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Khartoum Structure Plan's Strategies: A Review of Sustainability, Action and Prospects

Abdulhafeez Awad Hafazalla

Department of Urban and Regional Planning
Faculty of Environmental Design
King Abdul-Aziz University
Jeddah, Saudi Arabiax (E-mail: ahafazalla@kau.edu.sa)

Abstract: Khartoum, the capital city of Sudan, is experiencing severe planning problems including the lack of adequate levels of services, infrastructure, public transport, housing problems, environmental degradation and faintness of development controls. Four development plans were previously adopted since 1910, most of which were not adequately implemented as planned due to the absence of government's will, inadequate financial resources, and inadequate and unrealistic programs. A fifth structure plan has been prepared and adopted in 2009 for the next 25 years. The paper discusses the conformity of the plan proposal with sustainable development measures regarding five aspects that relate to the plan solutions viz., the methodology, development strategies, transportation, infrastructure, and development controls in order to avoid the destiny of the former plans that were unsatisfactorily implemented. The paper, applying deductive and comparative research methods, questioned the validity and sustainability of the plan's outcome such as creating nine new satellite towns to accommodate six million people for such an already sprawled city. The paper also highlighted some locational and land use planning problems of urban activities that also question the issue of sustainability.

Keywords: *Khartoum city, sustainability, structure plan, new towns.*

1. Introduction

Greater Khartoum is one of the rapidly growing cities in the region that have evolved in a relatively short period from a small colonial settlement into a large metropolitan area and expected to grow as a megacity in a short period. Such quick development was accompanied by complicated planning problems. The government of Khartoum state is working under the pressure of the shortage of financial and technical resources to resolve those complex urban problems and to provide services, infrastructure, and housing. Khartoum State authorities prepared and approved a structural plan in 2009 to set some future strategies to deal with those problems and planning issues and to control the urban development during the next twenty-five years.

The preparation of Khartoum structure plan came as a response to the international development policy frames that call for the improvement of the living conditions of the human settlements in the developing countries. Such policies have recognized the need for a multi-sect oral approach to urban development and for encouraging sustainable development in improved urban conditions (UNCHS & ILO, 1995). It advises local and national governments to improve the management of urban development in their countries, through assistance in promoting participatory efforts of all the stakeholders to implement the new approaches and introducing new urban management systems and techniques (UN-Habitat, 2003). This

Research will fulfil two main purposes. First; critically review and evaluate the main proposed structure plan strategies and to examine their effectiveness and sustainability. Second; discuss and highlight possible actions, prospects and set some guidelines that can contribute to the plan proposal.

Khartoum city is facing complex planning problems that constrict its role as an important urban centre. It also faces difficulties in the achievement of sustainable development. Sudan's government is sect oral in operation and lack sufficient coordinating mechanisms within their organizational and management structures and institutions at both central and local levels. Khartoum faces an unprecedented pressure on its resources and infrastructure, transportation and environment straining them to a breaking point. The government often adopts unrealistic policies and planning programmes, and there is often a failure to predict economic growth and population growth. All these factors have affected the planning practice and the development plans outcome which constrain applying sustainability measures. Urban planning in Sudan has failed to deal with the consequences of rapid urbanization, where city administrators failed to provide adequate services, housing, and infrastructure for the dauntingly increasing population and urban management (Post, 1996). The city faces a structural and gradual process of 'deplaning' and a continuous decline (Ahmad, 2000).

2. Theoretical background

This part of the paper provides a theoretical background of the main issues that relate to the research topic. Particular emphasis is given to three issues; sustainable development, structure plans theory and practice and the new towns paradigm.

2.1. Sustainable development

Sustainable development is taking global importance as a guiding document not only in human settlement development but also in all aspects of life. Its evolution passed through many stages. Table (1) outlines the evolution stages of sustainable development and related instruments. The world concern with environmental issues dates back to 1972 when it was clearly outlined in the Stockholm Declaration which dealt with the three elements of sustainable development economics, environment, and society. The Brundtland report provided a polarized concept of sustainable development and precise definition. A series of meetings and conferences took place on sustainable development under different titles after the Stockholm Declaration producing different instruments and was culminated in the last Quito Declaration on the New Urban Agenda in October 2016.

