Sustainable Construction in Sub-Saharan Africa: Relevance, Rhetoric, and the Reality

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1. Introduction and Background

Only with time was the concept of environmental sustainability going to become a dominant feature in the analysis of the relationship between the construction industry and the rest of the economy. Already, and as a result of the possible backward and forward linkages afforded by construction activities, the emphatic link between the construction sector and the wider economy has been theoretically and empirically acknowledged (Turin, 1969; Drewer, 1980, Moavenzadeh, 1984, Ofori, 1988). It is within this nexus that the significance of the construction sector to environmental sustainability is defined.

The construction sector, relative to its level of development, accounts for more than 60 percent of gross capital formation in most countries, and defines the physical infrastructure upon which effective growth and development is achieved. Construction activities extend beyond the erection of houses, hospitals, schools, offices and factories to civil engineering works such as roads, bridges and communication infrastructure. In fulfilling these roles, the construction industry exerts enormous demand pressures on global natural resources. The environmental significance of such pressures come into play when some of these resources are depletable and non-renewable, bringing the construction industry in direct conflict with the physical environment.

The concept of environmental sustainability focuses attention on the 'carrying capacity' of the physical and biotic environment under which all living species are sustained. This capacity has come under considerable pressure and threats from the huge and insatiable demands exacted by mankind for sustenance. This is particularly so given the huge increases in global population and the need to accelerate economic growth and development to ameliorate global poverty, the costs of which is disproportionately shared by the developing countries. Nevertheless, the strategies and processes that have been adopted in pursuit of economic growth and development, relative to the production and technological functions have been very resource intensive. These strategies and processes are themselves the products of habits and lifestyles that are constantly changing in ways that impose further demands on global natural resources.

The environmental consequences of undermining the earth's 'carrying capacity' unfolds regularly and often manifests in huge catastrophes such as flooding, mudslides, increased variability in global climate and the disappearance of several species of fauna and flora. These manifestations are clear evidences that one of the fundamental principles of environmental sustainability, which is that "current needs should be satisfied without compromising the needs of future generations" has been violated. In other words, the course of action presently adopted to provide food, shelter, clothing, and other basic necessities must not be at variance with the carrying capacity of the natural environment and must take full cognisance of the inter-generational as well as intra-generational equity implications of resource depletion.

The call and desire for sustainable construction is in realisation of the construction industry's capacity to make a significant contribution to environmental sustainability because of the enormous demands it exerts on global resources. The construction industry accounts for one-sixth of global fresh water consumption, one-quarter of

global wood consumption and two-fifths of global material and energy flows, and almost one-quarter of ozone-depleting gases come from air-conditioning units in buildings. Apart from global resource consumption, the industry also generates waste on a scale that dwarfs most other industrial sectors. Given the conflicting scenario of the rapid depletion in global natural resources simultaneous to the acceleration in global population, it is imperative that the attendant demands on global natural resources are balanced with the 'carrying capacity' of the physical environment.

Thus, the concept of sustainable construction is a direct response to the continuing rise in global resource consumption and the attendant deterioration in the global physical and biotic environment. However, just as the concept of environmental sustainability is still unfolding as knowledge about the environment improves, so is the understanding of sustainable construction as a concept, which now extends beyond the fabric of the built environment. Thus, the concept of sustainable construction now transcends environmental sustainability, embracing economic and social sustainability, which emphasises possible value added to the quality of life of individuals and communities.

Generally, responses to global environmental deterioration vary greatly, and so is the case with sustainable construction. A marked distinction exists between the developed countries and their developing counterparts in their ability to deal with environmental problems. This ability is defined by their capacity to initiate and implement effective environmental policies. However, there is a huge gap between these blocks of countries with regards to technical and financial capacities, which are crucial to the successful rearrangement of economic and social relations as applied to production and consumption. The main difference is in institutional capacity, which underpins effective policy formulation and implementation.

Specifically with regards to the construction industry, the developed countries have been able to steer the industry in response to global environmental concerns with a range of policy initiatives and instruments. Through legal, planning, and economic institutions robust fiscal and regulatory policies have been employed to steer the construction industry towards environmentally sustainable practices. The significance of institutions as a necessary prerequisite to environmental sustainability is often ignored, especially in the case of the developing countries where they are assumed to be present, allowing policies that are largely incongruent to the peculiarities of these economies to be formulated. Sub-Saharan Africa is a typical example of where policies that give no recognition to the dearth of financial, human and institutional capacities are openly advocated for the continent.

It is in response to such institutional gaps and policy vacuums that the relevance and realities of a sustainable construction process in sub-Saharan Africa is critically analysed. The object of such analysis is to pose numerous questions about the scope of and limits to the sustainable construction process in sub-Saharan Africa, particularly given the rudimentary state of the construction industry and the attendant challenges. As the experiences of other countries show, the structure, conduct and performance of the construction industry are crucial to the sector's ability to respond to policy initiatives and development strategies. The failure to appreciate that the functional existence of a construction industry is a necessary prerequisite to the sustainable construction process is akin to treating a castrated man with a dose of 'Viagra' with the hope that one day he can function again as a man, ignoring the need for his natural assets to be in place for any medicinal therapy to succeed. This simple analogy sums up the increasing frustration felt by many when esoteric policies, albeit prescribed with genuine intent but vague as to whether they are born out of pity or frustration, are prescribed for sub-Saharan Africa.

This paper is divided into seven sections, the first part being the introduction. The second part details a critical analysis of the link between the construction industry and the physical environment, inviting the call for sustainability in the construction process. This is necessary to acquaint ourselves with the various possible transmission processes through which the construction industry impacts on the physical environment. The third section presents the various understandings and approaches to sustainable construction, and particular attention is given to policies and strategies directed at achieving sustainable construction. By such analysis, the challenges of sustainable construction are highlighted, particularly the onerous nature of such challenges is discussed in the light of sub-Saharan Africa's experiences with construction industry development.

