



---

## **QUANTITATIVE ANALYSIS OF LEVEL OF WASTE MINIMIZATION PRACTICES BY CONSTRUCTION INDUSTRIES IN BAUCHI STATE**

**\* BABANGIDA BABA, \*\* AZEANITA BINTI SURATKON**

*\* Abubakar Tatar Ali Polytecnic P. M. B. 0094, Wuntin Dada, Bauchi, Bauchi State, Nigeria, \*\* Universiti Tun Hussein Onn Malaysia 101 Beg Berkunci, Parit Raja, Batu Pahat, Johor, 86400, Malaysia*

---

### **Abstract**

*Ineffective application of waste management plan during different stages of construction is evident in many cities around the world, as well as in Bauchi State in Nigeria. The management of construction processes to reduce, reuse, recycle and effectively dispose of wastes has a significant impact on the final cost, quality, time and environment. The aim of this research was to find out the most suitable strategies for effective waste minimization practices in Bauchi State. Structured questionnaires were sent to a total number of 77 identified registered construction firms in Bauchi through Survey Monkey, of which 70 (90.91%) were returned with valid responses. Several analyses such as frequency, mean, ranking was used to analyze the data. The study revealed that reuse on site and minimizing waste at source of origin to be the most frequently implemented construction material waste minimization practices. The study also showed minimizing waste at source of origin and reuse on site as the most effective waste minimization strategies in Bauchi. The study finally recommended recycling of construction waste as a viable option in construction waste management. This research will be of benefit to the clients, contractors and the various project stakeholders in the construction industry, by providing adequate knowledge regarding construction waste minimization, so that necessary steps can be taken for prevention. It will provide knowledge about the appropriate strategies to employ in order to improve profitability and protect the environment.*

---

**Keywords: Project, Construction, firms, waste and environment**

---

## **Introduction**

Causes of construction material waste include frequent design changes, poor quality of materials, workers mistake during construction, poor planning, poor site management, ordering errors, materials not in compliance with specification, effect of weather and others (Nagapan, *et al.*, 2012). As a result, extra materials for construction are usually purchased to cover the gap during construction. There is a growing consensus within the built environment in Nigeria that building materials account to 50% of the total cost of a building project and material wastage account for between 20 - 30% of project cost overruns (Ola-adisa *et al.*, 2015). A small savings in material cost through efficient management of materials can result in a reasonable profit (Joro, 2015). It is therefore evident that wastage of material will lead to increase in total cost overrun of building projects. This implies that in-depth review identification of causative factors of waste, assessment of these factors and any improvement in material wastage management on construction sites will enhance the cost performance of projects in Nigeria (Adewuyi & Otali, 2013).

Research also indicated that the construction industry produces around 120 million tons of construction, demolition and excavation waste per year which only half of this currently being recycled or reclaimed (Al-Hajj & Hamani, 2011). Many researchers had carried out research on minimizing this huge amount of construction waste worldwide. Minimization of waste at the source is the most widely practiced waste minimization strategy but will be more effective if only when undertaken in combination with other waste reduction strategies. It's practically impossible to eliminate waste at source but can only be minimized to a certain level (Sulala *et al.*, 2014).

Construction work is often described by either type, residential (home building) or non-residential (commercial and government buildings and infrastructure projects), or by funding source, public or private (Alwi *et al.*, 2002). The construction sector represents, for many countries, a core economic activity. It not only provides the infrastructure for all other industries, but also constitutes one of the largest single sectors in the economy on its own. Closely linked with public works, governments have relied on the construction sector as a strategically important industry for creating employment and sustaining growth.

For the developing economies, the construction sector plays a significant role because of its link to the development of basic infrastructure, training of local personnel, transfer of technologies, and improved access to information channels (Haufler, 2013). In practice, there has been a tremendous increase in building construction which led to the generation of waste at different stages of construction (Wahab & Lawal, 2011). Previous research also revealed that the construction industry, while contributing to overall socio-economic development of any country is a major exploiter of natural non-renewable resources and a polluter to the environment where by it contributes to the environmental degradation through resources depletion, energy consumption, air pollution and generation of waste in the acquisition of raw materials (Al-Hajj & Hamani, 2011). The construction industry has been found to be one of the most inefficient and wasteful sectors. Internationally, the construction and operation of built environment has been estimated to account for 40% of the total waste stream of countries, 15 – 30% of which ends up in landfill sites. Also, up to 15% of purchased materials at jobsites ending up as waste (Rao & Field, 2014). Research also indicated that the construction industry produces around 120million tones of construction, demolition and excavation waste per year which only half of this currently being recycled or reclaimed (Al-Hajj & Hamani, 2011).