Table 1. International instruments of sustainable development and its evolution Source: After (Mahbub, 2016) (UN, 2017) (Du Pisani, 2006)

	Instruments	Year	Contents/ description
1	The Stockholm Conference and Declaration	1972	The UN conference on Human Environment issued "Stockholm Declaration" dealing with environmental, economic and social justice, the three elements of sustainable development.
2	The World Charter for Nature	1981	The Charter is an ecological instrument proposed rules of sustainable use of natural resources that they should not be excessively used and recommended regeneration and reuse.
3	The World Conservation Strategies	1980	About fifty countries initiated " the World Conservation Strategy 1980" and "Caring for Earth: A Strategy for Sustainable Living, in 1991", the first time the term sustainable development was used as an instrument.
4	The Brundtland Report	1987	A report by Gro Harlem Brundtland providing popularized the concept of sustainable development and was defined as meeting the needs of the people and maintaining the economic development without compromising the needs of the generations to come.
5	The Rio Declaration	1992	Included twenty-seven basic principles incorporating environment in development policies inducing sustainable development.
6	Agenda 21	1992	A document integrating environment and development calls for the fulfilment of the basic needs of people, improved living standards, protected ecosystem, safe and prosperous future.
7	The forests principles	1992	Calls for management, conservation and sustainable development of the world's forests
8	The Copenhagen Declaration on Social Development	1995	Makes linkage between economic development, social development, and environmental protection, the key element of sustainable development.
9	Istanbul Declaration on Human Settlement: The Habitat Agenda Habitat II	1996	The City Summit held in Istanbul called for the development of human settlements adopting sustainable development measures.
10	United Nations Millennium Declaration	2000	Specified eight goals identified as Millennium Development Goals and integrate sustainable development principles in the country's policies.
11	Johannesburg World Summit on Sustainable Development 2002	2002	Reaffirming commitment to sustainable development.
12	United Nations Conference on Sustainable Development (UNCSD) (Rio+20)	2012	Recognized the importance of sustainable development, the inclusion of the private sector in the process and proposed the idea of green economy as an instrument for sustainable development.
13	The Sustainable Development Goals 2015, The New Sustainable Development Agenda	2015	Launching of 17 sustainable development goals to be achieved by the year 2030 known as SDGs.
14	The New Urban Agenda, Quito Declaration Habitat III	2016	Provides global principles, policies, and standards to achieve sustainable urban development, to transform into better ways of living in cities.

The heart of sustainable development is to ensure a better quality of life for all people, now and for generations to come. Its primary objective is to ensure prudent use of the available natural resources viz., land, human resources, capital and time. Land in its broader sense involves cultivable and developable land, water resources, minerals, forests, flora, and fauna. In such a scope, it is the primary task of the planner whose primary task is to utilize these resources in the best manner. Land use planning and city structure plans should apply sustainable development measures and conform to the valuable outcome of those conferences and documents.

Housing and human settlement development policies require the strong will of the governments to adopt more sustainable ways of shelter delivery, and they should adopt effective implementation strategies (Erguden, 2001). Sustainability implies the positive contribution that shelter and slum upgrading can have on urban development. This implies that the solutions outlined by the structure plan should indicate the sustainable use of the land and housing systems.

Sustainability is associated with the quality of life in the community. It deals with the economic, societal or environmental systems. The three constituents are promoting healthy, productive, meaningful lives for all population in the present and the future. Instead of viewing treating the three segments independently, they should preferably be treated in a way that shows the link between them (Fig. 1). For example, when dealing with economic production, enough attention should be given to the negative consequences on the environment and the society, which should be avoided or at least minimized, similarly when dealing with each segment. realisation of the human rights to adequate housing.

