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System Analysis, Urban Environmental Planning and Management: A Synthesis

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Abstract

Since urban places are built environments and ecosystems informed and shaped by their gestalt and complex nature due to the systemic and systematic configurations and interplay of their natural and human environmental elements; they are better synthesized, appraised, planned and managed through the methods of "systems analysis" for the synthesis and appraisal of the urban environment; with "urban ecosystems planning and management approaches" as strategic pathways for regulating different urban environmental problems relatively generated by harmful "ecological footprints" of byproducts and wastes from different urban human ecological activities, processes and material objects. It is in their respective "energy flow" and "synergy" with urban natural environment during the general processes of "urban metabolism" and "urban dynamism" that they transfer to it some harmful pollutants. Among the common urban environmental problems in Nigeria are pollution of atmosphere, land and water usually arising from the emissions of harmful greenhouse gases, spillages of harmful chemicals and byproducts and wastes that usually drain into urban water systems and land, indiscriminate cutting of trees and land excavation that respectively cause smog, green house effect, various waterborne diseases, blockages and over flooding of waterways and drainages, land erosion, de-vegetation and de-forestation. Thus, these problems if not effectively regulated may consequently militate environmental deterioration, climate change, drought, resources depletion, famine and various diseases capable of hindering urban environmental viability, livability, sustainability and sustainable development that negatively impact the living conditions, health, wellbeing and livelihood of people and other biota inhabiting urban places/ecosystems. Hence, for adequate application and result from systems analysis and ecosystems approaches; they must be supported by reliable data, effective and efficient application of Town and Country Planning Laws, proper environmental conservation and preservation through promotion of eco-friendly activities, methods and appropriate urban zoning and land-use practices capable of making urban places, "places for everything and everything in its proper place".

Key Words: Systems, systems analysis, urban ecosystem, urban planning and management.

1. Introduction:

The enormity and vast implications of urban environmental problems in Nigeria and similar countries are appalling and of serious concern. This is not only due to their negative effect on the viability, livability and sustainability of urban natural environment but also for their chain of spill-over negative consequences that contribute to different forms of pollution of urban land, water systems and space/atmosphere that contribute to blockages and over flooding of natural and manmade waterways and drainages, etc Such problems if not properly regulated are capable of instigating environmental deterioration and climate change, which end results could lead to desertification, drought, resources depletion, famine, various diseases and other hazards that negatively impact urban sustainable development vis-à-vis the living conditions, health, wellbeing and livelihood of people and other biota inhabiting urban places [1]- [3].

Due to the gravity of urban environmental problems in the Nigerian urban places as a result of uncontrolled very rapid urban growth; they make urban planning and management activity processes very challenging and daunting tasks; though very proactive processes with promising results when properly and appropriately applied. Sequel to the concern are also several questions raised by professionals, scholars and concerned citizens at different forums regarding the causes, nature and challenges of different urban environmental problems as well as the kinds of appropriate and effective measures that need to be applied in order to regulate or contain them in the planning and management processes of urban places for the purpose of achieving urban sustainable development [4]-[8].

Although urban environmental problems essentially have their relative sources from various forms of pollution of urban land, water and space/air/atmosphere; what however aggravates them in most urban places of Nigeria and similar countries of the Third World is the ineffective and inefficient application of "*Town and Country Planning Laws"*/*"Urban and Regional Planning Laws"* as to make the urban place *"a place for everything and everything on its proper place"*. Moreover, the laws are *"received laws"* from the colonial government which did not give due considerations to the environmental peculiarities and realities of urban places in Nigeria and similar countries. Probably, this is why the laws are often neglected or abused in the planning and management processes of urban places by the Urban Planning and Management Authorities, Agencies, Officials, Public and Private Organisations as well as the people living in the urban places [9]- [10].

It is therefore the premise of this paper that, since urban places are built environments and ecosystems informed and shaped by their gestalt, complex and holistic nature as unitary entities, due to the systemic and systematic configurations and interplay of their natural or physical and human or manmade environmental components and elements; they are better synthesised, appraised, planned and managed through *"systems approaches*" respectively by the means of methodological frameworks of *"systems analysis"*, *"systems planning"* and *"systems management"* approaches [11].

This paper has four main objectives. The first objective is to explain the conceptual and theoretical issues surrounding the *"system"* concept. The second objective is to stipulate the nature and associated problems of urban

environmental system/ecosystem. The third objective is to discuss the methodological framework of *systems analysis* which is essentially used for the *synthesis* and *appraisal* of urban environment or ecosystem. The fourth objective is to highlight and explain the patterns application of *urban ecosystems planning and management approaches* as strategic pathways of reconciling the human [bio-social] environmental elements with the natural [biophysical] environmental elements in order to effectively and efficiently regulate different environmental problems in the planning and management processes of urban places as provided by the Nigeria Town and Country planning Laws [9].

2. Materials and Methods:

As a policy paper, the materials used for its discourse/discussion are essentially drawn from primary and secondary sources of data. While the primary data was from the simple trend observation and analysis of the patterns of urban growth, change and transformation of urban site and situation of Sokoto Metropolis as the case study; the secondary source of data was regarding the available relevant literature particularly regarding the conceptual, theoretical and methodological frameworks issues and ideas about the conceptual, theoretical and methodological frameworks of *"system"*, *"urban ecosystem" "systems analysis"*, *"ecosystems "planning"* and *"ecosystems management"*. In addition, recourse was also made to the Nigeria Town and Country Planning Laws which are the bedrock and road map that technically and legally guide urban planning and management activity processes in Nigeria [9].

Sokoto metropolis is used as the case study due to its pattern of urban growth due to the rapid growth of Sokoto in the 1980s to the present for which reason its urban land has been under continuous expansion and pressure as a result of growing needs for residential, commercial, administrative and other urban purposes. Consequently, the very rapid growth of Sokoto from the 1980s to the present has come along with different environmental or ecological problems due to ineffective and inefficient application of Town and Country Planning Laws in the processes of its physical planning and management processes.

