International Journal of Construction Engineering and Management 2018, 7(2): 88-96
DOI: 10.5923/j.ijcem.20180702.05

Sustainable Construction Sites in Tanzania: Contractors' Practices and Their Perspectives

Sarah Phoya

School of Architecture, Construction Economics and Management, Ardhi University, Dar es Salaam, Tanzania

Abstract Sustainability is initially described as a desire to carry out activities without depleting resources or having harmful impacts on the environment. However, there is limited knowledge on how this desire is implemented by contractors in construction sites in developing countries. Therefore, this paper examines the nature of sustainable construction management practices implemented by contractors during construction phase for the purpose of mitigating environmental impacts. Questionnaire survey was adopted whereby 121 questionnaires were distributed to site managers, site engineers, foreman and gang supervisors from large on-going construction sites in Dar es salaam, Tanzania. Large on-going construction sites were selected through purposive sampling. The Collected data were coded and analysed using descriptive statistics Package (SPSS). Findings revealed that the most implemented sustainable practices in construction sites include reuse of construction materials, separation of waste skips on sites, selection of plants which are more efficient and master switch. The study further reveals that low contractors' level of knowledge on sustainable practices, relaxed regulations and negative perception are common challenges for implementing sustainable practices in construction sites. The study recommends that, effective training for contractors, providing them with up to date information on costs and benefits of sustainable construction practices and effective implementation of regulations is required to improve sustainable construction practices in construction sites.

Keywords Construction practice, Environmental Sustainability, Construction sites, Contractors

1. Introduction

The construction industry is a fundamental economic sector which permeates most of the other sectors. During the Fiscal Year 2016/17, the construction industry in Tanzania contributed 8% of all the Gross Domestic Product (GDP) wealth that was generated in the country. This puts it on the 5^{th} position among all sectors that contribute to the GDP [1]. The sector also employs 9% of the workforce in Tanzania. Despite these contributions, construction industry has been a major source of environmental damage. It consumes large amount of natural resources and produces a great deal of pollutants. Evidence from literature indicates that, the construction industry is responsible for about 50% of CO_2 emitted into the atmosphere; 20-50% of all natural resources consumed and 50% of all solid waste produced during the construction phase are causing many environmental impacts [2, 3].

Construction activities increase air and noise pollution; examples of these activities include removal of vegetative cover, grading, excavation, trenching, drilling, and transportation [4]. Some of them are conducted in locations other than the construction sites such as excavation/basting for construction material (sand and gravel) and access road construction. They cause a great risk on the environment, which must be addressed by contractors. In addition, construction sites constantly change from one site to another which also brings high environmental risk to a wide area [4].

The foresaid situation has increased pressure to make construction activities more environmentally acceptable and good practices on site to preserve the environment. This requirement has been highlighted by both international and local initiatives [5-8]. For example, Agenda 21 of sustainable construction in developing countries is one of the initiatives which require construction industries to implement sustainable practices in developing countries. In the same way, the Tanzania National Environment Policy (NEP) [6] and the environmental Act [7] requires all practitioners including construction activities to ensure sustainability, security and equitable use of resources for meeting the basic needs of the present and future generation without derogating the environment. On the other hand, The Agenda 2030 resolution includes 17 sustainable development goals (SDGs0 which need to achieved by 2030 by all countries [8]. These goals have been designed to integrate global ambitions

* Corresponding author:
sarahphoya@gmail.com (Sarah Phoya)
Published online at http://journal.sapub.org/ijcem

on tackling poverty, reducing inequality, combating climate change, and protecting ecosystems including oceans, forests and biodiversity. Construction industry is core area which can influence some of the achievements or failure of the 17 sustainable goals. Apparently, there is little evidence to show how sustainability is adopted and implemented in construction sites in developing countries.

While a number of literatures on sustainable construction exist, most of them focus on sustainable designs and planning [9], sustainable materials [10, 11], green building [12] stakeholders' participation [13]. Little attention has been paid to the way contractors adopt the environmental sustainable concept and their activities during the construction phase in the construction sites. Lack of such information and experience limits the mainstreaming of interventions to mitigating environmental impacts in construction sites. This paper therefore aims to analyse the sustainable practices implemented by contractors in construction sites focusing on the environmental dimension of sustainable construction.