The fourth section focuses on sub-Saharan Africa's construction sector, especially the structure, conduct, and performance, which is necessary in order to ascertain whether the current structure and organisation of the industry affords it the capacity to respond to the kind of policy initiatives likely to produce a construction process that is sustainable. The fifth part critically discusses the relevance of sustainable construction in sub-Saharan Africa, having taken into consideration the rudimentary state of the industry. In particular, whether or not a sustainable construction process is possible at such a low-level equilibrium of construction activities found in sub-Saharan Africa's construction sector, is critically analysed.

The sixth part critically considers the realities of sustainable construction in sub-Saharan Africa and further considers, in light of preceding discussions, whether achieving sustainable construction in sub-Saharan Africa's construction process is a possible reality or rhetoric.

2. Environmental Sustainability and the Construction Industry

The physical environment and the construction sector are linked principally by the demands made by the latter on global natural resources, and this assumes huge environmental significance with the rapid growth in global population growth and the attendant implications for natural resources. This is especially the case with housing and infrastructure, which are very resource intensive. The construction sector accounts for one-sixth of total global fresh water consumption as well as directly or indirectly consuming between 30 to 40 percent of total global energy. At the same time, the construction sector generates huge waste, accounting for between 20 and 30 percent of total waste generation, which becomes even more significant with the inclusion of demolition waste. In addition, some of this waste includes 'greenhouse' gases of which the construction industry is responsible for between 20 and 30 percent of all 'greenhouse' gas emissions. This is particularly the case when the building and production material phases of building are combined with the operational phases where the greenhouse gas implication of enhancing the thermal comfort performance in buildings is taken into account.

The intensity of natural resource consumption by the construction sector is shown in the cases of the Philippines and Chile. In the Philippines, wood consumption by the construction industry increased by 40 percent between 1990 and 2000. In Chile, 60 percent of all woods leaving the sawmills is consumed by the construction industry.[3] The environmental implications of such intensive consumption of wood are obvious and are reflected in the physical degradation of environmental media such as land and rivers, and have contributed to atmospheric pollution because of the vital role of trees in the ecosystem. Topsoil erosions and the attendant effects on loss of vegetation, landslides, and the rapidly expanding of desertification around the world attests to the adverse environmental effects of deforestation, which is accentuated by increased wood consumption by the construction sector.

Indirectly, the construction industry is also an intense consumer of global natural resources particularly at the processing stage of construction materials, the majority of which are very resource and energy intensive. These include:

- zinc;
- tin;
- iron ore;
- aluminium;
- lead;
- cement;
- tiles;
- bricks;
- steel;
- glass; and
- paint.

These products embody huge energy resources, which occur during the process of conversion from raw material to manufactured construction products. The 75 percent share accounted for in total energy consumed in the construction sector evidences the energy intensity of building materials. For example the embodied

energy for a square metre of fired clay is 158 mega joules while a square metre of corrugated iron sheet requires 605 mega joules of energy to process. Apart from the huge amount of energy embodied in these products, massive environmental pollution occurs during processing where toxic gases and effluents are discharged into the environmental media with devastating effects on aquatic and marine life, as well as contributing to atmospheric pollution. Some of the gases emitted at the material processing stage include 'greenhouse' gases, which have been implicated in the incidence of 'global warming', and these include:

- carbon dioxide (CO_2);
- sulphur dioxide (SO_2); and
- nitrogen dioxide (NO_2)

It is important to recognise that CO_2 is acknowledged to account for more that 50 percent of 'greenhouse' gases.

Although further work is required in this area of academic research, the estimates presented in Table 1 nevertheless provide a benchmark for considering the environmental implications of building materials processing.

Table 1: Analysis of Embodied Energy Content and Gas Emission for Three Construction Materials

Emission per Kg of product (dry material)			
Gas Types	**Structural Timber**	**Roof Truss**	**Cladding Boards**
CO_2	95.7g	98.4g	94.1g
CO	5.91g	8.33g	5.83g
NO3	3.39g	4.02g	3.34g
SO2	0.112g	0.121g	0.110g
Some selected raw materials consumed per product (dry material)			
Wooden raw material (wet/dry)	4900/2660g	5400/2940g	4830/2750g
Phosphate fertilisers	0.300g	0.331g	0.295g
Nitrogen fertilisers	1.71g	1.88g	1.61g
Potassium fertilisers	0.300g	0.331g	0.295g
Pesticides	0.0173g	0.091g	0.0170g
Fossil fuels	1.40 MJ	1.38MJ	1.38MJ
Renewable energy (Higher heating value of logs)			
Renewable energy (Higher heating value of logs)	54.6MJ	60.2MJ	56.5MJ
Fossil fuels	1.40MJ	1.38MJ	1.38MJ
Electricity	0.0140MJ	0.0100MJ	0.00695MJ

Source: Tarja Hakkinen (1994), Environmental Aspects of Building Materials. First International Conference on Sustainable Construction, Tampa - Florida, November 6-9.

Three building materials common to construction activities have been considered for this exercise and each reveal a high presence of 'greenhouse' gases and embodied energy emitted during the manufacturing process. These products include:

- structural timber;
- roof trusses; and
- cladding boards.

Table 1 shows the amount of CO_2, CO, NO_3, and SO_2 that are released during processing. Thus, the construction industry has a pivotal role to play in global environmental sustainability because of the huge potential it affords

for reducing resource consumption intensity and enhancing global environmental sustainability. This aside, given that the products of the industry are used to underpin and facilitate all facets of socio-economic relations, it is possible to enhance social sustainability through the construction process. This is particularly the case with the labour intensive nature of construction activities and the opportunities it presents for poverty alleviation.

However, the capacity for job creation is crucially dependant on the nature and sophistication of the forward and backward linkages between the construction sector and the rest of the economy. The proportion of building materials and personnel sourced within the economy and the end use to which construction products are put defines this capacity. Where huge proportions of construction materials and expertise are imported, especially at the high value-added end of construction procurement, the backward linkages with the rest of the economy are weakened. Similarly, possible forward linkages with the rest of the economy are also weakened where the end products of the construction industry are used to facilitate activities that have little impact or consequence for local economy. This is particularly the case in the developing countries with post construction maintenance where the huge opportunities for job creation are lost due to the weak forward and backward linkages that construction activities have with the rest of the economy. The same applies to other areas of the construction process, where social sustainability could be enhanced, such as the equitable distribution of social costs and benefits associated with construction activities. In these areas, the institutional capacity to initiate and implement policies, and above all, the existence of a functional construction industry are important prerequisites to success.