Sokoto metropolis was founded in 1804 as the capital of Sokoto Caliphate. During the colonial period in the 20th Century it has served as the provincial headquarter and during the post-colonial period respectively as the Capital of North-Western state in the 1970 and presently as the capital of Sokoto State in Nigeria. The city of Sokoto is situated at about eight [8] kilometers northwest of the confluence of the rivers of Rima and Sokoto which is within the location of longitude 5.13604 E and 5.30231 E and latitudes 12.95661 N and 13.08379 N. Its location, site and situation were during the Sokoto jihad very good for strategic defensive and various agricultural and economic purposes and being the main reasons that informed its initial occupation by the Jihadists in 1804. In the course of its urban history since the jihad period, Sokoto has grown to eat up its peri-urban fringes as a result of different migration trends into. This was due to the various opportunities it provided as a regional centre both during the pre-colonial, colonial and post-colonial periods [12]-[15].

However, due to the very rapid growth of Sokoto Metropolis, by 2019 its urban land area extended to usurp the neighbouring village

settlements. Its population was then about 578,744 at a density of 96 persons per square kilometer and 3% growth rate. Due to the rapid growth of Sokoto in the 1980s to the present, its urban land has been under continuous pressure as a result of growing needs for different urban land uses which consequently make tis patterns of growth chaotic. Since then different environmental or ecological problems started to emerge due to ineffective and inefficient application of Town and Country planning laws [16].

3.1 Discussion: Conceptual and

Theoretical Frameworks:

The *system* concept originated from the Greek word/term *"systema"* which is used to refer to the compound of several inter-locking isomorphic component parts and elements which in their form, structure and function are organised and operate as a holistic unitary entity due to their commonality, inter-relationship and interdependence on one another. Since then, the system concept has been used in both Natural and Social Sciences for the purposes of gaining apt cognition, understanding, conceptualisation, analysis and explanation of anything, matter or phenomenon that exists as a holistic unitary entity. Due to the relevance and importance of the conceptual framework of "*system*", it has also contributed to the development of theoretical and methodological frameworks of *"systems approaches"*: *"systems analysis"*, *"systems planning"* and *"systems management"*.

For example in the Biological and Ecological Sciences where the application of the system concept was said to have first begun, the system concept and systems approaches have been used for the purposes of studying, analysis, understanding, and explanation of characteristic nature and patterns of organisation and operation of similar Biological species or organisms as in the work of Darwin. In other Natural Sciences such as Physics and chemistry the system concept and approaches are used respectively as in the works of Newton regarding the *"planetary" "celestial"* or *"solar" systems and* Robert Boyle and Tibor Ganti regarding the *chemical* systems [17].

In the Social Sciences especially in Sociology the concept and approaches are being used regarding the *"Social systems"* as in the works of Durkheim, Spencer, etc; in Political Science as regard *"Political systems"* as in the works of Aristotle and Plato; in Economics as regard *"Economic systems"* as in the works of Adams Smith. In Human Geography and Planning studies, for example, the system concept, systems analysis, systems planning and management approaches are being used for the study, analysis, understanding, explanation, planning and management of different *"Geographic systems", "environmental systems", "regions" or "ecosystems"* as originally in the works of Ritter and Vidal de la Blache to mention but a few [18].

The system concept has been defined from relatively different perspectives and ways. For example, it has been defined simply as "a complex whole, a set of connected things or parts, a department of knowledge or belief considered as an organised whole" [19]. Similarly, it is also defined as "a group of elements organised in such a way that every other component and element that form the unitary whole or entity is to some degree directly or indirectly inter-related and interdependent with one another" [20]. In the same vein, a system has also been defined as "an entity

consisting of a set of interdependent and interacting parts that is separated from its surrounding environment by definable boundaries" [21].

The most advanced definition of system is that advanced by [22] with the use of framework of *"Mathematical tools of set theory"* as the guide. They defined a system as any phenomenon composed by *"a set of "objects" together with "relationships" between the objects and their "attributes"*. Accordingly, while the set of objects are those similar elements that constitute groups of system's different component parts; the set of relationships are the bondages or linkages that tie them together.

As such, while relationships between the set of system's objects [i.e. components parts and elements] are what inform and shape the system's patterns of organisation and operation or form, structure and functions as to make it a holistic unitary entity; attributes are what define the system's relative characteristics, features or properties. Attributes are therefore the parameters that provide the basis of understanding, conceptualisation, definition and analysis/evaluation [i.e. synthesis and appraisal] or generally diagnosis of both internal and external manifestations of a system with the view to ascertaining its actual state of affairs. Hence, because attributes are what make a system gestalt, complex and stochastic; they are usually the target for regular observation, reconciliation, manipulation and regulation for the purpose of ameliorating the system's associated problems in its planning and management processes. Thus, relationships and attributes of a system are generally what distinguish the nature and other imperatives of different kinds of systems: "real", "conceptual", "open", "closed", "simple" and "complex" or "stochastic".

Comparatively, while a real system is fundamental with verifiable characteristics and existence, the conceptual system is abstract and imaginary. Similarly, whereas an open system is real and has flows of energy, information and strong relationships between its objects; the closed system has no flows and links between its objects due to which it is static. In the same vein, while simple system has few objects that are directly linked with one another; the complex system is rather made up of variety of objects which characteristics or attributes are random and their relationships or linkages are both direct and indirect with each other. The nature of complex systems is however informed and shaped by their gestalt, intricate and stochastic characteristics and patterns of organisation and operation, due to which they are more dynamic than any other types of systems. The examples of real, open, complex and stochastic systems are *"social"*, *"political", "economic" and "environmental"* or "*ecosystems"* which bases of study, understanding and analysis have further been advanced by the ideas of "*General systems theory"* as a unifying theory for all sciences [17]-[18] &[23].