2. Literature Review

2.1. Sustainable Construction Sites

The word sustainability was initially introduced by the Brundtland United Nation Conference on Environment and Development [14]. Later, many progressive world events had taken place to increase the sustainability agendas. Some of the sustainability key documents that have been produced in order to realize the agenda include Agenda 21 [5] The Rio Declaration on Environment and Development [15] Millennium development goal 2000 [16] and 2030 Sustainable Development Goals [8].

From these documents, sustainability has been defined as a process of meeting the needs of the present without compromising the ability of future generations to meet their needs. While the initial concept of sustainability was on environmental oriented, many definitions currently focuses on sustainable and sustainable development and have been extended to be based upon the three pillar of sustainability which are environmental, economic and social development [6, 17-20].

In construction perspective sustainability focuses on creating and operating health built environment based on resource efficiency and ecological design [21]. Various concepts such as sustainable and green building, sustainable and green construction and sustainable and green project management have been used interchangeably to represent sustainability. Pitty et al., [22] and Wyatt [23] explain that sustainable construction includes 'cradle to grave' appraisal, which includes managing the serviceability of a building during its life time. Ofori [24] affirms that sustainable construction is structure, the construction process and occupancy processes that are environmentally responsible and resource efficient throughout a building's life-cycle.

Summing up the arguments, sustainable construction is considered as an approach for the construction industry to move towards sustainable development by taking into account environmental, social and economic issues through its life cycle. However, only environmental dimension of sustainable construction will be discussed in this research focusing on construction phase of project life-cycle.

2.2. Environmental Sustainable in Construction

Environment sustainability in construction have been emphasised by many authors [21, 2, 19-21]. To some authors, environmental sustainability primarily refers to energy efficiency [25] or efficient resource conservation [26], waste management [27] and reduce pollution [28]. In general view, the environmental sustainability focuses consumptions and emissions within the physical, biotic and anthropic context of the construction sites in relation to environmental impact. Kibert [21] highlighted seven core principles of environment sustainability across the building life cycle. These principles include reducing resource consumption, 2) reusing resources, 3) using recyclable resources, 4) protecting nature, 5) eliminating toxics, 6) applying life cycle costing, and 7) focusing on quality. Other Authors support Kibert principles and group environmental sustainability into two elements, resource consumption and emissions and solid waste [2]. Accordingly, the environmental aspects related to resource consumption involve material resources, energy efficiency and waste management. Environmental aspect of emissions and waste include waste, air pollution, water and soil pollution. In general, one can say that sustainable construction sites focus on model of input and output process, thus, how activities in the site have achieved efficiency use of resources, energy efficiency, conservation of water, biodiversity, reduce air, water and soil pollutions. Table 1 summarizes the authors and the environmental dimension on construction sites.

2.3. Sustainable Construction Practice

Different practices for sustainable construction sites have been developed; for example, Building Research Establishment Environmental Assessment Methodology (2009) presents aspects in which construction sites have to adhere to maintain sustainable environment. They pointed different themes such as energy efficiency, materials, water and waste management. Similarly, UN resolution in 2015 developed 17 Sustainable Development Goals (SDGs) and 169 strategies. Some of the SDGs can be achieved through sustainable construction sites. The following are Goals which construction sites required to comply in order to achieve sustainable agenda.

Table 1. Authors and the environment criteria for sustainable construction sites

Environmental sustainable consideration in construction projects	Araújo (2010)	Thomas et al, (2013)	Buson et al. (2009)	Carvalho and Rabechini (2011)	DJSI (2013)	Elkington(2012)	ETHOS (2012)	Fellows and Liu(2008)	Fernández-Sánchez and Rodríguez-López (2010)	GRI (2013)	Thomas and Costa, (2017)
Natural resources consuption	√	√	√	√		√	√	√	√	√	√
Solid Waste	√	√	√	√		√		√	√	√	√
Energy efficiency	√	√	√	√	√			√	√	√	√
Water and bioversity conservation		√		√	√			√	√	√	√
Air, water and soil Pollution		√					√	√	√	√	√

2.3.1. Water and Sanitation (SDG 6)

SDG 6 of 2030 sustainable development focuses on access to water and sanitation for all. Water conservation is main key to construction activities since Construction activities consume amount of water [4]. Also construction activities use chemicals and materials which can pollute water sources. Construction activities such as maintaining a clean job site, hydrating workers, and cleaning equipment and tools require water. Therefore, clean and efficiency use of water in construction is paramount to achieve sustainable practices. Strategies are required to reduce water consumption without impairing the construction process. Reducing water demand and usage can be achieved through using water recycling, incorporating water saving devices and good management [4].