The construction industry also has the potential to enhance global economic sustainability by its structure, conduct and performance. An economically efficient construction industry enhances environmental sustainability by ensuring least-cost methods of construction and optimal allocation of resources while discouraging waste. Of course there is a need to distinguish between technical or allocative and distributional efficiencies[1] given that a market may be technical or allocationally efficient yet may not necessarily be efficient on grounds of distributional equity, especially where the equilibrium price remains unaffordable to many outside the market. However, a technically efficient production process, especially in a perfectly competitive market environment should guarantee competitive prices that can be passed to consumers in form of lower product prices. Furthermore, economic sustainability can further be achieved within construction when associated social and environmental costs are internalised and reflected in final product price. However, this requires key macroeconomic variables such as prices, wages, and interest rates to be flexible and dictated by market forces. In other words, product, capital and labour markets should operate freely and unhindered by economic agents such as governments, trade unions, and monopolistic market structures capable of distorting market efficiency.

Similarly, and within the biophysical sphere, the scope for enhancing environmental sustainability is also huge, especially with regards to global resource consumption and in particular, depletable and non-renewable natural resources. This can be achieved by substituting recycled materials for new ones. For example, the Friends of the Earth and the Wuppertal Institute for Climate and Energy have since realised the huge difference that a sustainable construction process could make to global environmental sustainability. A drastic reduction in natural resource consumption by European Construction, particularly in energy intensive materials has been demanded.[2] In the case of the United Kingdom's construction industry, Friends of the Earth have demanded a 72 percent reduction in cement consumption, 88 percent reduction in aluminium, 83 percent in steel, 73 percent in timber and 50 percent reduction in aggregates. These reductions are considered necessary for the United Kingdom to fulfil its environmental targets and obligations by 2050. However, this would take a huge amount of environmentally proactive efforts where the synergies between the environment and development are captured in design and incorporated in the construction process to create buildings that are durable, functional and environmentally sustainable.

Evidently, construction activities have huge impacts on the physical and biotic environment, but the real challenge is to find ways of achieving dramatic shifts in attitudes in the different areas of the construction process. Many players exercise considerable influence at various stages of the building process, including

[1] The concept of technical or allocational efficiency is about the elimination of imperfections and externalities, allowing the market to work efficiently and thus allocate resources efficiently, especially in reconciling both social costs and benefits.
[2] Building (1997), February 21, p. 7.

design, construction, maintenance, building use and demolition. They include the architects, builders, the financial industry, local and national governments, the providers of many kinds of services associated with the use and maintenance of buildings, and the firms, organisations and households that either own or occupy buildings. Unless these players quickly embrace the rapidly unfolding environmental realities where changes to the global physical and biotic environment are becoming irreversible, the problems would not only persist but the consequences could become unmanageable.

Concerted efforts must not only be concentrated on sourcing new and environmentally friendly construction materials, but attention must also be given to innovative recycle and reuse. This would require, as part of the strategy, a practice of producing buildings and materials with a longer life span, which are easy to recycle and dispose of at a minimal environmental cost. Thus, adverse impacts of construction activities and products on the physical environment would only be effectively minimised through efficient use of natural resources, especially depletable and non-renewable resources.

3. Sustainable Construction Policies and Processes

This section briefly considers what it may take to achieve sustainable construction in the experiences of those countries that have attempted sustainable construction, especially with regards to policies and processes. It is necessary to undertake such an exercise in order to gauge the possibilities or challenges to sustainable construction in sub-Saharan Africa. This section draws heavily on the experience of the United Kingdom where the environment has ascended highly on the political order. It is also the case that the United Kingdom pursues its environmental agenda with a combination of policy instruments and regulatory measures, including economic policy instruments and command and control measures. Above all, the United Kingdom's government sees the construction industry as an important area in which to pursue its environmental sustainability objectives (DETR, 1999). This is because of the importance of the sector to the wider economy where it contributes 10 percent to the UK's gross domestic product and employs 1.5 million people. The industry is also noted for its huge consumption of primary products such as the 260 million tonnes of minerals consumed as aggregates and raw material each year. Equally, construction and demolition waste represents a significant proportion of total waste generation. For example 70 million tons of construction and demolition waste, including clay and topsoil was generated in 1989 in the UK. Thus, sustainability in the construction process is considered necessary to the wider UK environmental agenda, and given the unique position of the industry as the delivery vehicle for government's built environment policy, it is considered ideal for implementing environmental sustainability measures. The point that must not be lost here is the fact that the recognition of the importance of the construction industry by the UK government is not in isolation of the effective backward and forward linkages it has with the rest of the economy.

In the UK, the whole process of sustainable construction is actively led by the government, who have set out some key aims and objectives, namely:

- to promote awareness and understanding of sustainable construction;
- to present government's view on how the construction industry could contribute to sustainable construction;
- to indicate how government policies will be used to effect the necessary changes to facilitate sustainable construction; and
- to stimulate businesses to take action and to set and monitor progress towards targets for sustainable construction, these targets to be continually improved upon.

Also, specific areas where the construction industry is expected to contribute to the aims of sustainability were identified as follows:

- the construction industry must be profitable and more competitive,
- the construction industry must deliver buildings and structures that provide greater satisfaction, healthy environments, and value to clients and users,
- the construction industry must adopt corporate and social responsibility towards its stakeholders,
- the construction industry must enhance and better protect the environment, and

- the construction industry must minimise the impact of its activities on energy consumption and natural resources.

The approach adopted by the UK government is interesting given that the first step was to set the aims and objectives of sustainable construction. This is important to the promotion of awareness and understanding of the sustainable construction process. As part of the awareness process, the role expected of the construction industry and the policies to be employed by the government and their likely impact are explained. Such clarity of purpose is tremendously important, especially at the crucial time of seeking to encourage change in households and businesses.