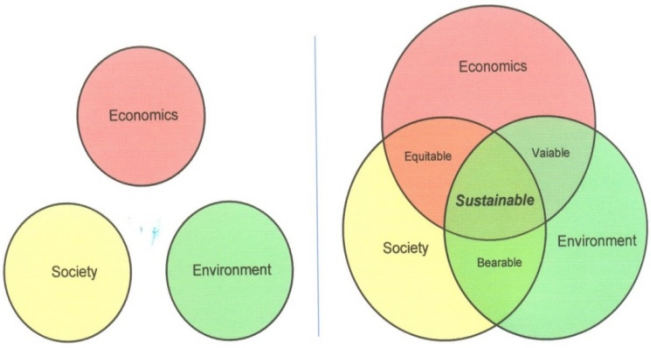

Fig. 1. Segments of sustainable development as unrelated and linked parts Source: After (Sustainable Measures, 2018)

2.2 Structure plans theory and practice

Rethinking the way nations view their future and the vision of their built environment is no longer optional, and it is becoming imperative (UN, 2017). Structure plans are one of the basic types of the development plans, which include but not limited to local plans, district plans, action area plans, and subjects plans and a long list or urban improvement prescriptions of spatial planning. The structure plan is a statutory policy document that includes a written statement and diagrammatic maps and plans; its main function is to interpret national and regional policies into a spatial plan, establishing community goals and objectives, policies and general proposals. Structure plans provide a framework for the local plans and indicate action areas, provide guidance for development control, provide a basis for coordinating decisions, and finally bring before the official authorities the planning main issues and decisions (MHLG, 1970). Supplements may include statistical, spatial and GIS data basis and surveys results.

Sustainable development views the three systems in a way that the objectives should realize social progress which recognizes the needs of all, adequate protection of the environment, maintenance of high and stable levels of economic growth and employment.

The principles involve putting sustainable development in the centre, fair shares for all people, valuing nature, polluter penalties, good governance and adopting a protective approach. Anis-ur-Rahmaan and Anis (1996) pointed out that sustainable development under the Islamic ideological rule means “prevention” is better than “cure” and they suggest that it advocates the utilization rather than wastage of consumable resources; conservation rather than depletion of the natural resources; and improvement rather than demolition of the built environment (Anis-ur-Rahmaan & Anis, 1996).

Land use planning and structure plans are strongly connected to sustainable development as they deal with the urban land factor. The Habitat Agenda (paragraph 105) recognizes the importance of sustainable urban development in that it "requires consideration of the carrying capacity of the entire ecosystem supporting such development, including the prevention and mitigation of adverse environmental impacts occurring outside urban areas" (UN-Habitat, The Istanbul Declaration of the Habitat Agenda, 1997). The international policy frames entailed a commitment to realising better living standards, ensuring safer human settlements, and making them healthier, liveable, equitable, sustainable and productive. It also constitutes a commitment towards increased freedom, improved quality of life within the settlements and progressive

A structure plan provides a framework for the coordinated provision and arrangement and allocation of future land use and urban activities, land subdivision and development in new unused urban areas (Greenfields) and in existing developed or redevelopment areas (brown fields) in metropolitan and regional areas. The structure plan coordinates the provision of transport networks, public open space, infrastructure and services networks, urban water management, development standards and community and other infrastructure investment and staging programs (SWA, 2012). It is a vital planning instrument for the exploitation of land held in different land tenure types. It often looks into the existing urban conditions, explores and identifies the planning problems, and the future needs of the population and urban activities.

A structure plan is a long-term strategic plan that addresses and incorporates strategies and the directions of future development and State planning policies. It often aims to fulfil the objectives of realizing optimized, long-term, positive environmental, economic, social and cultural effects of green fields. It is important to note that structure plans are not used for the built form design of small residential lots (SWA, 2012).

The challenges of planners face involve bringing about the community goals into practice and resolve the conflicting objectives of all the community sectors and come with a plan that reflects all the interests. Issues dealing with land allocation and planning requires qualified planners who are capable of preserving the value of planning and inducing the future change of the community. Incompetent planning practitioners who are unable to serve and interpret the interests of the politicians, organizations, cultural values, public, the wider community and NGOs, future generations or the profession will cause disastrous results (Campbell & Marshall, 1998).