Water collected in rain barrels can be used at a tool or boot cleaning station. More sophisticated (and costlier) collection systems that can store and pump water may be appropriate on larger projects that require temporary irrigation or dusting-down of the site to protect air quality. Water conservation includes application of water saving techniques and dry construction methods [30].

2.3.2. Energy Efficiency (SDG 7, SDG 9)

SDG 7 of sustainable development focuses on access to affordable, reliable, sustainable and modern energy for all. The target is to ensure universal access to modern energy services, improve efficiency and increase use of renewable sources. SDG 9 focuses on build resilient infrastructure, promote sustainable industrialization and foster innovation. Thus the goal focuses on investments in infrastructure such as transport, irrigation, energy and information and communication technology. In the development of infrastructure, technological progress is the foundation of efforts to achieve environmental objectives, such as increased resource and energy-efficiency.

There is high use of energy in construction activities and sometimes have negative impact to environment [31]. EPA estimates that 30% of energy used in the construction sites is inefficiently used or wasted. Improving energy efficiency in construction sites can provide cost saving of 15% [32]. In construction sites, energy is required for transportation and onsite construction activities such as fueling generators to provide temporary power, powering a job site trailer, temporary lighting for the site and building, fueling earth-moving equipment, powering hand tools, and testing building equipment. All these activities consume fuel or electricity during construction [9].

The use of energy server Florence tube light for lighting system has the potential to reduce energy used in construction sites. According to Ndayirajile [32], replacing standard florescent tube with energy efficient florescent tubes would reduce CO_2 emission by 27tonnes per year. On the other hand, the use of solar-powered equipment and tools, diesel-electric or hybrid equipment, and renewable energy sources for temporary power has potential to reduce the impact of energy to the environment. Other effective strategies include electing energy star appliances and equipment, shutting down lights and computers at the end of the workday, using LED lamps, and installing programmable thermostats.

2.3.3. Materials and Waste Management (SDG 11, SDG 12, SDG 14)

SDG 11 focuses on making cities inclusive, safe, resilient and sustainable. In this goal the focus is to allow cities to continue to thrive and grow, while improving resource use and reducing pollution and poverty. The fact that cities are facing challenge of high populations, housing, infrastructure are highly demand and this will lead to utilization of high amount of natural resources. The construction activities which will ensure conservation of natural resources will be potential for sustainable environment.

SDG 12 focuses on sustainable consumption and production patterns. Sustainable consumption and production aims at "doing more and better with less," increasing net welfare gains from economic activities by reducing resource use, degradation and pollution along the whole lifecycle, while increasing quality of life. SDG 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development and SDG 15 focuses on protection, restoration and promotion sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Construction activities such as demolition, excavation and concreting produce huge amount of waste which has negative impact on the environment. Over 34% of demolition materials and extraction waste end up in the landfill every year. However, it was established that over 75% of construction generated waste has a residual value which can be recycled, salvaged and re-used [4]. Yetes [33] investigated the main types of construction waste and sustainable strategies that could be used to minimize the amount of waste produced. In the same thinking, Yuan [34] establish 30 key indicators that can be used to improve effectiveness of site operation. Among the strategies recommended include, establishment of waste management plan by focusing on types of waste and the procedures for handling it and responsible person. This helps in separation of different types of waste in construction sites. Other strategies include using the three Rs (reduce, reuse and recycle).

The principle of lean construction is recommended as a strategy to reduce waste in construction [35]. Although 20-30% of building-related C&D debris is recovered for processing and recycling, the opportunity exists to recover more than twice this amount through better planning and management. These will minimize utilization of natural resources.