This was followed by wide consultation with all stakeholders, including construction businesses, trade associations, research organisations and individuals, and a consensus has emerged that:

- there is a need for an integrated policy framework for sustainable construction,
- the government is best-suited to lead the initiative, and
- an awareness for a co-operative and more inclusive approach.

These three themes and perspectives underpinned the UK government's policy response to the sustainable construction process. Fiscal policies of taxation and government expenditure appeared to be prominent and used extensively to encourage good sustainable practice in the construction process. Taxes such as the Landfill tax have been introduced to facilitate waste reduction and enhance sustainable waste management. Similarly, the Aggregate Levy is planned for 2002 to reflect the environmental costs of aggregate quarrying and to force the use of recycled aggregates from demolished construction waste. Similarly, a Climate Change Levy is being introduced in 2001, which is also expected to discourage energy consumption by businesses, especially given the inverse relationship between the tax and amounts of energy consumed. Amongst the various sectors, the construction process is a particular target given its energy intensity right from the building materials manufacturing phase through to the post construction phase.

Government expenditure is also used to provide incentives in the form of capital allowances for energy efficient investment initiatives, particularly renewable energy initiatives. The UK government has also used its muscle as a major customer of the construction sector to encourage the industry towards a sustainable construction process. This has been achieved by requiring all government departments and agencies to emphasise life-cycle costing when procuring construction services and to commit to ISO 14001 environmental management systems in the management of their housing stock.[3]

Apart from economic instruments, command and control measures have also been used, especially through planning regulations. In particular, numerous Acts and guidelines have been issued by the government to encourage sustainable construction, especially relating to conservation, re-use and recycle of construction waste. Voluntary codes of conduct such as those being developed by BRE on particulate emissions have also been encouraged. Furthermore, the adoption of environmental management systems (EMS, ISO 14001) and Eco-Management and Audit schemes (EMAS) have been encouraged to facilitate accurate monitoring of environmental impacts throughout the supply chain process. This has also been achieved by the government with guidance on the integration of EMS with the principles of sustainable development.

It is fundamentally important to appreciate the factors that underpin what is rapidly unfolding as a successful sustainable construction strategy and policy in the United Kingdom. This is due mainly to the availability of appropriate institutions and procedures, which facilitated policy processes and implementation and enforcement. For example, in the absence of such vital institutions and procedures, the scope for using fiscal measures as incentives towards sustainable construction is limited, especially where construction firms are unregistered and operates largely within the informal and unregulated sector of the economy. Similarly, these fiscal measures would have remained inactive had the UK fiscal regime been rudimentary and undeveloped. Thus, a viable and successful sustainable construction process is possible only where there is capacity to formulate and enforce

[3] The government consumes 40 percent of the industry's total output.

sustainable development policies. Functional legal systems, a functional construction industry, and effective government and market institutions define this capacity, which is important to formulating and implementing environmental policies. As demonstrated in the case of the United Kingdom, the existence of a thriving construction industry and participatory stakeholders are vital to the sustainable construction strategy. It is also clear that these stakeholders do not just exist in name but are empowered to function and remain active, which is vital to any consultative process on sustainable construction. This is an experience that cannot be taken for granted in the developing countries where the construction industry and associated trades and institutions exist largely in name, which challenges the scope for the sustainable construction process in these economies.

4. Sub-Saharan Africa's Construction Sector

This part deals with the structure, conduct and performance of Sub-Saharan Africa's construction sector as a prelude to understanding its capacity to facilitate a sustainable construction process. As explained earlier, and with the exception of South Africa, the structure of the rest of Sub-Saharan Africa's construction sector is very fragmented and underdeveloped, severely limiting its potential to evolve into a functional industry (ILO, 1987). Aside from the highly fragmentary structure, the other most noticeable feature of sub-Saharan Africa's construction sector, which perhaps best explains its problems, is the lack of co-ordination in the industry. This has hindered the development of professional cadres of trades and management personnel, which makes it exceedingly difficult to subject the sector to regulatory policies and improvement programmes.

It is hardly surprising therefore that the sector is bedevilled by technical and managerial difficulties arising from skill shortages, and as a result, applications of technological and management techniques to construction processes. These attributes owe much to the fact that most construction firms are owned and managed by sole trader-type entrepreneurs with little knowledge of the workings of the construction industry (Ofori, 1991). They operate largely in the informal sector of the economy and are usually unregistered, explaining the lack of corporate approach to management, which further explains the transient nature of most construction firms in the developing countries (Ofori, 1991). This has severely affected skills training and retention of expertise in the industry as construction workers become highly mobile, walking in and out of the industry depending on performance in other sectors of the economy. The impact can be seen in the rigid adherence to management techniques and practices handed down from colonial times, which as a result of inadequate skills and capacity have remained unchanged and irrelevant to immediate requirements. This is particularly the case with the construction procurement systems for construction services in sub-Saharan Africa, which are deemed inappropriate and incapable of addressing the dynamics of the construction industry and its external environment (Rwelamila, 1991). Thus, inadequate technical training, inappropriate procurement systems, and general lack of management skills make it difficult for contractors to cope with the complexity of tendering procedures and contractual documentation. This in turn affects the quality of construction output and services offered to clients.

Similarly, the environment in which construction activities occur in sub-Saharan Africa is generally unfavourable to the kind of entrepreneurial initiatives needed to develop and modernise the industry (Ofori), 1980a). Although seasonality of work is a typical feature of the construction industry globally, it is nevertheless more pronounced in the developing countries such as sub-Saharan Africa because of overt reliance on the government for work, and the narrow base of the private sector. However, government construction orders fluctuate with income, especially multilateral and unilateral financial assistance, which often facilitate the foreign exchange devoted to imports, including construction materials. In the absence of domestic capacity to effect material supplies, the construction industry is forced to operate far below capacity each time the government suffers fluctuations in income. This helps perpetuate the informal approach to construction activities as seasonality of construction materials discourages long term strategic planning, which in turn hinders access to investment capital. Usually, detailed investment appraisal is required by financial institutions to grant business loans, which is usually impossible in an uncertain economic environment brought about by the huge variations in construction demand. As a result, a vicious circle emerges where uncertainties prevent access to capital investment, making it difficult to maintain and procure plants and equipment. In the absence of financial capital for investment, firms can only operate on a very small scale, forfeiting the huge advantages that are normally associated with economies of scale.