3.2 The Methodological Framework of Systems Analysis:

Systems analysis is a system approach for the synthesis and appraisal of systems. It is a "field or method of inquiry that aids a decision maker to choose a course of action by systematically investigating his proper objectives, comparing qualitatively where possible the cost, effectiveness and risks associated with

alternative policies or strategies for achieving them". It is as such one of the core methodological frameworks in the social sciences that shares common theoretical and methodological ideas with "functionalism", "structural functionalism", "organicism', "operational research", "cybernetics", "input-output analysis" and "systems engineering". Thus, the methodological framework of systems analysis is as multi-dimensional as it is multi-disciplinarian not just because it encapsulates the conceptual, theoretical and methodological ideas of Natural and other Social Sciences but also because it is data intensive and requires adequate data processing system in the process of its formulation and application [24].

As a method and technique, systems analysis iteratively utilises both statistical and empirical methods for the coherent conceptualisation, systemic and systematic study, synthesis, appraisal, planning and management of patterns of organisation and operation as well as other imperatives of different systems: social, political, economic, environmental and other systems. For these reasons, the methodological framework of systems analysis virtually employs both inductive and deductive approaches as well as quantitative and qualitative methods, techniques and tools or instruments of primary and secondary data collection, analysis, processing and presentation. It is very applicable to urban system [25].

Accordingly, by system synthesis it refers to the inductive and deductive processes of filtering or sorting and unifying the various elements of a system in accordance with the characteristic nature of their corresponding components with the view to establish their respective patterns of inter-relationship and inter-dependence for the purposes of understanding and appraisal of the system's actual state of affairs especially regarding its relative patterns of organisation and operation.

By appraisal on the other hand, it specifically refers to the process of evaluation, valuing and analysis of systems' natural and human components and elements for the purposes of exploring their nature, effects and consequences or implications and other imperatives through the means of field study so that ameliorative or intervention measures can appropriately be proffered and applied in the planning and management process of the system like the urban ecosystem. Appraisal is as such a learning process used in aiding the search for the most appropriate approach for policy, planning and management initiatives as regards the kinds of projects, programmes and other strategic pathways ways that need to be formulated, developed and applied or put in place for the purposes of ameliorating or solving different problems associated with different systems [26].

Comparatively, while among the statistical methods and techniques are for the synthesis of systems include among others abstraction, simulation, scanning, modeling, calibration, forecasting, projection and prediction; the empirical methods and techniques for the appraisal/evaluation of systems essentially through the means of field study include among others, "input-out analysis", "cost benefit analysis" [CBA], planning balance sheet analysis [PBSA], "goals achievement matrix" (GAM), "optimization techniques" (OT), "social impact assessment" [SIA], "environmental impact assessment" [EIA], "strategic environmental assessment" [SEA], "strength, weaknesses, opportunities and threats analysis" [SWOT], "trend analysis" [TA], "risk and hazard assessment" [RHA], "scenario development"

[SD], "bench marking" [BM], "remote sensing" [RS], "scenario development" [SD], "life circle assessment" [LCA], "environmental management accounting" [EMA], "geographic information system" [GIS] etc [18], [26]-[28].

Therefore, as a core methodological framework in Social Sciences, Systems analysis is essentially useful for heuristic purposes and making best choices among different alternatives in the decision making and taking processes. This is due to the deep and broad insights it provides for diagnostic, resource allocation and solving different kinds of problems associated with different systems like the urban environmental problems as the main concern of this paper. Because of its importance and relevance in the Social sciences particularly Human Geography and Planning Studies; it has contributed to the development of various theories and models of urban and regional planning, management and development that generally constituted the "systems approaches" which are used not only to evaluate or analyse and explain different spatial patterns of urban places/ecosystems but also to develop strategic pathways of regulating urban environmental/ecological problems. For example, the approaches are useful in providing insights into the patterns of "urban growth", "urban change", "urban social space" and "urban spatial structure", "urban spatial interaction and "urban spatial integration" as they generally relate to different "urban land uses" and "urban activities" [29].

3.3 The Nature and Associated Problems of Urban Environment/Ecosystem:

The concept or phenomenon of *"environment*" is very much associated with that of *"culture"* especially regarding their structural and functional configurations as well as relevance and importance to the continuous existence and survival of human beings on the earth. Their importance is such that while the natural/physical/geographic environment elements provide human beings with their sources of continuous existence and survival on the earth; the cultural operational, perceptual and behavioural elements provide them with their means of existence and survival. Thus, as two most associated, broad, all-pervading, intriguing, outstanding and important concepts or phenomena in the Social Sciences, both environment and culture are *"easy to describe but difficult to define".* In spite of that, the environment can simply be defined as any surrounding area in which confines some living and non-living things co-exist and are supported by the configurations of geographic/natural and human/manmade elements for their continuous existence, survival in the area, as stipulated by figure 1 [30].

It was in order to provide adequate perspectives and approaches of conceptualisation, analysis and explanation of what generally inform and shape the environment as an *"ecosystem*" that Human Ecology School developed the concept and theory of *"human ecology"*. Their main focus is to elucidate the principles governing the nature, patterns and processes of inter-relationship, inter-dependence and interaction of the natural or physical and human or manmade environmental objects that form the different components and elements of any given

ecosystem. Hence, the environment as an ecosystem has thus come to be conceptualised generally by the Human Ecology School as *"Man-Nature"* or *"Socio-Nature"* phenomenon constituted by the systems and subsystems of natural and human components and elements as stipulated by figure 2 [18], [32]-[33].