2.3.4. Air Quality (SDG, 11)

SDG 11 focuses on making cities inclusive, safe, resilient and sustainable. The focus is to reduce pollutions in air, water and soil. In construction site, it is important to develop air quality plan for the indoor air and outside activities. In order to protect the health of workers, air quality has to be protected. In these sites, air is polluted with activities such as gases from building materials, from activities such as excavation, grading, emissions from fuel-powered equipment and generators, and toxic cleaning products [36]. Quality air is protected by:

- Utilizing temporary compounds to separate work areas and limit passage of dust and flying materials in site,
- Use cleaning products that are environmentally friendly,
- Utilize sweeping compound when necessary,
- Encouraging workers to prefabricate some works which pollute the air on the exterior of the building.

3. Methodology

This study investigated the environmental dimension of sustainable construction sites in Dar es salaam Tanzania. It adopted a mixed approach combining qualitative and quantitative research. The questionnaire survey was the main instrument used for data collection. The investigation involved site managers, site foremen and gang supervisors from on-going large construction sites in Dar es salaam Tanzania. To get potential sites a preliminary survey was carried out to map out potential large construction sites in Dar es Salaam. Construction projects are registered by the Contractors' Registration Board (CRB) based in Dar es Salaam. A list and physical addresses of large on-going construction sites in Dar es Salaam was obtained from CRB and several projects were selected purposely based on the criteria established by the researchers. These criteria include large construction sites which have concurrent /multiple activities in progress and with labours working in different trades. The site was considered large when the project value was 1,500,000,000 Tsh equivalent to 700,000 USD and above. The researcher believes that large projects have more resources which is potential to implement sustainable practices.

Questionnaires were administered by research assistants. Out of 150 questionnaires distributed, 121 (81%) were fairly filled and returned. The first part of questionnaire was based on profile of the respondents such as age, education and experience. The second part of questionnaire covered implementation of sustainable practices in construction sites. A total of 29 sustainable practices were identified from literature and were categorized in four themes. These themes include waste management and material efficiency, energy efficient, water conservation and air quality.

Respondents were required to rank the way they implemented them by using a 5-point Likert scale. In a Likert scale, they were asked to respond to each of the statements in the themes in several scales, normally five-point scale. The ratings used were: 1-Very poor, 2-Poor, 3-Moderate, 4-Good, 5-Very good. The hypothesized value is the middle of the used Likert scale which is equal to 2. This type of scale is acceptable in other construction management research. For example, [37] used a similar approach to construct a success measurement model for construction projects.

The collected data was analysed using Statistical Package for Social Sciences (SPSS). The sign test was performed to test the null hypothesis that the median of a distribution is equal to some value (The hypothesized value is the middle of the used Likert scale equals 2.5). In the test, the Spearman correlation coefficients between each item in group and the whole group, the mean and the standard deviation of factors were calculated. The correlation coefficients of all the fields are significant at $\alpha = 0.01$ (p-value < 0.01) or $\alpha = 0.05$ ($0.01 <$ p-value < 0.05) as indicated in Table 2.

Table 2. Correlation coefficients matrix for the four themes of sustainable practices in construction sites

	Materials and Waste management	Energy efficiency	Water efficiency	Good air quality
Correlation	0.56	0.66	0.81	0.70
P- Value (Sig.)	0.00	0.00	0.00	0.00
Total	121	121	121	121

The sustainable practices items were ranked based on the mean and Relative Agreement Index (RAI) method of descriptive analysis as shown below.

*Relative Agreement Index (RAI) (%) = Σ a (n/N) *100/5*

Where; a is the constant expressing weighting given to each response (ranges from 1 for very little up to 5 for very high), n is the frequency of the responses, and N is the total number of responses (121). The Relative Agreement index for all themes was calculated. Relative Agreement Index (RAI) comparison table was used to rank the results by taking into account the average scores and the RAI as follows:

Table 3. Relative Agreement Index (RAI)

Average Mean Score	RAI (%)	Ranking
4.0 to 5.0	80 to 100	High (H)
3.0 to 4.0	60 to 80	Medium (M)
1.0 to 3.0	20 to 60	Low (L)

4. Findings and Discussion

4.1. Respondents' Profile

Results revealed that all respondents (100%) were men and majority (63%) ranging in age from 20 to 45. years. In terms of educational background, majority of them (72%) had college education and above. These results indicate that this group (site managers, site foremen and gang supervisors) are semi-skilled who require further training after primary education. In terms of practical experience, findings reveal that more than 70% of the respondents had practical experience of more than five years indicating that they have enough exposure to construction activities which can enhance implementation of sustainable practices.