Also, delays with interim and final payments as well as onerous contract conditions faced by construction firms have also imposed huge constraints on the industry in the sub-Saharan Africa. Many construction firms have

suffered financial ruin and bankruptcy because of delays in interim and final payments, which is especially the case with government contracts. This is further compounded by the huge political instability that prevails, and where new regimes often refuse to honour the contracts issued by their predecessors, leaving many construction firms extremely and unnecessarily vulnerable in the process.

These endemic problems have affected the development of indigenous construction capacity with the result that a dualistic structure has emerged in sub-Saharan Africa's construction sector. This structure reveals the predominance of local construction firms at the much lower value-added end of construction activities while the high value-added end of the industry is dominated by foreign-owned construction multinationals. The example of Malawi typifies the situation in other sub-Saharan African countries

Table 2 confirms the dualistic nature of sub-Saharan Africa's construction sector. In the building contractor sub-sector, the predominance of local firms in construction activities to the value of 350,000 Kwacha can be observed. However, above 2 million Kwacha, domestic capacity to participate at this level declines rapidly and the vacuum is filled by non-domestic yet sub-Saharan African countries' construction firms.[4] However, above 5 million Kwacha, foreign construction firms maintain a strong presence where they account for 44 percent of market share. As would be expected these are probably huge and indivisible projects that require high technological and managerial content, reflecting the lack of domestic capacity to operate at such high value added levels of construction activities.

Table 2 Classification of contractors in Malawi (1993) (in Million Kwacha)

Building Contractors							
Project Cost	**Total**	**Domestic**	**%**	**Non- domestic (local)**	**%**	**Foreign**	**%**
350 000	338	365	86	23	14	0	0
750 000	37	29	78	8	22	0	0
1 000 000	21	14	46	7	41	0	0
2 500 000	9	2	17	7	78	0	0
5 000 000	5	2	40	3	60	0	0
Unlimited	25	1	.04	13	52	11	44
Total	**485**	**413**	**85**	**61**	**13**	**11**	**2**

Civil Engineering Contractors							
Project Cost	**Total**	**Domestic**	**%**	**Non- domestic (local)**	**%**	**Foreign**	**%**
800 000	17	5	29	12	71	0	0
1 500 000	1	0	0	0	0	1	100
5 000 000	-	-	-	-	-	-	-
10 000 000	3	0	0	3	100	0	0
Unlimited	19	0	0	3	16	16	84
Total	**40**	**5**	**13**	**18**	**45**	**17**	**42**

Electrical Contractors							
Project Cost	**Total**	**Domestic**	**%**	**Non- domestic (local)**	**%**	**Foreign**	**%**
75 000	109	87	80	22	20	0	0
100 000	14	9	64	5	36	0	0
300 000	7	1	14	6	86	0	0
1 500 000	-	-	-	-	-	-	-
Unlimited	23	2	9	4	17	17	74
Total	**153**	**99**	**65**	**37**	**24**	**17**	**11**

Source: Malawi country position paper: Southern Africa Construction Industry Initiative Conference, Swaziland, 3-7 May 1993.

[4] These are mostly South African and Zimbabwean construction firms.

The lack of domestic capacity is even more pronounced in the civil engineering sector where domestic firms account for only 13 percent of market share compared to the 45 percent and 42 percent accounted for by non-domestic local firms and foreign firms respectively. It is also worth noting that no local domestic firms are involved in any civil engineering projects above 1.5 million Kwacha. The electrical sector also shows similar characteristics to those of building contractor and civil engineering sectors where local firms have failed to feature prominently in construction works above 300 000 Kwacha. Thus, there are serious capacity problems throughout sub-Saharan Africa's construction sector, ranging from lack of capacity to produce technical and managerial construction skills through to developing a materials supply sector and maintaining an effective supply chain of construction materials.

However, various measures have been proposed to facilitate construction capacity development in countries such as sub-Saharan Africa, including joint partnership with foreign firms, preference margins for local firms, and a rash of other measures to enhance the performance of contracting firms (Ofori, 1991). Nevertheless, these measures have yielded sparse results, indicating that the problems faced by sub-Saharan Africa's construction sector are symptoms of a more fundamental problem, which is deeply embedded in the structure of the wider economy.

The absence of effective institutions to facilitate policies and underpin their implementations has been accorded much less recognition in the literature on construction industry development. Most construction analysts and practitioners tend to believe that Public Works Departments (PWDs) encapsulate all the needs of construction industry to develop. While Public Works Departments might be necessary, they do not operate in a vacuum and have to rely on other key government and private institutions to function and be able to influence the development in the construction industry. Indeed, a critical look at (PWDs), especially those in sub-Saharan Africa, reveals that they operate with limited terms of reference and as such are not disposed to policy formulation that might influence the development of the construction industry. They exist only to fill the gap left as a result of a dearth of local entrepreneurship. Thus, PWDs were established mainly to facilitate the procurement of public works and as such cannot substitute for appropriate construction supporting and enhancing institutions.

The role of institutions in economic development is widely acknowledged and has been defined as the rules of the game in a society, and are humanly devised constraints that shape human interactions (North, 1981, Ostrom et al, 1993). Institutions have three interrelated components, including constitutional order, institutional arrangements, and cultural endowments. The constitutional order encompasses written and unwritten state law or rules and regulations that govern all activities. The constitution as an institution safeguards both human and property rights, which serves as incentives to citizens and foreign investors alike to engage in various activities necessary for their overall economic development.

Institutional arrangements on the other hand, refer to rules and regulations, which govern organisations and are devised by collective and individual actions of members. This category of institutions deals with firms and organisations that are the driving force in an economy. For example, construction firms organise factors of production such as land, labour and capital to produce and deliver the goods and services that consumers want. However in order for the construction industry to engage in such activities, certain rules have to be in place. These rules can take the form of contracts, which set the parameters for transactions. In particular, public organisations responsible for public services require regulations to guide and enforce the delivery of services for which government or public as well as private institutions are established. Thus, where formal channels such as the Courts, Tribunals, the market and professional bodies that can set the process of self-regulation in motion, do not exist to enforce contracts, maintain discipline, or facilitate exchange, contracts and other obligations would be rendered unenforceable.