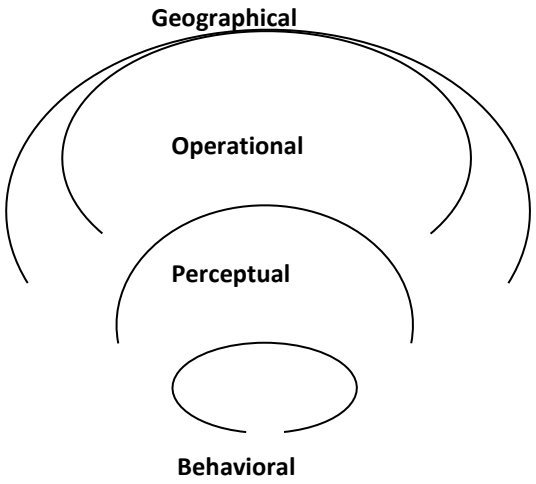

Fig.1: Classification of environment

Source: Sonnenfeld, J. (1978:28) in Blunden, J. et. al. (eds.), *Fundamentals of Human Geography: A Reader*, London: Harper and Row Publishers.

The ways of handling the environment can be either through its conservation and preservation by means of wise use, adequate utilisation of its resources and adoption of appropriate eco-friendly activities and practical environmental management approaches such as *"green infrastructure"* initiative [GI] and *"Eco-development"* [ED] practices that are capable of replenishment or regeneration of the environment and its resources or through adoption of harmful activities and bad practices or approaches that are harmful, injurious and destructive to the environment, to include among others, over-consumption and mismanagement of environmental resources without due regards for environmental conservation and preservation and utilisation of its resources [34]-[37].

The Man-nature/Socio-nature conception of the environment/ecosystem has its roots in the ideas of *"Man-environment"* paradigm which views the relationships of Man/human being and the environment as mutually inter-dependent rather than the old view of Man solely being dependent on the environment as advanced by the *"environmental-determinism"* otherwise also known as *"environmentalism"* school of thought. The idea of inter-dependent relationship of Man and environment was conceived because both Man and environment impact one another to the extent that while the environment is the main source of subsistence, sustenance, existence and survival of human beings on the earth; the viability, livability and sustainability of the environment depend on how Man/human being as its beneficiary and custodian handles it [38].

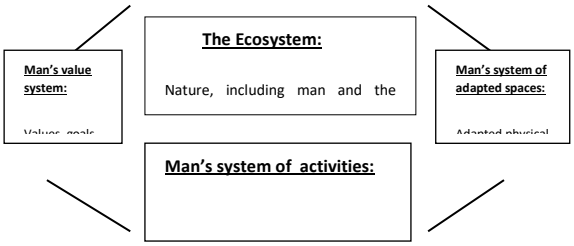

Fig. 2: The man-nature system.

Source: Chadwick, G. (1981:19) A System View of Planning, Oxford: Pergamon Press.

However, the urban place/area as a built environment is the most stupendous ecosystem and human habitat due to the aberrational condition of its environment which by and large is informed and shaped by three main factors that contribute to the very rapid growth, change and transformation of people's entire web of life and the natural or geographic environment. The factors are very rapid *"urbanisation"*, widespread *"modern technology"* and *"capitalist modes" of production, manufacturing, processing, transportation, distribution and consumption of goods and services.* As drivers of urban growth and change these factors have contributed to the evolution and development of social, political, economic and other central functions of urban places across the World.

Due to their effect on attraction and concentration of large, dense and heterogeneous population of people into the urban places through very rapid rural-urban and urban-urban migration and commuting processes; the factors have made urban places the nucleus and melting pots of people and nerve center of agglomeration economy that promotes proliferation and preponderance of various economic and other ecological activities, processes and material objects/technologies that exist and carried out on urban land and space by the multitude of people as individuals, households, formal and informal enterprises, public and private organisations.

High concentration of people into urban places and the development of urban agglomeration economy are what virtually contribute to over-consumption of environmental resources which are being used as raw materials in the production, manufacturing, processing, distribution and consumption of different goods and services. The factors also contribute to the increasing needs of urban land and space for residential, commercial and other purposes/uses; the result of which also lead to very rapid expansion and transformation of urban site and situation, especially regarding its morphology: physical form, structure and architecture. Similarly, the factors generally contribute to the changes in the entire ways of life of people in urban places, especially their social, political and economic structures, relationships, behavior, values, norms, perception and life style with individualism and competition being the common features that motivate and guide their patterns of association and interaction [7], [39]-[46].

Associated and accompanying the factors in the processes of urban growth, change and development are also various urban problems, one of which is the urban environmental problems that have their different sources from the negative ecological footprints of byproducts and wastes generated by some urban harmful activities, processes and material objects/technologies. It is in their respective and relative energy flow and synergy with the natural environment in the form of input-output during the general processes of *"urban metabolism"* and *"urban dynamism"* that they usually transfer risks and vulnerabilities to the urban natural environment [36].

Consequently, in the long run, the transferred vulnerabilities of different negative ecological footprints on the urban space and land are what negatively affect and impact urban atmospheric, weather, climate and land vegetational conditions with their untold chain of spill-over negative effect on urban environmental deterioration or degradation capable of generating drought, resource depletion, hunger

and different diseases which consequently usually hinder urban sustainable development by downplaying the living conditions, health, wellbeing and livelihoods of human beings and other biota inhabiting urban places or ecosystems.

Among the common environmental/ ecological problems of most urban places in Nigeria and similar countries of the Third World include pollutions of atmosphere, water and land respectively as a result of massive emissions of harmful greenhouse gases into the atmosphere, spillages of harmful chemicals and other bye products and wastes into the water systems and on land which consequences respectively contribute to smog due to green house effect and various waterborne diseases. In addition, excessive land excavation for building and construction purposes, indiscriminate cutting of trees for cooking and other purposes as well as indiscriminate dumping of solid byproducts and wastes of different products on land also respectively contribute to land erosion, de-vegetation, de-forestation, blockages and over-flooding of natural and manmade water systems and drainages, etc. [47]-[50].