4.1.1. Waste Management and Material Efficiency

Waste management group consists of 10 sustainable practices. The finding indicates that reuse of element was ranked highest with Relative Agreement Index equals to (81%), and P-value = 0.00. The P-value was smaller than the level of significance α = 0.05. The mean of this factor is significantly greater than the hypothesized value (mean=4.05) and Relative Agreement Index range between 80%-100% indicated that it was highly implemented in construction sites. This finding is similar to Yetes [33] and Menard [34] who found that building components, rubble, earth, concrete, steel and timber (formwork) are valuable assets in construction which can be re-used. In doing so, utilization of natural resources is minimised.

Separation of waste and the use of demolition materials were also considered to be higher as the mean score was higher than hypothesized (Mean, 3.9 and 3.8 respectively). However, the weighted mean ranged between 60% and 80% indicating that they are moderately implemented. As illustrated in Table 2, the Relative Agreement index of other practices ranged from 20% to 60% indicating that they were less implemented. This implies that implementation of waste management in construction sites is still low except for few items. This finding is in line with Yuan [30] that effective waste management on construction sites commences with the encouragement of segregation of individual waste streams" as it is being produced, and this is being practiced in construction sites.

4.1.2. Energy Efficiency

The energy efficiency group consists of 10 sustainable practices. The results showed that "Selecting of plants which are more energy efficient" is ranked high with Agreement Index equals to (72%), and acceptable P-value= 0.00 The mean of this factor is 3.6 which is higher than hypothesized mean. Master switch to turn off all appliances was ranked the second with relative index equals 70%. Use of fuel efficiency vehicles was ranked the third with the relative index value of 62%. The findings are in line with Chan et al., [38] and Ndayirajile [32], that reduction of emission of CO_2 and other pollutants; reduction of expenditures on fuels such as diesel is the best practice that contributes to the efficiency of energy in a construction site. Other factors such as the use of renewable energy and use of fuel with low carbon were ranked low with weighted mean value below to moderate (48% and 38%).

4.1.3. Water Efficiency

Water efficiency group comprises of 5 sustainable practices in construction sites. The weighted mean of the factors surveyed under this group was ranged from the highest Relative Agreement Index value of (57) % for construction site water efficient plumbing features to the lowest weighted mean value of (37%) for application of water servicing techniques". This implies that practices such as treatment of grey water in order to be used for other purposes (e.g casting of concrete); curing to reduce water bills as well as prevention of release of polluted water on the land; protecting the underground water from contamination due to disposing of contaminated water from serviced plants, bathrooms and kitchen and rain water harvesting systems are rarely implemented although these are the important parameters in sustainable construction practices. The findings are in line with Waidyasekara [39] that a number of approaches need to be applied to reduce the amount of water that has been consumed at construction sites.