Cultural endowment, as an institution, is also crucial to organisational efficiency and sets the norms that people use to interpret their experiences within society. These are informal yet crucial to organisational efficiency and development, especially where formal institutions are lacking. For example, non-payment for services that is threatening the replication of urban and rural services in sub-Sahara Africa is a culture that needs to change and where formal institutions fail possibly because people feel alienated from it, cultural endowment provides an

alternative mechanism for effecting change. A very good example is the MASAKHANE campaign in South Africa to encourage and awaken people to their civic responsibilities. Thus, policies and initiatives aimed at developing sub-Saharan Africa's construction sector without appropriate supporting and enhancing institutions are doomed to fail.

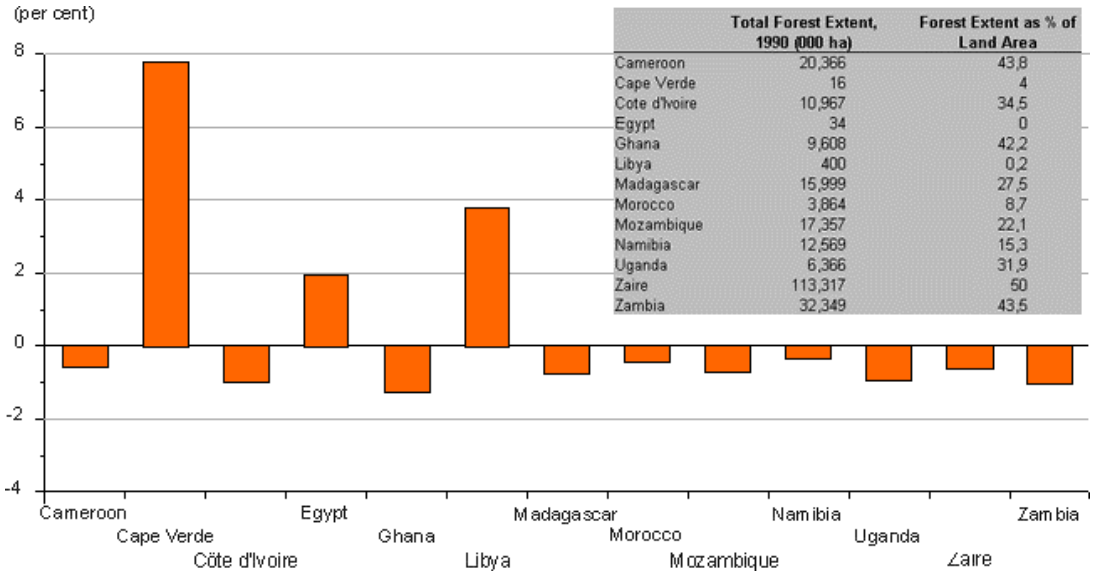
5. Relevance of Sustainable Construction in sub-Saharan Africa

A critical look at the structural characteristics of sub-Saharan Africa's construction sector discussed above might tempt one to ask the question as to why the sustainable construction process should be the preoccupation of sub-Saharan Africa. This question seems even more real when one considers the proportion of global resources accounted for by sub-Saharan Africa relative to other regions of the world. Considering the transboundary nature of the effects of global environmental pollution and degradation, it might be asked why sub-Saharan Africa should not exploit their natural resources for development just as the presently developed countries or the rapidly emerging developing countries have done and are still doing.

Similarly, it is also arguable that given the fact that, apart from South Africa and a few other countries, sub-Saharan Africa procures almost all of its manufactured building material needs, in which case it might be argued that its construction industry is already making significant strides towards a sustainable construction process. This is particularly the case where these imported materials are manufactured with adherence to the best environmental standards. Furthermore, these arguments become even more plausible when the huge re-use and recycling taking place in sub-Saharan Africa's informal housing sector, albeit arising due to poverty, are considered. These structures are constructed from basic materials and are easily recycled with minimal environmental impacts.

However, a critical look at these arguments indicates that there are possible grounds for seizing on the opportunities presented by a sustainable construction process to address some of sub-Saharan Africa's pressing environmental problems. Sub-Saharan Africa is experiencing a rapid decline in its environmental capital and resources, especially its tropical rain forests and aquifers.

Figure 1: Average annual change in the extent of forest cover in selected African countries (1981-1990)



	Total Forest Extent, 1990 (000 ha)	Forest Extent as % of Land Area
Cameroon	20,366	43,8
Cape Verde	16	4
Cote d'Ivoire	10,967	34,5
Egypt	34	0
Ghana	9,608	42,2
Libya	400	0,2
Madagascar	15,999	27,5
Morocco	3,864	8,7
Mozambique	17,357	22,1
Namibia	12,569	15,3
Uganda	6,366	31,9
Zaire	113,317	50
Zambia	32,349	43,5

Source: Food and Agricultural Organisation (FAO, 1993, 1995)

As figure 1 shows, most of the affected countries are in sub-Saharan Africa where average annual change in the extent of forest cover is declining rapidly, a situation which is rapidly becoming unsustainable because of the impact on the population. There are numerous problems associated with the intense exploitation of the physical

environment, some of which include desertification; soil compaction, soil erosion, and nutrient depletion. The United Nations statistics clearly show that as at 1992, over a billion hectares of African land had been lost to desertification, stretching its ability to feed its population.[5]