Therefore, in order to understand, appraise/analyse and explain the causes, nature, implications and strategic pathways of preventing urban environmental problems from occurring or containing/controlling those that have already occurred as to reduce them to the barest minimal level before they ultimately contribute to urban environmental deterioration or degradation that utilisation of the methodological frameworks of *"systems approaches"*: *"systems analysis"* and *"urban ecosystems planning and management approaches"* becomes obvious, apparent, pertinent and necessary in the planning and management processes of urban places in Nigeria and similar countries.

3.4 Application of Urban Ecosystems

Planning and Management Approaches:

Planning and management are inter-related and inter-dependent proactive activity processes. While planning is the continuous activity process of making and taking decisions by Policy Makers and implementers regarding the choices of best alternative course/s of actions in solving different types of problems or regarding utilisation of available resources for the achievement of some goals and objectives for different purposes; management on the other hand is the activity process of *"organising"*, *"controlling"* and *"monitoring*" the procedures and processes of achieving planning goals and objectives. Management is what steers and re-enforces planning activity process. Like planning; it is a forward looking and resilient proactive activity process of *"watching and warning"* about the critical thresholds capable of engendering the optimal state of a system and for achieving planning goals and objectives. For this reason, management relies on predictive tools, instruments and indicators of appraisal/evaluation and monitoring processes of development policies, projects and programmes [28], [51].

In their respective processes of application, both planning and management are data intensive due to which reason they respectively rely heavily on objective and comprehensive information, knowledge or substantial intelligence about the phenomenon or issue under study in order that it can serve as the basis for policy and action. Like systems analysis, both

planning and management activity processes rely heavily on careful, logical and rational thought and judgment by the Planners and Managers. Because of the relevance of *"logic"* and *"rationality"* in planning activity process; the concept of planning per se has been defined simply as the *"process of human forethought and action based upon that thought"*. It is as well defined as the *"application of scientific methods to policy making"* [18], [52].

Urban Planners and Managers in their in the planning and management processes, their thoughts and judgments are usually being guided by the ideas of *"theories of planning"* and *"theories in"* or *"for" planning*". Comparatively, while the *theories of planning* are normative in their essence regarding how to rationally improve planning procedures; the *theories in/for planning* deal with the required behaviour or conduct of planners regarding how to justify their actions in tackling or surmounting the challenges associated with planning activity process [52]

The relevance and importance of theories *of* and *in/for* planning are what generally contributed to the development of *"systems approaches"* which methodological framework is *systemic* and *systematic* in the study, analysis, understanding and explanation of different systems; the An example of which is the *"Urban ecosystem*. As a human built environment and habitat, it is constituted by the natural and human components and elements which patterns of interplay, organisation and operation are as contradictory due to which it requires appropriate planning of its physical environment *i.e. "the land on which activities of living are based, the building which house these activities and the artifacts which are necessary for society to function"* [27], [53]-[54].

The urban ecosystems planning and management approaches are peculiaristic strategic pathways which common objective, goal and function is the maintenance of urban ecosystem. They as such the main pillars that ensures the attainment of optimal environmental viability, livability, sustainability and urban sustainable development of urban places with the view to improving the living conditions, health, well being and livelihood of people and other biota inhabiting urban places. The wellbeing of environment is usually attainable through the means of wise use of environmental resources and appropriate environmental management practices that promote environmental conservation, preservation and regeneration or replenishment [55].

Among the environmental management practices of conserving and preserving the natural environment are "Green infrastructure" [GI] and "Eco-development" [ED] approaches. Whereas the main objective of Green infrastructure [GI] approach is the "protection of biodiversity by means of practices capable of replenishing natural environment for the purposes of promoting adequate clean air, water, green spaces, fertile soil, etc, that can improve the ecosystem's fresh atmospheric and climate conditions; the main objective of Eco-development [ED] approach on the other hand is generally for achieving "qualitative sustainable development" rather than "economic growth" which essentially usually contribute to over-consumption of environmental resources. However for the purpose of achieving sustainable development, the ED approach rather emphasises the need to restructure society and economy in such a way that development should work with the nature in mind and action rather than against it. Thus, ED

is as ecocentric as it is anthropocentric in its approach of providing protection to the environment [34]-[37].

Thus, due to the importance and relative peculiaristic nature of ecosystems planning and management approaches, they have variously been formulated and developed by different organisations and scholars for the purpose of regulating the respective aberrational conditions of disorder and problems associated with the urban environments of different countries as a result of the negative effect of some endogenous and exogenous factors instigated by their very rapid urban growth and change. The approaches have been applied in different countries of the World with remarkable success among which are Japan, Baltimore, Maryland, Phoenix, Arizona, etc.

In the process of their application for the purpose of solving urban environmental problems, the urban ecosystems approaches are also as *evolutionary* as they are *revolutionary.* They are evolutionary because they follow the *"incrementalist"* mode of urban planning and management process which is based on *piecemeal or step-by-step* systemic and systematic implementation approach especially for the identified problem areas of the urban place. They are revolutionary in their approach because they are critical of how Town and Country Planning laws are ineffectively and inefficiently applied especially in Nigeria and similar countries. For this reason, the approaches seek to radically and progressively change how the Laws are applied so as to provide the required basis for achieving their main objective of regulating different urban environmental problems.

The approaches are usually carried out through the methods and techniques of urban physical planning that provide adequate basis for proper urban zoning and land use practices capable of making urban places *"the places for everything but everything on its proper place"*. Accordingly, this is by way of appropriate segregation of harmful urban social, economic and other ecological activities, processes and material objects or technologies that are indiscriminately located and carried out on urban space, so that the flow of the negative effect of their respective ecological footprints are prevented or contained before they become injurious and destructive to the wellbeing of the urban natural environment, human beings and other biota.