Table 4. Nature of Sustainable Practices Implemented in Construction Sites

	Sustainable practice	Mean score	P-value	RAI (%)	Group Rank	Total Rank
	Waste management					
1	Separation of waste skips on site	3.9	0.00	78	2	2
2	Reuse of materials from excavations for backfilling	3	0.00	60	4	8
3	Reuse of element: building components, rubble, earth, concrete, steel and timber (formwork)	4.05	0.00	81	1	1
4	Reuse of waste concrete for pavement	2.5	0.00	50	5	13
5	Reuse of roofing slates recovered from demolition	2.3	0.00	46	7	15
6	Recycling of material	2.5	0.00	50	5	13
7	Disposing wastes by burying them and covering them with soil	2.4	0.00	48	6	14
8	Returning usable and wastes packaging to suppliers	2.2	0.00	44	8	17
9	Reuse of demolition wastes	3.8	0.00	76	3	3
10	Offsite preparation of material such as timber ,steel and aluminum	2.4	0.00	48	7	14
	Energy efficiency					
11	Use of fuel with low carbon emission	2.00	0.00	38	9	20
12	Avoiding oversized machines	2.35	0.00	45	8	16
13	Selection of plants which are more energy efficient	3.60	0.00	72	1	4
14	Servicing of plants and generators every time and correctly	2.65	0.00	53	6	11
15	Use of renewable energy sources	2.00	0.00	38	9	20
16	Use of fuel efficiency vehicles	3.3	0.00	62	3	6
17	Use of public transport	2.7	0.00	50	7	13
18	Construction site shares construction plants between main contractors and subcontractors	3.25	0.00	61	4	7
19	Temporary site accommodation well insulated	3.20	0.00	60	5	8
20	Master switch to turn off all appliances	3.50	0.00	70	2	5
	Water efficiency					
21	Construction site water efficient plumbing features	2.85	0.00	57	1	9
22	Treatment of grey water	2.60	0.00	52	3	12
23	Rainwater harvesting system	2.05	0.00	41	4	19
24	Protect underground water from contamination	2.7	0.00	54	2	10
25	Application of water servicing techniques	1.9	0.00	37	5	21
	Good air quality					
26	Maintain a smoke free job site	2.25	0.00	45	2	16
27	Buying of available nearby material to reduce air pollution produced by vehicles	2.15	0.00	43	4	18
28	Control air pollution from excavation, grading, generators and dust from cement	2.20	0.00	44	3	17
29	Clean and inspect temporary offices to filter the dust	2.7	0.00	54	1	10

4.1.4. Good Air Quality in Construction Sites

Indoor air quality in construction sites group encompasses 4 sustainable practices. The finding indicates that the Relative agree value for this group ranged from (54) % for clean and inspect temporary offices to (43%) for buying of available nearby material to reduce air pollution produced by vehicles. This range is in the lower range indicating that construction sites are less implement strategies for reducing air pollution. This finding is in line with Rahman [36] that the control of air pollution is challenges for many organisations. Therefore, more effort is needed to streamline air pollution control strategies in construction sites.

4.2. The Top Five Sustainable Practices in Construction Sites

Table 5 shows the top five factors and related groups from the total implemented sustainable construction practices. The results show that three of them are related to the materials and waste management and two are from energy efficiency.

Table 5. Top five sustainable practices

		Mean	RAI (%)	Rank
1	Reuse of element: building components, rubble, earth, concrete, steel, timber formwork	4.0	81	1
2	Separation of waste skips on site	3.9	70	2
3	Reuse of demolition wastes	3.8	76	3
4	Selecting of plants which are more energy efficient	3.6	72	4
5	Master switch to turn off all appliances	3.5	70	5

4.3. Groups Ranking

Table 6 indicates that materials and waste management as well as energy efficiency are the main sustainable construction practices implemented in the construction sites. However, the level of implementation of these practices is still low with the relative index ranging from 20% to 60%. The implementation of water efficiency and good air quality in construction sites is still at infant stage as they have the mean weight below the hypothesized mean of 2.5. The mean weight for water efficiency and air quality are 2.4 and 2.3 respectively.

Table 6. Main groups ranking

	Group	Mean	RAI (%)	Rank
1	Materials and waste management	2.9	58.1	1
2	Energy efficiency	2.7	54.9	2
3	Water efficiency	2.4	48.2	3
4	Good air quality	2.3	46.5	4

4.4. Challenges for Implementation of Sustainable Practices

Respondents were required to fill an open question regarding the challenges facing them in implementation of sustainable construction practices. The findings indicate the following:

1. Lack of enough training on sustainable construction practices
2. Lack of support from local authorities, regulations, enforcements and incentives
3. Poor perception on implementation of sustainable construction practices that may lead to high final construction costs and reduce profit
4. Lack of good exemplary projects or practical examples of construction sites that have implemented sustainable construction practices.

These findings are in line with Djokoto et al [40] that the constraints of sustainable construction practices are due to lack of education concerning sustainability, many construction industries are not aware of sustainable construction practices and no economic incentives from the government.