2.3 New towns paradigm

The idea of the new towns adopted in the structure plan of Khartoum is influenced by the modernist approach of planning lead by Ebenezer Howard and Le Corbusier and **"**Congrès International d 'Architecture Moderne**"** (CIAM). Le Corbusier believed that the harmonious city must be planned by experts who understand the science of urbanism. Hobson (1999) suggested that new towns, as a tool of the modernist planning project, cannot meet the criteria of social justice as eliminating domination and oppression (Hobson, 1999). Le Corbusier asserted that new towns should be built on a clear site (Hobson, 1999). New towns in Europe came as a new urban policy that formed a solution to the overcrowding and traffic congestions in the city region, and the emergence of high-density residential developments that changed the urban character coupled with a desire to create better-living patterns all driven by urbanization characterizing the post-war period. Only a few of the new towns of England have succeeded in their aims. Milton Keynes is one of those exceptions mainly because it is located in a wealthy region. Concerns were about employment, deprivation, underused public spaces, the dominance of car use and characterless streets, crime and drugs, and lifeless city centres (Karimi & Vaughan, 2014).

The planning principles of the new towns in Britain involved neighbourhoods centred around a primary school and public spaces, zoning of the industrial and residential areas, pedestrian-friendly town centres, ease of movement integrated green infrastructure network, innovative architecture and design, emphasis on social housing and self-containment and space for social and community development (TCPA, 2014). The practice of the new towns though sounds an attractive idea in the western countries. It ranged between failures and successes in the developing countries. The population, the natural setting, and the economic conditions played an essential role in the degree of success. New towns in countries with substantial stable and good economic conditions such as Malaysia have successful cases such as Putrajaya, while countries such as Bangladesh, the case of Purbachal, and Egypt have mixed failures and successes (Hasanat & Shamsul Hoque, 2016), (Al-Lahham, 2011).

The new towns proposed in the structure plan of Jeddah City, for example, included four villages. The proposal of the new towns in the structure plan of Jeddah city was remarkably unattractive as a solution to the problem of urban growth. The proposed new towns were not adopted or developed more than ten years since the structure plan was first adopted. One of the alternative strategies was the infill and densification by changing zoning regulations in some areas where density is to be increased.

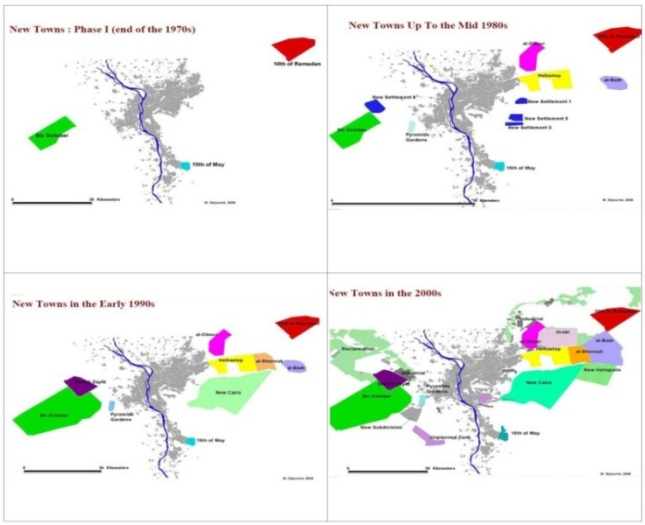

Fig .2. The development of the new towns around Cairo, Egypt[i]

The new towns around Cairo were characterized by the lack of independent economic base which caused reliance on the central city of Cairo and heavy, pendulous traffic flows for jobs, services, and recreation, slow development of cities ascribed to the lack of finance and tenure system, the lack of attractiveness potentials, inappropriate sitting and locations of the new cities. The relative closeness of the new towns to Cairo caused magnetic expansion (Al-Lahham, 2011). Most of the previously mentioned issues are not compatible with sustainability measures. Feeler (1990) argued that the reasons why the new towns of Egypt failed to attract inhabitants are the lack of central planning, the lack of employment opportunities, the lack of cultural and social facilities and the lack of economic base that supposed to be built prior to the residential areas, settlement size not conforming to the economic potential, the lack of vitality, emphasis of targeting low-income making the settlements unattractive, higher cost of living than Cairo, and Alexandria, although housing prices are low, they are still unaffordable by low-income households (Feiler, 1990).