Figure 2:
Areas affected by deforestation

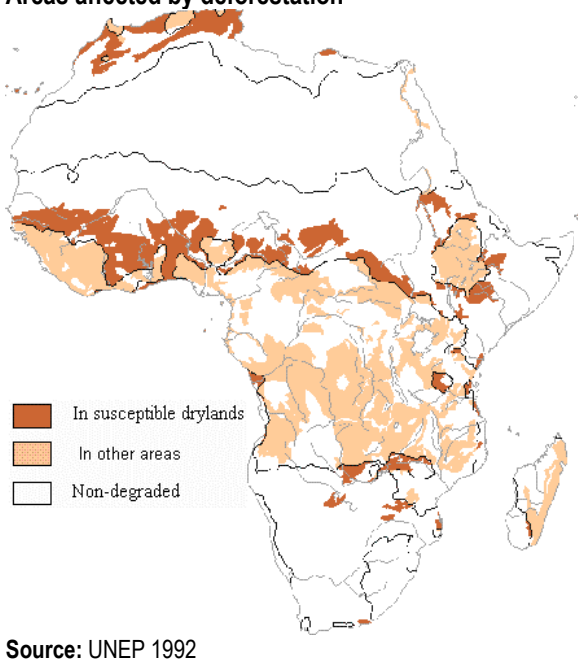
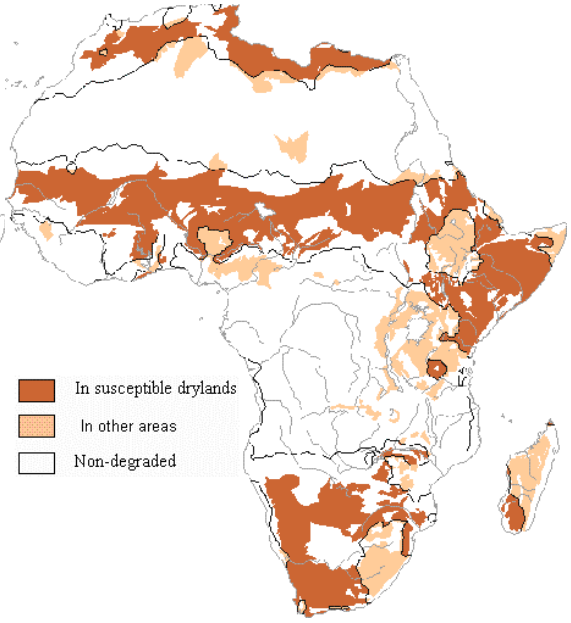


Figure 3
Areas affected by overexploitation of vegetation



Source: UNEP 1992

As Figure 2 shows, sub-Sahara's ecological balance is increasingly threatened by increased deforestation, especially in susceptible dry-land areas where deforestation is more pronounced. The incidence of desertification is directly related to deforestation and estimates show that up to 13 000 km^2 of forest are cleared every year. However, the persistence of drought and encroaching desertification have drastically reduced agricultural and grazing land (UNEP, 1997).

For individual countries within sub-Saharan Africa, experiences with the rate of forest depletion vary considerably. For example, Guinea-Bissau loses between 20 000 to 35 000 hectares of forest annually, while Senegal and Nigeria suffer annual losses of about 50 000 and 250 000 hectares of wooded savannah respectively. The case of Ethiopia is instructive where forest cover has declined from 40 percent of the total landmass to just 4 percent in less than a century (UNEP, 1997).

It is important here to respond to some of the assumptions made above about the dependence of sub-Saharan Africa's construction sector's on imports, which may be taken to imply that the sector is already sustainable. This may not necessarily be the case, especially when it is considered that there is a direct relationship between natural resources depletion and foreign exchange earnings, which are used to facilitate imports, including construction materials and expertise.

Thus, achieving reductions in construction-related imports through sustainable process, especially given the resource intensity of these materials that is transmitted through prices, would assist in reducing the rate of forest depletion. This is particularly the case given the negative terms of trade between primary commodities and manufactured products (Ebohon, 1996). This means that as prices of imports increase and primary commodity prices fall, as is often the case, a real resource is constantly transferred from the developing countries to the developed countries by having to export more primary commodities for less manufactured products.

[5] UNEP, Our planet: United Nations Environmental Programme Magazine for Sustainable Development, Vol. 6, No 5.

Another important consideration for adopting a sustainable construction process in sub-Saharan Africa, is its rapidly expanding population and the huge demands made on infrastructure. Given the limited resources in these countries and the constraints so placed on replicating infrastructure to areas of disamenities, possible savings through sustainable construction should facilitate further expansion in infrastructure and services. Similarly, the huge potential in employment opportunities associated with sustainable construction, provided sub-Saharan Africa is able to seize the initiative by better organising and synchronising its construction industry with the rest of the economy, affords social and economic sustainability. In this regard, sub-Saharan Africa has much to gain from a sustainable construction process, but the reality of achieving it is debatable in the light of the structure, conduct and performance of the industry and the evident lack of institutional capacities to effect the changes necessary to deliver sustainable construction.

6. Reality and Scope for Sustainable Construction in Sub-Saharan Africa

This section draws heavily on the discussion above to ascertain the scope and reality of sustainable construction in sub-Saharan Africa. We have argued that although sub-Saharan Africa's consumption of global natural resources is relatively minute compared to other regions, and that they import almost all construction material, there is still the need for sustainability initiatives such as sustainable construction. The range of policies discussed, including economic and regulatory measures, especially planning regulations are possible only in economies with appropriate institutional supports for policy introduction and implementation.

To seek to influence the construction sector or any other economic sector of the economy towards desirable goals and objectives requires accurate information, especially data upon which effective policies are formulated, monitored and adjusted. In the developing countries, especially in sub-Saharan Africa, the paucity of data is well acknowledged, particularly the constraints imposed on effective planning (Ebohon, 1992). Thus, economic and urban plans are formulated with little regards for accurate data and information. Although there are government institutions charged with the tasks of gathering statistical information and planning, they exist only in name. Those that have had to contend with development issues will acknowledge that it is not unusual to seek statistical information from government offices in sub-Saharan Africa and be referred to the local offices of the United Nations operating in the area of enquiry. Indeed in many African countries, it has not been possible to execute a population census for years, and the figures commonly used are projections from the colonial era.

Accurate data and information are critical to achieving an effective sustainable construction process. As shown in the case of the United Kingdom, information is needed on building materials used in construction, including the types of materials, how they are employed and the amount consumed. Similarly, it is important to have accurate information about the number of construction operatives, their mode of operation and the sectors in which they operate, which are vital to being able to sequence and target policies towards their development, or as in this case, influence their environmental behaviour and practices.