The federal government of Nigeria involves in most of the complex projects such as road, sea and air port and some heavy engineering projects at about 64.9% of the project executed. This is followed by state government which is responsible for about 22.7% of the projects in the industry, although there is still some form of partnering with different groups of investors in the industry (Mudi, *et al.*, 2015).

The Nigerian construction industry continues to be the major stimulant in the country's economic growth and development. This strong interrelationship between the economy and the construction industry further strengthens the need to ensure that project planning and management are cost-effective (Babatunde & Low, 2013). But experience has shown that excessive project cost and time overruns have been all too evident involving works undertaken by both the indigenous and foreign contractors (Eastman *et al.*, 2011). These were due to design errors, unexpected site conditions, increasing project scope, weather conditions and other project changes. It is also evident that those contractors

who perform and deliver their earlier projects successfully fails to deliver similar projects in future and facing time and cost overrun.

## **Literature Review**

### **Construction Projects**

Nigeria as a nation is still at the infancy stage of infrastructural development where a lot of construction activities are being carried out across the nation by the federal, state and local governments as the major clients in Nigeria (Oyedepo, 2014). All these construction activities are carried out by construction companies either indigenous or multinationals whose structure at times affects the level of construction output in the construction industry. But, the execution of most of these construction works are being carried out by the foreign construction firms but changes in government, transformation agenda and local content policy in infrastructural sector has created rooms for Nigerian indigenous contracting firms to grow and participate in the developmental processes (Odediran, *et al.*, 2012). There is more than five hundred ongoing construction works in Bauchi state.

### **Construction material management**

Worldwide, Proper material management is the key factor in achieving sustainability. Materials management in construction projects is a key function that significantly contributes to the success of a project. The management of materials in construction projects is made challenging by materials shortages, delays in supply, price fluctuations, damage and wastage, and lack of storage space. Materials management is a vital function for improving productivity in construction projects (Doloi *et al.*, 2012).

In Nigeria, results of researches obtained showed that there are no adequate human and material resources for formulation and implementation of waste management policies, (Igbinomwanhia, 2014). There is urgent need for the formulation and implementation effective and efficient solid waste management policies in Bauchi state and Nigeria in general. World-wide, researches contributed tremendously in the field of construction waste minimization.



Figure 1: Pile waste in construction site



Figure **Error! No text of specified style in document.:** Mortar waste

### Research Methodology

The methods adopted for this research is quantitative approach. The research design of the study is an approach to plan, review and control research process for obtaining answers to the questions being studied and for handling some of the difficulties encountered during the research (Creswell, 2013). Research design is an action plan for getting from the initial set of questions to be answered, and there is set of conclusions (answers) about these questions. Questionnaires was developed and used for data collection.

### Population and Sampling

The population of this research were construction firms in Bauchi participating on different types of construction projects. In this research, use of census is administered. A total number of 77 construction firms with valid registration in Corporate Affairs Commission were identified and selected as target population in Table 1.

Table 1 Population of the respondents

Population	Total number of construction firms
Small	26
Medium	46
Large	5
Total	77

The instrument used to achieve the objectives is explained. Quantitative approach through questionnaire survey was chosen. Target population and the sample size is indicated. Descriptive statistics involving tables, mean and percentages were used to analyze the data collected. Inferential statistical tools of correlation were used in data analysis. The reliability test was conducted using the Cronbach's Alpha which gives an acceptable value.

### Results Discussion

The result of the survey on the level of practices in Bauchi construction industry. Reuse on site with the highest mean of 3.86 is in the high category and ranked first. Most of the respondents reuse on site compared to leave at the site which have the lowest mean of 1.70 in the Low category and ranked last. The reuse on

site is the most frequent practice on construction site. The reason behind this is because, when the reuse on site is carried out, the production of waste will be reduced as supported by Ahmad *et al.*, (2014). He stated that the most popular practices at construction site are reused on site. Most of the waste produced will be reused at a construction site. For instance, soil, concrete and block debris will be reused for back filling and embankment at the construction site. Woods are also frequently reused on site. The second ranked mean is 3.57 also in the High category which represent the proportion of respondents that minimize waste at the source of origin. This practice is highlighted by Esin & Cosgun. (2007), as the most effective method which primarily prevent waste generation and reducing it as much as possible. This will reduce the reuse, recycling and disposal needs thus providing economic benefits.