Although there are relatively different ways of applying/implementing urban ecosystems planning and management approaches; however, one of the most appropriate way especially in Nigeria and similar countries is through the *"diagnostic planning and management"* approaches and processes which have three main objectives. Their first objective is *diagnosis* for the purpose of exposing the root cause/s of different urban environmental problems. This is because *"the first step in solving any problem is to state it"* and that *"a problem once stated is about half solved"*.

Their second and third objectives are respectively *treatment* and *cure* of the problems through the rudiments of *"comprehensive"* and *"incrementalist"* [*i.e. step-by-step* or *piecemeal*] modes of urban planning and management processes with the *"Urban Master Plan"* [i.e. policy document that directs urban physical planning, management and development processes] as the main reference point and guide for the systemic, systematic and orderly regulation or control of urban growth, change and development of urban places/ecosystems as

well as their relatively associated environmental or ecological problems.

Generally, there are two main inter-related phases in the process of application/ implementation of urban ecosystems planning and management approaches. While systems analysis is the first phase, systems planning and systems management together constitute the second phase. Systems analysis is the first phase because it is from it that the required relevant and reliable intelligent information or data for gaining insight about the actual state of urban environment is ascertained through the means of statistical and empirical methods, techniques and tools or instruments of system synthesis and appraisal/evaluation.

Application of systems analysis per se involves four [4] stages. The first is the *"conceptual"* stage which deals with clear statement of the research problem, stipulation of research objectives and definitions of concepts as well as other issues of concern related to the study problem. The second stage is data collection from the field usually carried out by means different tools and instruments of data collection. The third stage is data analysis and interpretation of results attained from the synthesis and appraisal of the urban environment. The fourth is experimentation in order to verify the validity and reliability of the chosen best course of action as for it to serve as the basis of policy and action for the regulation of the identified environmental or ecological problems.

In the processes of diagnosis, treatment and cure of different urban environmental problems or generally application of both system analysis and urban ecosystems planning and management approaches, there are also six [6] standards/requirements to be observed. The first is adequate observation of behaviour modes of urban natural environment, especially as regard how its characteristics are impacted by the patterns of organisation and operation of the human environmental elements. This is because adequate observation is key and very important instrument that helps in the diagnosis of the existing state of affairs of the urban environment under study with the view to ascertaining or establishing its specific problematic areas of disorders that require necessary attention and action for treatment and cure by the Urban Planners and Managers.

The second standard/requirement is to look for the feedback structure of the symptoms o ailments as modes of disorder of the urban environment. The third standard or requirement is identification of the nature, level and rate variables associated with the feedback structure and the fourth is simulation of dynamic behaviour of the environment by using computer simulation models. The fifth and six standards or requirements are run concurrently. They are the points at which the urban planning and management approaches are introduced or applied to the urban system under study with the view to the structural modification of the its environment in association with the various urban activities and land uses. This is done by means of urban zoning, land use survey and other appropriate urban planning and management approaches that are capable of improving the behaviour patterns of the urban environment in order to serve as the bases of regulating its different associated environmental problems.

The main elements on which specific special control measures are to be focused in the application or implementation of the ecosystems planning and management approaches are urban population, different

ecological activities and processes and various material objects as to how they are located and carried out on the urban land and space. This is in order to ascertain the degree of fitness between the existing urban zoning and patterns of urban land uses: residential, commercial, recreational, etc. with the officially approved Master plan of the urban place under study/investigation especially for the purposes of their structural and operational modification as the case may warrant [36].

4.0 Conclusion and Recommendations:

The conclusion drawn from the discourse/ discussion of this paper is that an urban place as a built environment is a gestalt, complex and stochastic ecosystem both in its characteristics, form, structure and function. As a holistic unitary entity, it is constituted by the natural and human environmental components and elements [i.e. the biophysical and bio-social spheres] which contradictory patterns of interaction, organisation and operation create negative ecological footprints as aberrational conditions that transfer risks and vulnerabilities on the urban environment through the processes of energy flow and synergy in the form of input-output during urban metabolism and dynamism; thereby becoming problematic to the urban land, water and space/air/atmosphere.

In the long run, this negatively affect and impact urban atmospheric, weather, climate and land vegetational conditions that contribute to environmental deterioration or degradation with their untold chain of spill-over negative consequences on environmental, viability, livability and sustainability that usually instigate drought, resource depletion, hunger and different diseases that posed serious challenges to urban sustainable development vis-a-vis the living conditions, health, wellbeing and livelihoods of human beings and other biota inhabiting urban places or ecosystems.

Among the common environmental/ ecological problems of most urban places in Nigeria and similar countries of the Third World include pollutions of atmosphere, water and land respectively as a result of massive emissions of harmful greenhouse gases into the atmosphere, spillages of harmful chemicals and other bye products and wastes into the water systems and on land which consequences respectively contribute to smog due to green house effect and various waterborne diseases. In addition, excessive land excavation for building and construction purposes, indiscriminate cutting of trees for cooking and other purposes as well as indiscriminate dumping of solid byproducts and wastes of different products on land also respectively contribute to land erosion, de-vegetation, de-forestation, blockages and over-flooding of natural and manmade water systems and drainages, etc.

Therefore, in order to properly understand and appropriately plan and manage urban places/ecosystems the methodological frameworks of urban ecosystems approaches become pertinent and useful. This is apparently due to their systemic and systematic nature and methods of application that give adequate regard and importance to the effective and efficient application of of the Town and Country Planning laws for the appropriate regulation of different urban environmental problems by means of proper reconciliation of the natural and human environmental components and elements through proper urban zoning and land-use practices that make urban places the places for everything but everything on its proper place.