3. The planning of Khartoum

Greater Khartoum is the capital city of Sudan. It consists of a conurbation of three cities; Khartoum, Khartoum North, and Omdurman separated by rivers. The three cities are integrated and functionally perform as a single large metropolitan area, but each city has a substantial degree of independence and self-containment. Greater Khartoum is the major urban centre in Sudan where all high order national services are located. The population of Greater Khartoum is 5.5 million and expected to reach 13 million by 2033 (MEFIT, 2009). Four development plans were previously prepared for Khartoum; Mac Lean's Plan in 1910, Doxiadis Master Plan in 1959, MEFIT Structure and Beautification Program in 1974, Doxiadis and Mustafa Structure Plan in 1991.

The structure plan by MEFIT / CENTECS is the fifth plan prepared in 2009 for the next 25 years. Hafazalla (2008) highlighted the pitfalls of these plans and the wide gap that existed between proposals and implementation. Those development plans were not designed on practical grounds, and

they lack utility value. The majority of the proposals inherent in the plans were not implemented and sometimes changed or kept as records (Hafazalla, 2008). For example, a crucial unanticipated decision was taken to relocate the site proposed for the new airport from Khartoum North to South Omdurman, causing land speculation, and fuelled up the land prices and squatting around the area and attracted the urban development in the direction of the new location. The failure of implementation was primarily a result of the lack of political will and administrative capacity of the governments.

4. Sustainability of Khartoum Structure plan's strategies

This part of the paper gives a concise discussion of issues that have been given substantial consideration in the structure plan of Khartoum and have a considerable impact or entail argument on realizing sustainable development. The discussion deductively explores the extent to which Khartoum Structure Plan failed or succeeded in the achievement of sustainable development.

4.1. Plan Methodology

The methodology adopted for the structure plan of Khartoum is likely similar to the practice in the 1960s and the 1970s in Britain when the agenda of the broader environmental movement began to focus on substantive issues such as scarcity of natural resources, the planning system remained primarily preoccupied with accommodating and managing urban growth and car-based expansion. Development plans, produced in a culture dominated by architects and engineers who treated the environment as a recreational resource (Davoudi & Layard, 2001). The evidence is clear in that the structure plan of Khartoum gave detailed waterfront plans of the rivers while less emphasis was given to the other vital issues such as infrastructure, squatting, and the environmental degradation which form the fundamental issues that address sustainability.

The methodology adopted is likely blueprint planning. The plan depicted a high bureaucracy of plan preparation portrayed in the large number of committees which involved politicians, administrators, and non-professionals who distracted the professional vision of the structure plan. It is usually the primary task of the consultant to bring about the public vision into the plan's outcome under a purely professional ground and centred on sustainability.

It is observed that the structure plan of Khartoum has adopted a strict (project-based) methodology which disaggregates the plan into 1200 projects that can be implemented in phases of five years identifying the prospect project stakeholders and the project cost estimate. Structure plans are known and classified in professional practice as comprehensive plans. Such a project-based method is a sect oral method of development which may not fulfil sustainability objectives in terms of viewing the societal segments of development as interlinked elements. Projects are strictly scheduled out into the phases with no remarkable flexibility and any clear interrelationships between projects that can have a specified impact on development and no clearly identified goals and objectives of each phase. Such a method of phasing would have been appropriate if the country adopts regular five-year socio-economic plans where the objective of each phase is to be designed in conformity with those socio-economic plans. Sustainable development requires organized planning implementation to attain predefined future goals that meet its measures. The main focus of the plan should be the conceptual outcome that resolves and comprehensively address all the planning issues, next focusing on implementation issues, phasing, and finance.