5. Conclusions

Based on the research findings, it can be concluded that the concept of Sustainable construction practices in construction sites is not new among contractors in Tanzania. The nature of sustainable construction practices implemented in construction sites is still low whereby waste management and energy efficiency are leading practices. Reusable of materials such as formwork, timber, steel, concrete, wood, asphalt, gypsum, brick, salvaged building components (door, windows and plumbing fixtures) in construction sites is a salient practice which are highly implemented. This indicates that there is an opportunity for preserving the environment by reducing consumption of natural resources as well as reduction of the amount of construction waste dumped illegally in dams, river courses and any available hollows.

The other practices implemented in construction sites include separation of waste materials, selection of plants which are more efficient (produce low carbon) and control switch for turning off all appliances. However, sustainable practices in water efficiency and good air quality were still at infant level. The practices such as application of water serving techniques and rain harvesting were the least ranked. This indicating the shortcoming especially in improving green construction sites. The findings of this study shows lack of awareness of the importance of implementation of sustainable practices in construction sites; poor perception and weak enforcement of regulations are factors which hinder the implementation of sustainable practices in construction sites. The study recommends that effective training of contractors and provide up to date information on costs and benefits of sustainable construction practices and effective implementation of regulations are required to improve sustainable construction practices in construction sites.

REFERENCES

[1] The United Republic of Tanzania, (2017). National Budget 2016/2017 Ministry of Finance, Government Printer.

[2] Thomas, N. I. R.; Costa, D. B.; Guimarães, M. S. O. (2013). Identification of the Primary Needs for Sustainability and Improvements in Working Conditions on Construction Sites. In: CIB WORLD CONGRESS, Brisbane, 2013, Proceedings ... Brisbane, 2013.

[3] Khasreen, M. M.; Banfill, P. F. G.; Menzies, G. F. (2009). Life-Cycle Assessment and the Environmental Impact of Buildings: a review. Sustainability, v. 1, n. 3, p. 674-701, 2009.

[4] Goodhew, S. (2016). Sustainable Construction Process: A resource Text, Blackwell.

[5] CIB (2002). Agenda 21 of sustainable construction in developing countries, A discussion document, CSIR Building and Construction Technology, Pretoria.

[6] Government of Tanzania (1997). National Environmental Policy Vice President's Office, Dar es Salaam.

[7] The United Republic of Tanzania. (2004). The Environmental Management Act, No. 20 of 2004.

[8] United Nation (2015). Transforming our world: the 2030 Agenda for Sustainable Development.

[9] Kibert, J.C. (2016). Sustainable construction; Green Building design and delivery, Willey.

[10] Jovanović-Popović M., Kosanović S. (2009). Selection of building materials based upon ecological characteristics: priorities in function of environmental protection, Spatium, International Review 20 (2009) 23-27.

[11] Hradil P., Wahlstrom, M., Talja, A and Pikkuvirta (2014). Re-use of structural elements. Environmentally efficient recovery of building components. VTT Technology 200, 2014. [online] Available at: http://www.vtt.fi/inf/pdf/technology/2014/T200.pdf. [Accessed 27 February 2018]

[12] Sheth, K. N. (2016). Sustainable Building Materials used In Green Buildings; 9th International Conference on Engineering and Business Education (ICEBE) & 6th International Conference on Innovation and Entrepreneurship (ICIE).

[13] Bal, M, Bryde, D, Fearon, D., Ochieng, E. (2013). Stakeholder engagement: Achieving sustainability in the construction sector, Journal of Sustainability 5(2).

[14] World Commission on Environment and Development (WCED) (1987). Our Common Future. Oxford University Press, Oxford (1987).

[15] United nation (1992). The Rio Declaration on Environment and Development – United nation conference.

[16] United Nation (2000). Milllenium Development Goals.

[17] Adela J.W. Chen, Marie‐Claude Boudreau, Richard T. Watson, (2008). Information systems and ecological sustainability. Journal of Systems and Information Technology, 10(3) 186-201.