When it comes to policy instruments for implementing sustainable construction, the scope is limited by numerous factors. If we take economic policies and instruments as an example, the fact that a huge proportion of the population operates outside of the mainframe economy, drastically reduces policy activism and effectiveness. In sub-Saharan Africa, most construction industry operatives are not tax-registered and do not pay taxes, making it very difficult or impossible to subject them to any fiscal discipline of influence.

There is tremendous scope for achieving sustainability through the use of government expenditure as a policy instrument, especially given that the government is the major client of construction firms in the formal sector. It is possible and appropriate for the government to demand sustainable construction practices. However, this possibility is also limited by various factors. Dwindling government income and a limited revenue base may limit the use of government expenditure as a policy instrument for achieving sustainable construction. In the face of other competing demands, less emphasis may be put on measures and processes likely to lead to sustainable construction, especially if these mean additional costs, particularly with regards the use of government grants and subsidies as incentives for adopting sustainable construction processes.

As in the case of the United Kingdom discussed above, it is important to remember that the government leads the initiative on sustainable construction for the simple reason that environmental debates have assumed a

significant political dimension. Thus, while the role of the government is fundamental in the sustainable construction process, the influence exerted by the population through the political process and institutions is fundamentally important. In sub-Saharan Africa, a political process that guarantees political continuity and participation is hardly in place because of prevailing political instabilities. Thus, where there is a wide perception that the government of the day is not going to last in office, its policies are likely to be ignored and any investments made, deemed as high risks.

In addition, the lack of effective and efficient planning and legal systems also restricts access to effective regulatory systems and measures, which does not facilitate initiatives such as sustainable construction. Although every developer, commercial or self-builder, is required by regulation to submit plans and apply for planning permission, this seldom happens. Thus, the lack of capacity by the government to apply and enforce planning rules and regulations is largely responsible for the dysfucntionality of sub-Saharan Africa's built environment and has serious implications for the biophysical environment. In Khartoum, Sudan the building plans submitted for planning approval are often completely different from what is built.[6]

Thus, the combination of economic and regulatory measures by which the sustainable construction process as demonstrated in the case of the United Kingdom would be difficult to implement in sub-Saharan Africa. This is because of the absence of the necessary government and private institutions to facilitate the process. In the particular case of sustainable initiatives, the role of institutions as a necessary prerequisite to successful implementation of sustainable policies and processes is well documented (Ebohon, 1996). Perhaps more significant is the constituents of the institutional problems cited in the developing countries as impediments to sustainable development (Lampietti, et. al. 1995).

Table 3: Commonly Identified Institutional Problems

Regions	Inadequate skills & personnel	Lack of political and public awareness	Gaps & Duplicat-ion	Competit-ion & lack of co-ordination	Poor monitoring	Inadequate legislative framework
Africa (14)*	10	7	8	10	12	7
South Asia (5)*	3	1	1	4	4	1
East Asia and Pacific (14)*	2	0	0	1	1	1
Middle-East & N/Africa (2)*	1	1	2	2	1	1
Latin America and Caribbean (1)*	0	0	1	0	0	1
Central and Eastern Europe (7)*	2	0	1	1	7	6
Total	**58%**	**27%**	**39%**	**58%**	**79%**	**52%**

Source: Lampietti, J. A. and Subramanian, U. (1995).
***** Number of environmental projects monitored in each region.

As shown in Table 3, these problems are all related to lack of institutional capacities in various sectors of the economy. The problems common to all the projects studied include inadequate skills and personnel, poor monitoring, lack of political and public awareness of the concept of environmental sustainability and inadequate

[6] Personal observation during an invited visit by UNESCO in 1995 following my observation of the increasing number of high rise building being built but always tend to remain unoccupied from the 4th floor upwards because of the fear of average Sudanese of heights. It was also particularly the case that despite very low water pressure and power difficulties to supply water to upper floors, high rise buildings are still being built.

legislative framework. It is evident that the problems of inadequate skills and personnel prevail in almost all the projects studied in Africa. In 10 out 14 projects, inadequate skills and personnel were found to be a problem. This contrasts markedly with other developing regions of the world, such as Latin America and the Middle East and North Africa, who seem to have the skills capacity and personnel to effect sustainable projects.

Poor monitoring also featured strongly, and again this was found to predominant in Africa where it featured in 12 out of the 14 projects considered. Also of significance are an inadequate legislative framework and the gaps and duplication variables, all of which are most pronounced in Africa relative to other regions. Similarly, lack of political and public awareness, inability to identify gaps and avoid duplication of projects, and inadequate legislative framework not only predominate in Africa, but far exceed the extent of those found in other regions of the world.

Thus, it is upon the structure, conduct, and performance of sub-Saharan Africa's construction sector as well as the enormous institutional constraints it faces, that its capacity to achieve sustainability in the construction process is questioned. This does not mean that sub-Saharan Africa can afford to ignore the issues of sustainability, especially as in the case of a sustainable construction process. However, what this analysis emphasises, is the need to have the necessary institutions in place before contemplating sustainable strategies and policies. In the case of sub-Saharan Africa, a functional construction process has attenuated forward and backward linkages with the rest of the economy - a necessary prerequisite to achieving a sustainable construction process.

7. Conclusion

The above analysis has shown that the construction industry is an ideal candidate for enforcing environmental sustainability because of its fundamental role of enhancing the quality of life and facilitating economic growth and development. In this role, the industry consumes huge amounts of global resources because of the resource intensive nature of its activities. Nevertheless, it has been argued that it is possible to fulfil this role with drastic reductions in the natural resource consumption, but first, countries have to position themselves in order to employ a range of policies that influence the construction process. This has been shown above to be impossible without the necessary and appropriate supporting institutions, which are necessary to enable the formulation and implementation of effective policies to drive the process. In the case of sub-Saharan Africa, the dearth of such institutions and institution building capacity makes a mockery of the call for sustainable construction processes in the continent. Thus, the conclusion is that unless these institutions are in place to facilitate appropriate policies, attempts and efforts at achieving a sustainable construction process in sub-Saharan Africa is unrealistic and rhetorical.

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