The proposed structure plan has shown a large span between the structure plan and detailed building and housing design alternatives. The plan included some urban design proposals for some selected parts, samples of land subdivision including three-dimensional drawings. However, the structure plan, though it is a strategic long-term diagrammatic proposal, the methodology have gone far beyond its scope, while more detail was needed in some issues that strongly related to sustainability such as infrastructure and environmental qualities and housing.

The proposed structure plan did not identify the urban growth boundaries (UGB) which helps the planner and the planning authorities to have clearly defined limits within which land uses and urban activities could be allocated or provided. The UGB helps also defining a clear boundary between greenfield and the brownfields of the regions. Problems and issues of each can be dealt with separately because they are different. The plan also ignored that Greater Khartoum is a conurbation of three well-defined cities, each having a specified natural setting, physical setting, economic and cultural differences. It may be somewhat controversial, which is more sustainable; to deal with Greater Khartoum as a single urban entity or to deal with each city as a separate entity in the first step and a single entity in the next step.

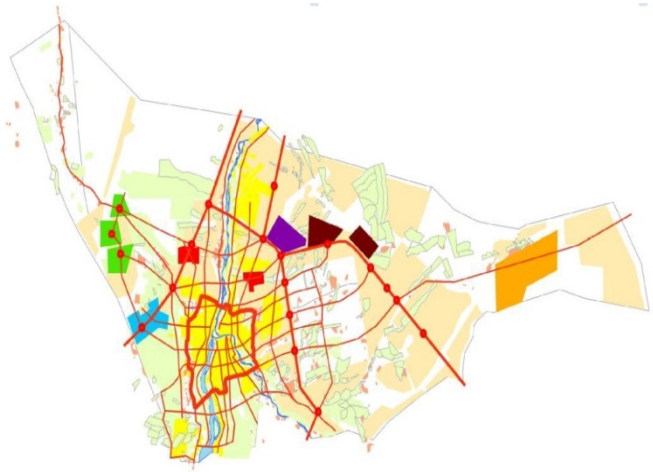

Fig .3. The proposed new nine satellite towns in the structure plan of Khartoum Source: (MEFIT, 2009)

4.2 The structure plan proposed strategies

The structure plan ignored Touti Island that has a unique location at the Niles confluence (MEFIT, 2009). Touti is not only unique at the local level but also a distinctive landmark that can be globally pinpointed. Touti represents a remarkable planning opportunity that can contribute to the development of Greater Khartoum owing it to its semi-virgin and physically and economically underused land that can absorb much of the demand for some central activities needed by the city while conserving the natural setting of the island. It is likely that the proposal has taken into account the will of Touti inhabitants

who resist any interference in the physical setting of the island. Sustainability dictates that current resources should be used for the people and the generations to come. However, such a situation needs to be resolved by simultaneously preserving the will of the people and develop the island for the benefit of all on the win-win principle.

The plan gave the proposals for five different levels; trans-national, interstate, regional, urban and rural. Such a methodology created a cumbersome plan outcome. Planning in each level requires different methodologies in terms of plan details, issues, policies and strategies, and the plan's outcome
It is argued that high urban densities help to achieve the provision of economically viable levels of services and amenities and enhance social sustainability. However, on the downside, the compact city may become overcrowded and may cause the loss of urban quality of life, loss of public spaces, congestion, and pollution (Jenks, Burton, & Williams, 1996).

The principal activity areas were unsatisfactorily emphasized in the structure plan, such as the new airport, the CBDs of the three towns and the major industrial areas and warehouses. Such activities form the major traffic generators. The proposed plan layout did not reflect the influence of these activities. CBDs of the three towns remained without a remarkable increase in their size. Theories show that as the city expands the CBD increases and invade the surrounding areas.