The following are the recommendations of this paper, thus:

1] First and foremost, in the processes of understanding the causes and nature of different urban environmental problems and the development as well as application of strategic pathways of preventing or containing different urban environmental problems, the respective utilities of the methodological frameworks of systems analysis, ecosystems planning and management approaches must respectively be employed for the purposes of synthesis and appraisal of the urban environment or ecosystem.

2] In order to properly and appropriately prevent and control/contain the different urban environmental/ecological problems, the Town and Country Planning/Urban and Regional Planning Laws must effectively and efficiently be applied in the processes of planning and management of urban places, so that the urban environment can adequately be protected through proper urban zoning and land uses practices based on the idea of every urban activity to be located and performed on its proper place in the urban places with urban comprehensive and incremental modes of planning and management as well as the urban Master plan being the main guides.

3] In the processes of applying the urban ecosystems planning and management approaches in order to make them effective and responsive they must be as "ecocentric" and anthropocentric as possible.

4] The urban environment must be protected through adequate conservation and preservation measures by means of proper approaches of consumption, utilisation and re-generation of environmental resources with the ideas of "green infrastructure" and Eco-development [ED] as eco-friendly environmental management practices and methods as the main guide.

5] For the purpose of re-generating the forest and urban greenbelts the common practices of incessant cutting and burning of trees for cooking and indiscriminate digging of land for soil and granite for building as well as spillages of byproducts and waste of different activities must be curtailed with alternative ways to be provided.

References:

1] A. Damilola and E.O. Ibem [2010] "urban Environmental problems in Nigeria: Implications for sustainable development". Journal of Sustainable Development in Africa, 12 [2].

2] T. E. Olagunju [2015] "Drought, Desertification and the Nigerian Environment: A Review", *Journal of Ecology and Natural Environment, [7], pp. 96-209.* T. E. Olagunju [2015] "Drought, Desertification and the Nigerian Environment: A Review", *Journal of Ecology and Natural Environment, [7], pp. 96-209.*

3] D. U. Okali [2008] "Climate change and Sustainable Development challenges to Nigeria", in Popoola, et.al [eds], Contemporary Issues in Sustainable: Issues for and challenges for Nigeria, Ibadan: Post Graduate publication, University of Ibadan, pp. 61-81.

4] A. A. Yusuf [2010], "urban safety, urban Renewal and Urban Planning: The Challenges for Sustainable City Development", being a Seminar Paper on *Sustainable City Development* organised by NEPAD in collaboration with the Ministry for Inter-Governmental Affairs.

5] M. A. Iliya [2010], "The Problems of an Unplanned City: Implications for Sustainable Development", being a Seminar Paper on *Sustainable City Development* organised by NEPAD in collaboration with the Ministry for Inter-Governmental Affairs.

6] H. Aliyu, K. B. Attahiru, and S .G. Yauri [2017], "An Overview of Physical Planning and its Challenges on Sustainable Development of Nigerian Cities", A Conference article on *Sustainable Development Goals in Nigeria: issues and Challenges*, A publication of the Faculty of Social Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria, published by Mayor Pritz, pp. 420-431.

7] M. Awumbila [2017], Drivers of Migration and Urbanisation in Africa: Key trends and issues, *Background for UN Expert Group meeting on Sustainable Cities, Human mobility and international migration*, 7-8 Sept.

8] A. Z. Rilwanu, T. Yalwa and S. Yauri [2017], " Informal Settlements, Sustainable Development and the Environment", *Sustainable Development Goals in Nigeria: issues and Challenges*, A publication of the Faculty of Social Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria, published by Mayor Printz, pp. 432-444.

9] C. S. Ola [1977], *Town and Country Planning Law in Nigeria*, Ibadan: Oxford University Press.

10] G.W. Kanyeihamba [1980], "The impact of received law on the planning and development in Anglophone Africa", the *Journal of Urban and Regional Research* [IJURR], Volume 4 , No. 2, June, 239-265.

11] J. B. Mcloughin [1969] *Urban and Regional Planning: A System Approach,* London: Faber and Faber, London.

12] A. B. Mamman [1999] The Process and Nature od Per-urban expansion in Nigeria: The Sokoto Case Study, *Unpublished PhD Thesis*, School of Geography, University of Birmingham.

13] A. B. Mamman [199] *The Process and nature of Per-urban expansion in Nigeria: The Sokoto Case Study,* unpublished PhD Thesis, School of Geograpgy, University of Birmingham.

14] M. A. Shamaki and I. m. Dankani [2012], "Urban Growth and Development of the Sokoto Urban Area: Implication for Sustainable Development" in D.A. AbdulRahman, I. S. Ogundiya, T. Garba and I. M. Dankani [eds], *50 Years of Nigeria's Nationhood: Issues and Challenges for Sustainable Development*, Crown Publishers, Ibadan, Nigeria.

15] D. Dantuni [2011], Appraisal of the implementation of Sokoto Master Plan- 1983-2003, unpublished M.Sc. Dissertation, Geography, Department, Usmanu Danfodiyo University, Sokoto.

16] R. Abubakar [2021] "Socio-economic status of slum Dwellers In Sokoto Metropolis, Nigeria", *The Sokoto Journal of Geography and the Environment, [SJGE], Vol. 3, No.1, June, pp.19-32*.

17] D, Harvey [1983] "The Urban Process under Capitalism: A framework for Analysis, in R. W. Lake [ed.] Urban Analysis: *Perspectives in urban form and structure,* New Jersey: Routledge, PP. 191-227.

18] G. Chadwick [1981] *A Systems View of Planning: Towards a Theory of Urban and Regional Planning process*, Oxford: Pergamon Press.

19] Oxford English Dictionary.

20] R. J. Johnston et.al. [[1994] *Dictionary of Human Geography*, 3rd ed, Oxford: Blackwell Publishers.

