance the continuous functioning of infrastructure and amenities (Ilesanmi, 2010a, 2010b). This indicator received a higher ranking when compared to existing NSAFs. For example, it was discussed under 'environmental management' in Green Star Communities with a weight of 2%. In BREEAM Communities, strategy to maintain infrastructure was noted under community engagement of facilities (GO 04) with a weight of 1.2% of its total weight (BRE, 2012). However, there was no consideration for infrastructure maintenance in LEED-ND and PCRS.

The high-ranking characteristics of the indicators as influenced by the context of metropolitan Lagos, and in comparison, with existing NSAFs further establishes the peculiarity of the indicators that could enhance the delivery of sustainable neighbourhood in metropolitan Lagos. For example, the following preferences were specific to findings from metropolitan Lagos: waste collection and management has priority over renewable energy; security of lives and properties has priority over diverse mobility options, and nearness to basic amenities has priority over diverse mobility options. However, findings from this study show some similarities with some NSAFs in terms of preference when the indicators are compared to one another which is noteworthy. In agreement with BREEAM Communities: waste collection and management has priority over strategy to maintain infrastructure; strategy to control pollution has priority over waste management; environmental impact assessment has priority over efficient use of resources, and effective land usage; social amenities and infrastructure have priority over security of lives and properties. The indicator set agrees with Pearl Community Rating System (PCRS) that: cost of construction, operation, and maintenance has priority over home affordability; social amenities and infrastructure have priority over security of lives and properties. It supports Green Star Communities that: home affordability has priority over support for home-based business; nearness to basic amenities has priority over diverse mobility options; social amenities and infrastructure have priority over security of lives and properties. Lastly, it agrees with LEED-ND that: use of renewable energy has priority over greenfield preservation, and social amenities and infrastructure have priority over security of lives and properties.

This discussion on the role of context in shaping the ranking of the indicators suggests that their uptake can help address the current sustainability challenges at the neighbourhood level in metropolitan Lagos ensuring that new neighbourhoods are not in themselves unsustainable, but instead contribute to the overall sustainability of metropolitan Lagos. The uptake of these indicators in another context outside metropolitan Lagos without establishing their characteristics in terms of their ranking and priorities may not achieve the desired result.

5.3. *Interrelationship and interdependence*

The aspect characteristics of the indicator set suggests the interrelationship in addressing the various sustainability aspects and dimensions. For example, there is no single indicator that addresses economic issues without the link to either environmental or sociocultural concerns. 17 out of the 23 indicators representing 73.19% address more than one dimension of sustainability. For example, the cost of construction, operation, and maintenance which has the highest weight would not only contribute to economic aspects but also sociocultural. The indicators are inherently not a single issue or single dimension in nature. The interrelationship characteristic of the indicator

Table 4
Comparison of the distribution of indicators in BREEAM Communities and CASBEE.

Indicators	Env	Sc	Ec	Env-Ec	Env- Sc	Sc-Ec	Ec-En-Sc
Proposed Indicator set	8.69%	17.39%	0	8.69%	30.43%	13.05%	21.75%
BREEAM	20%	13%	0	0	29%	25%	10%
CASBEE	26%	9%	6%	6%	26%	13%	2%

set has some similarities with existing NSAFs as presented in Table 4 using Dawodu et al. (2017) dimensional analysis approach. Environmentally and socially (Env-Sc) focused indicators have the highest distribution of indicators across the frameworks. However, the percentage distribution of the indicators with planar characteristics (that is, addressing the three dimensions) is higher in the proposed indicator set when compared to BREEAM Communities (10%) and CASBEE (2%). This suggests that the interrelationship of the indicator set can help to enhance and promote the overall sustainability of new neighbourhoods in metropolitan Lagos.

5.4. Role of critical realism

Critical realism adopted for this study was useful in interpreting and obtaining a deeper understanding of the findings. It helps to suggest reasons for the findings, examining it from the perspective of the present reality in metropolitan Lagos. The characteristics of the indicator set of a NSAF that emerge in this paper can be explained on the following basis.