One of the strategies of the structure plan is to relocate and decentralize the governmental institutions which are historically located in the city centre of Khartoum city. This practice has inhabitants are poor people who certainly cannot afford to expand or extend houses vertically, similar to the Egyptian model. This makes the self-help housing applied in Khartoum an unsustainable mode owing it to the large plot size standards and the tolerant process of allocation and absence of cost recovery. The housing sector in Sudan is characterized by the weak building industry, unskilled labour, poor or traditional building technology, lack of formal finance, weak regulatory framework, diminishing land supply and commercialization of public land, lack of services and infrastructure (Hafazalla, 2007). These problems make the self-help the dominating mode. The densification and the new towns strategies require efficient building industry and more sustainable market-oriented housing modes and abandonment of the sites-and-services mode, before the adoption of those modes.

4.3 Transportation

Sustainability is strongly associated with the efficiency and the mode of the transportation system. Modes of transportation have different impacts on the environment and sustainability. There is a working hierarchy of transportation modes prioritized according to their sustainability, pedestrian and cyclist first, next public transport, and then private cars come last in principle. Pedestrian and cyclists besides being non-polluting they contribute to human health (Marshall, 2001). Many alternative urban transportation policies influence the travel demand and reduce trip generation hence contributing to sustainable development. A basic element in development plans is the traffic movement and the design of roads and the modal split design of the traffic. The road system and hierarchy is a major component of the structure plan. Marshal (2001) pointed out that sustainable measures of transport include creating compact cities through densification, mixed-use development, public transport oriented development, controlled settlement size, creating walk and cycle friendly development and optimizing the location of services concerning homes (Marshall, 2001).

been going on during the last two decades or so. Apparently, the structure plan confirmed and adopted this practice without reconsideration of its viability. Similar actions were done before to the railway station, shopping and vegetable markets and public transport terminals. The primary purpose is to reduce the attraction of traffic in the CBD. Theoretically, CBDs are an essential element in urban structure and play vital economic, cultural and touristic role, besides providing the highest order services of the economy.

The city centres are dominated by retail and wholesale services, business, finance, and administrative activities, shopping, hotels, restaurants, transportation terminals, and tourist activities but few residential uses. The CBD is traditionally the focal point of the city. Its strength and attractiveness is a result of the concept of economy of agglomeration. Apparently, the structure plan's strategy of decentralizing these activities or partial relocation results in weakening the vital role of the CBD. Resolving the traffic should not be at the expense of weakening the role played by the CBD, which would instead be consolidated.

Housing provision in Sudan heavily relies on sites-and-services and squatter upgrading, the two arms of self-help. Such options affected the massive consumption of urban land, though they play a significant role in housing provision they resulted in the problem of urban sprawl. The strategies of building new towns will further exacerbate the conditions unless alternative housing options are adopted. The densification strategy will not be applicable because the current self-help mode is an owner-occupier mode and the

Out of these strategies, the structure plan adopted densification strategy and large settlement sizes that can accommodate around 600000 populations. On the other hand, the plan did not adequately consider other sustainable transport strategies. A review of the transportation master plan for Khartoum which was prepared by the State Ministry of Physical Planning (MEFIT, 2011) (MEFIT, 2009), shows an intensive local area-based traffic survey and analysis of the traffic, while one of the structure plan's main elements is the primary and secondary transport networks. Other local roads and modes are treated in the local and the detailed development plans.

Major transport routes assignment is a basic task of the planner who functionally connects the major city parts and functional zones and the major city traffic generators through careful analysis of the city structure. The detail and technical designs of roads including road capacities and junctions usually comes at a later stage after the approval of the development plan and carried out by specialists and traffic engineers. A consultation with transport engineers at the planning stage is an integral part of the planning process to ensure commitment to the technical standards. A salient remark on the structure plan proposal is that the primary road network is not strongly nested or interlinked and connected to the primary traffic generators. Also, the lack of continuity and resilient hierarchy reduces efficiency. The plan is dominated by a strong, long distance, single irregular ring road linking the three cities, forming a primary element of the plan.