21] B. J. L. Berry [1976] "The Geography of Economic Systems" Geographic Fundamental, Vol. 1. 1, pp.447-505.

22] A. D. Hall and R.E. Fagen [1956] "Definition of System", *Year Book of Society for the advancement of General Systems theory*, vol. 1, pp. 18-28.

23] L. V. Bertalanffy, l. v. [1971] *General System Theory*, Allen Lane: Penguin.

24] A. W. Steiss, (1974) *Models for the Analysis and Planning of Urban Systems,* London Lexington Books, pp. 1-16.

25] A. W. Steiss, (1974) *Models for the Analysis and Planning of Urban Systems,* London Lexington Books, pp.31-39.

26] N. Lichfield, et. al. (1975) *Evaluation in the Planning Process,* Oxford: Pergamon Press.

27] M. Roberts [1999] *An Introduction to Town Planning Techniques*, London: UCL Press Limited.

28] D. Conyers and P. Hills 1984] *An Introduction to Development Planning in the Third World*, Chichester, New York: Hohn Wiley and Sons.

29] R. J. Bennett, et.al [1983] "Spatial structure, Spatial interaction and their integration: A Review of Alternative models, Journal of Environmental Policy, Vol. 11, pp.625-645.

30] J. Sonenfeld [1978] “Geography, Perception and the Behavioural Environment”, in J. Blunden [ed] Fundamentals of Human Geography: A Reader, London: Harper and Raw Publishers, pp. 26-32.

31] I. G. Simmons [1973] “Conservation” in J.C. Doornkamp and J.A.Dawson [eds], *Evaluating the Human Environment*, London:Edward Arnold publishers, Ltd.

32] R. Park [1983]”Human Ecology”, in R.W. Lake [ed.], *Readings in Urban Analysis: Perspectives on Urban form and structure,* New Jersey: Rutgers.

33] G. D. Mitchell [1977], *A Dictionary of Sociology*, London and Henley: Routledge and Kegan Paul, pp. 62.

34] M. S. Amali and L.Tailor [2010] “From Green belts to infrastructure planning practice and Research, https:// do/ng/ 100108/102697451003740122.

35] U.G. Gabriel [2018] Green infrastructure: Conceptual Approach for mitigating and adopting climate change in Nigerian Cities: Case Study of Lagos, in the Case, methodology and objectives.

36] P. J. Marcotullio and G. Botce [2003], “Defining an Ecosystem approach to urban management and policy development, United Nations University [UNU] and Institute of Advanced Studies [IAS] Report.

37] C. J. Barrow [2003] *Environmental Management and Development,* London and New York, Routledge Taylor and Francis Group.

38] J. Blunden [1978] “Introduction”, in J. Blunden, et. al [eds.] *Fundamentals of Human Geography: A Reader,* London:Harper and Raw.

39] U. I. Ukwu [1980] “Urbanisation and its implications for the Development of Nigeria”, in E. C. Amucheazi [ed.], *Readings in Social Sciences: Issues in National Development*,Enugu, Nigeria: Fourth Dimension Publishing Co. ltd., pp.167-182.

40] D. Harvey [1976] Explanation in Geography, London: Edward Arnold Publishers.

41 G. Germani [1973] “G. Germani “Urbanisation, Social change and great transformation”, in G. Germani [ed.] *Modernisation, Urbanisation and the urban crisis*, Boston: Little Brown and Company, pp. 3-58.

42] K. Marx and F. Engels [1973] “The City, the Division of Lbour and the Emergence of Modern Capitalism”, in G. Germani [ed.] *Modernisation, Urbanisation and the urban crisis*, Boston: Little Brown and Company.

43] Giddens [1990] *The Consequences of Modernity*, Stanford, C. A: Stanford Press.

44] A. Adedeji and R. Rowland [1973] *Management Problems of Rapid Urbanisation in Nigeria: The Challenge to Government and – The Report of the 4th National Conference on Local Government*, held in Sokoto, 5-8th Jan., 1972, Nigeria, Ile-Ife: University of Ife Press.

45] U. I. Ukwu "Transport and Communication as factors in the modernisation and Development of Nigeria, op. cit.

46] B. J. L. Berry [1981], *Comparative Urbanisation [Divergent Paths in the 2th Century]*, London: Macmillan Press Ltd.

47] O. U. Esio [2004] "The effect of Climate change on food production", *Research Journal of Agriculture and Environmental Management,* Vol. 3 [11].

48] N. E. Ebele and N. V. Emodi [2016] "Climate change and its impact on Nigerian Economy", Journal of Scientific Research and Reports, pp. 527.

49] O.A. Thompson [2010] "Climate Change and Food Security in Nigeria", *Journal of Meteorology and Climate Science,* Vol. 8, No. 2, Nov.

50] M. N. Ezemonye, C. N. Emeribe, O. O. Egharagbeni and N. N. Ubachukwu [2020], "Heavy Metal Levels in Soils around Selected Municipal Solid Waste Dump Sites in Akure, Ondo State, Nigeria", in the *Sokoto Journal of Geography and the Environment [SJGE]*, Volume2, December, pp.1-18.

51] J. Ratccliffe [1981] *An Introduction to Town and Country Planning*, [2nd ed], London: Hutchinson.

52] A. Faludi [1984] *A Reader in Planning Studies,* Oxford: Pergamon Press.

53] ChurchMan [1968] *The Systems Approaches,* London: Dell Publishing.

54] G.R. Crook [1974] "Physical Planning", inM. J. Bruton [ed.] The Spirit and Purpose of Planning, London: Hutchinson and Co. Publishers, pp. 85-123.

55] A. D. Boyce and Imoniyi, S. S. [2010] "Environmental Sustainability and Urban growth in Nigeria", Journal of Environmental Research and Policies, 5 [11], pp. 43-50.