[18] Ilias, S., Omar, O. Waleed, R. Moho, W., Moho, S (2015). Proposed conceptual Model of Construction Firms performance: Sustainability indicators in Malaysia. University Sains Malaysia Press, Pinang.

[19] Ochieng, E., Wynn, T.S., Ruan, Y., Price, A. Okafar, C., (2014). Integration of sustainability principles into construction project delivery. Journal of Architectural Engineering Technology, 3.

[20] Kibert, C. J. (2005). Sustainable construction: Green building design and delivery. Hoboken,.NJ:.John.Wiley.&.Sons.

[21] Thomas, N. I. R.; Costa, D. B. (2017). Adoption of Environmental Practices on Construction sites, Journal of Ambient Construction 17(4) 9-24.

[22] Pitty, M., Tucker, M., Riley, M. & Longden, J. (2007). Towards sustainable construction. promotion and best practices. In construction Innovation, 9(2) 201-224.

[23] Wyatt, D. P. (1994). Recycling and Serviceability: The Twin Approach to Securing Sustainable Construction: Proceedings of First International Conference of CIB TG 16 on Sustainable Construction, Tampa, Florida, USA, 6-9 November, pp. 69-78.

[24] Ofori, G. (1998). Sustainable construction: principles and a framework for attainment comment. Construction Management and Economics, 16(2), 141-145.

[25] Tsai and Chang (2015). Sustainable design indicators: Roadway project as an example / Ecological Indicators 53 (2015) 137–143.

[26] Ochieng, E., Wynn, T.S., Ruan, Y., Price, A. Okafar, C., (2014). Integration of sustainability principles into construction project delivery. Journal of Architectural Engineering Technology, 3.

[27] Hill R, Bowen P (1997). Sustainable construction: principles and a framework for attainment. Journal of Construction Management Economic 15: 223-239.

[28] Zour, X and Mon, S (2013). Hiarachical evaluation of onsite environmental performance to enhance a green construction operation, civil engineering and Environmental System 1-19.

[29] Oke, E.O and Aigbaubao, O.C (2017). Sustainable Value management for construction projects, Spring International, Geographical Journal 182(4) 395-405.

[30] Yuan H. (2013). Key indicators for assessing the effectiveness of waste management in construction process, ecological indicators 2(4) 476-484.

[31] Xiaoling, Z., Wu, Y., Shen, L., and Skitmore M, (2014). A prototype system dynamic model for assessing the sustainability of construction projects, Journal of Project Management 32(1) 66-76.

[32] Ndayirajile (2006). Modelling Study of Energy Use on a Construction Site, MSc thesis, Strathclyde University.

[33] Yates J.K. (2013). Sustainable methods for waste management in construction, Innovation information, process Management (13(3) 281-310.

[34] Menard, S., (2017). An examination on the waste management practices in the local construction site. Hongkong surveyor 13(1) 39-48.

[35] Klotz L., Horman M., and Bodenschatz, M., (2007), 'A Lean Modeling Protocol for Evaluating Green Project Delivery', Lean Construction Journal, 3(1) 46-64.

[36] Rohman, H., A. (2014). Air Quality and Sustainable Redevelopment: The Case of Construction in Dudley Square, MSc thesis, Tufts University.

[37] Megha, D. & Rajiv, B. (2013). A Methodology for Ranking of Causes of Delay for Residential Construction Projects in Indian Context, International Journal of Emerging Technology and Advanced Engineering, 3(3), http://www.ijetae.com/files/Volume3Issue3/IJETAE_0313_66.pdf retrieved on 12th September, 2017.

[38] Chan, E. W., Qian, Q. K. & Lam, P. (2009). The market for green building in developed Asian cities- the perspectives pf building designers.. In energy Policy, 37 3061-3070.

[39] Waidyasekara, K.G.A., De Silva, L., Rameezdeen, R., (2016). "Water use efficiency and conservation during construction: drivers, barriers and practices", Built Environment Project and Asset Management, 6(5) 553-566.

[40] Djokoto S.D, Dadzie J and Chemang-Ababio E (2014).

Barriers to Sustainable Construction in the Ghanaian Construction Industry: Consultants Perspectives, Journal of sustainable Development 7(1) 134-143.