- The contextual balance characteristics of the indicator set can be said to be influenced by the growing call for neighbourhoods that promote liveability in metropolitan Lagos as espoused by Ibem et al. (2015). This was also evident in the stakeholders' understanding of a sustainable neighbourhood as responses focused majorly on enhancing the quality of living.
- Whilst the socio-cultural dimension under which there is liveability accounts for 12 of the 23 indicators, the result from the stakeholders' preferences through which the indicators were weighted and ranked ensures an intergenerational balance of the indicator set. This was evident in the distribution of the weight across the three main dimensions of sustainability adopted for the study (environmental: 37.95%; economic: 31.1%; and socio-cultural: 31.0%). From the critical realism lens, this may be attributed to the existing reality in metropolitan Lagos, that while some neighbourhoods are affordable that promotes local economy; there exist huge environmental challenges in terms of waste management, pollution control, and greenfield preservation amongst others. In addition to this, the aspect characteristics of the indicator set where at least 17 out of the 23 indicators can be explained under more than one dimension of a sustainable neighbourhood can also be explained in this light. Explaining from the critical realism philosophical position, the high concentration of pressure indicators from the DPSIR framework points to the growing population of Lagos State which has led to the increased demand and consumption of available resources- a scenario which may perhaps be different in a city of lesser population. This is because, the more the population, the higher the consumption rate of resources reason for the campaign to ensure sustained urban population growth. For example, there is a demand for energy, land, security, participatory planning and design to diverse population mix, and green fields amongst others. Four, the characteristics of the indicators as either process, features, or performance indicators is a reflection that in metropolitan Lagos, there is need to focus beyond provision of some components (e.g. infrastructure which is a feature indicator) to the establishment of some process indicators like strategy to maintain infrastructure to ensure longevity of the infrastructure. The consideration of other process indicators (such as waste collection and management, impact assessment) is also helpful, as they will not only lay a good foundation for the sustainability of the proposed neighbourhood but could also serve as an avenue for awareness and social learning amongst the diverse groups of stakeholders.
- It is also important to note that the discoveries do not only apply to Lagos but also similar cities within sub-Saharan Africa. The argument follows that though certain communities maybe closer in similarities in terms of their wants and needs, ultimately societies will have specific needs that are unique to them. However, by understanding the context specific limitation, it becomes more prudent to adopt indicators that are needed through scientific prudence and verification, limiting the waste of economic resources in developing new ones. However, developing new indicators is also welcomed if it is more tailored to addressing the specific challenges of the sub-Saharan city in question.

6. Conclusion

Whilst the notion of the universality of indicators has provided a conceptual understanding and justification of the adoption of some existing NSAFs for decision-making by some countries, especially in Sub-Sahara African cities, their characteristics in various contexts seem to be the distinguishing factor. This has been demonstrated in this paper by how the context of metropolitan Lagos influences the characteristics of the selected indicator set. For example, there seem to be differences in terms of weighting and ranking of indicators when compared to a similar one in an existing NSAF. Therefore, this study has provided a new understanding that although the indicator set may be universal and be applicable to all cities, their characteristics remain the peculiar factor.

Having explored the characteristics of an empirically selected indicator set for a NSAF, this study concludes by supporting the argument that the indicator set of a NSAF cannot be transferred directly for use in another context without some empirical basis prior to its integration into the decision-making process of new neighbourhood development. For example, there is a need to ensure that the ranking of the indicators which indicates the expected priority in the decision-window, aligns with the preferences of the local stakeholders where it is being adopted. This is because a high-ranking indicator in a context may be a mid-ranking indicator in another context. In addition to this, the characteristics of an indicator as a 'response indicator' depends on the interventions that can be made available in a context which are influenced by technological know-how, political will, and sustainability awareness amongst others.

To address the contextual limitations of this study which focus on metropolitan Lagos, future studies can begin to explore the characteristics of the indicator set in other emerging cities in Nigeria and sub-Sahara Africa countries, to establish any similarities or differences using a comparative analysis. For example, the Green Building Council South Africa (GBCSA) and Ghana Green Building Council (GHGBC) announced the launch of the locally applicable version of the Green Star Certifications originally developed in Australia for use in South Africa and Ghana respectively with the aim of delivering sustainable settlements. However, the success of the implementation of this is an area yet to be explored, as to whether the weight and ranking assigned to the indicators agree with the preferences and priorities of the stakeholders.

In addition, because the attention of this study was on ex-ante indicators (which are integrated in the decision-making process of a proposed neighbourhood in its planning and design stages prior to construction), further research can explore the ex-post indicators which

will be useful to evaluate a neighbourhood after some years of operation and occupancy. This is on the basis that sustainability is a process which suggests that regular monitoring is important to ensure that the neighbourhood continues to exist and function under the ambit of the sustainability agenda proposed or envisaged at its planning and design phases.

In terms of policy recommendations, the established characteristics of the indicators can help practitioners understand the relationships between the indicators and the strength of each one in terms of capacity to deliver various aspects of sustainability. Beyond this, it would be useful in prioritising the indicators when such situation arises in the decision-making process of a new neighbourhood. As an addition, the integration of the indicator set into the substantive aspect for decision-making, can be helpful to operationalise and achieve the 'SDG 11 targets' aimed at the delivery of sustainable communities at the neighbourhood scale in metropolitan Lagos.

CRediT authorship contribution statement

Ayomikun Solomon Adewumi: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing- original draft, Visualization, Writing- review and editing. **Vincent Onyango:** Supervision, Validation. **Dumiso Moyo:** Supervision, Validation. **Husam Al Waer:** Supervision, Validation. **Ayotunde Dawodu**: Validation, Writing- review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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