The plan treated the three cities as a single entity. Primary road network enables traffic to enter and leave the city rapidly and safely or to circulate freely within it. The primary road system's function is to divert away through traffic and to link major urban activity areas. The plans layout did not adequately consider these measures. Such solutions do not conform to sustainable transport measures.

4.4 Infrastructure

Infrastructure is a principal component in the preparation of the structure plan. It is an essential element to be addressed if sustainability is to be achieved. The main problem of most developing countries is that the provision of urban infrastructure is far below the desired levels. Conditions in Khartoum necessities that infrastructure provision should be given the highest priority, owning it to the remarkable shortage of water supply, electricity supply, sanitation, drainage, solid wastes disposal, and urban transport. Choguill (1996) put forward a model for the provision of sustainable infrastructure in the developing countries that involved ten steps. He suggested that infrastructure can be provided progressively, taking into consideration the financial and technical constraints in the developing countries (Choguill, 1996). The plan did not satisfactorily give clear infrastructure systems at the urban level including sitting of the primary infrastructure components and primary networks.

4.5 Development controls

Haywood (1985) described the urban planning problem of Khartoum in terms of, "firstly; the lack of effective mechanisms for planning and control of the city's growth, which has resulted in a pattern of sprawling low-density land uses with inadequate services and deteriorating environmental standards. Second, planning control, land-use zoning and building bylaws are often applied arbitrarily. Third, planning problems are exacerbated by high population growth rates and national economic problems" (Haywood, 1985).

The regulatory instruments in Khartoum include some planning and land laws that date back to the early period of the Anglo-Egyptian colonial rule that continued without reform despite the enormous urban expansion (Post, 1994). Planning and building bylaws are severely inadequate. Sustainable development requires an effective regulatory framework and effective development controls that aim to reduce environmental degradation, inefficient use of land resources and the preservation of the natural environment and ecological setting and reduce pollution. Clear and strictly applied standards, zoning regulations and density controls are vital components of the development plans. The plan consultants seem to have faced a real problem of inadequacy of the existing regulations and development controls, keeping them insufficiently resolved.

5 Conclusions

The structure plan of Khartoum covered sustainable development measures in the discussed issues with varying emphasis and depth. Some were unsatisfactorily covered and may need rethinking. These involve the clarity of the urban systems, comprehensiveness and development controls. Some strategies look attractive in theory such as the new towns strategy and the densification, but in reality, they can hardly be achieved under the current circumstances of the country, besides that their adoption in such circumstances may not conform to sustainability measures. The proposed settlement size of six-hundred thousand populations in the structure plan, for example, seems an over-sized satellite town, or a large city.

The new town's strategy, as proposed by the Khartoum structure plan, may further require reconsideration, based on the theoretical review and the detailed analysis of similar cases, with particular reference to Egypt and England. Sustainability measures need to be further enhanced in the development plans outcome. The new towns overuse the available land resource which conflicts with sustainability measures. The two proposed strategies are conflicting, the densification strategy of the old city region and the new towns strategy. While the first increase the population in the city centre, which can be regarded as sustainable, the second attracts population to the urban fringe causing urban sprawl and can be regarded as an unsustainable solution.

Lessons learned include questioning why the previous development plans did not work and why the existing conditions are far behind the desired levels. It is necessary to identify clear and realistic objectives capable of being implemented and the need to design comprehensive programmes. Solutions should reflect the conformity with the available resources and investment flows so that it can reflect more sustainable development solutions.

Acknowledgment

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Disclaimer

It should be noted that many of the reports of the structure plan pointed out by a reviewer are not published and held by the consultants, which would have shown more details of the proposal. The author was able to review some reports that included the "Transportation Master Plan of Khartoum, Phase 1 report: Data Collection and Analysis" and two volumes of the master, which were quite enough for the research scope. However, another report on The Sanitary Master of Khartoum was not accessible, though it could have added more depth in infrastructure analysis.

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[i] *Source (after): http://siteresources.worldbank.org/INTHOUSINGLAND/Resources/339552-1180637750307/Cairo.pdf, accessed 19.8.2015,*