In the Moderate category, disposal to landfill is ranked three (3) with a mean of 3.07. This indicated that a reasonable proportion of the waste is taking to landfill which is not a good practice as mentioned by Ola-adisa *et al.*, (2015) saying that most waste is disposed of indiscriminately in dump sites and landfills which implies that only a fraction of construction waste is actually recycled. In this category, Sale to another person, disposal off site and reuse off site were ranked fourth, fifth and sixth with a mean of 2.76, 2.59 and 2.54 respectively. When the waste is sold to another person it can be reused or recycled which is a good practice but disposal off site is not a god practice.

In the low category, give to another person, recycle off site, recycle on site, buried at site, buried off site, burning on site and leave at site have a mean: 2.49, 2.31, 2.26, 2.01,2.01, 1.99, and 1.70 which ranked; 7, 8, 9, 10, 11, 12 and 13 respectively. In this category, the level of recycle is low. This showed that there is a need for proper application of recycling practice as supported by Akinkurolere & Franklin (2005) and Ola-adisa *et al.*, (2015) . Most of the practices in low category are not good practices to be carried out on the construction site.

Table 2: Rating of the level of practices of waste minimization

Management practices	Very low		Low		Moderate		High		Very high		Total	Weighted mean	Rank
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%			
Reuse on site	2	2.86	8	11.43	16	22.86	16	22.85	28	40.00	70	3.86	1

Minimizing at source	3	4.29	6	8.57	22	31.43	26	37.14	13	18.57	70	3.57	2
Disposal to landfill	3	4.29	21	30.00	20	28.57	20	28.57	6	8.57	70	3.07	3
Sale to another person	9	12.86	21	30.00	20	28.57	18	25.71	2	2.86	70	2.76	4
Disposal off site	13	18.57	23	32.85	16	22.86	16	22.86	2	2.86	70	2.59	5
Re-use off site	13	18.57	24	34.29	16	22.86	16	22.86	1	1.43	70	2.54	6
Give to another person	11	15.71	30	42.86	14	20.00	14	20.00	1	1.43	70	2.49	7
Re-cycle of site	23	32.86	20	28.57	12	17.14	12	17.14	3	4.29	70	2.31	8
Recycle on site	22	31.43	20	28.57	17	24.29	10	14.29	1	1.43	70	2.26	9
Buried at site	32	45.71	17	24.29	10	14.29	10	14.29	1	1.43	70	2.01	10
Buried off site	33	47.14	17	24.29	10	14.29	10	14.29	0	0.00	70	2.01	11
Burning on site	31	44.29	20	28.57	9	12.86	9	12.86	1	1.43	70	1.99	12
Leave at site	33	47.14	16	22.86	10	14.29	10	14.29	1	1.43	70	1.70	13

## Conclusion

This research quantitatively analysed the level of waste minimization implementation in Bauchi. Reuse on site and Minimizing waste at source of origin emerged to be the most significant variables as in Table 2. These are the most significant variables identified and it indicates that objective one was achieved. The study stressed that level of waste minimization is very low because of the perception of firms operating within Bauchi. It is recommended that a research should be carried out on the effectiveness of the waste minimization practices in combination of two or more strategies in Bauchi state. This is because, in the literature it is stated that the waste minimization is more effective when it is in combination with another method (Sulala *et al.*, 2014)

## References

- Adewuyi, T.O. and Oтали, M. (2013). Evaluation of causes of construction material waste: Case of Rivers state, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 6(2009), 746–753.



- Ahmad, A. C., Husin, N. I., Zainol, H., Tharim, A. H. A., Ismail, N. A., & Wahid, A. M. A. (2014). The Construction Solid Waste Minimization Practices among Malaysian Contractors. *MATEC Web of Conferences* 15, 7(July), 1–9. <https://doi.org/10.1051/mateconf/20141501037>
- Akinkulore, O. O., & Franklin, S. O. (2005). *Investigation into Waste Management on Construction Sites in South Western Nigeria Department of Civil Engineering , Faculty of Engineering , University of Ado-Ekiti , Nigeria China University of Geosciences , 430074 , Yujia Shan , Wuhan Hubei Province , .* 2(5), 980–984.
- Al-Hajj, A., & Hamani, K. (2011). Material Waste in the UAE Construction Industry: Main Causes and Minimization Practices. *Architectural Engineering and Design Management*, 7(4), 221–235. <https://doi.org/10.1080/17452007.2011.594576>
- Alwi, S., Hampson, K., & Mohamed, S. (2002). Waste in the Indonesian Construction Project. *Proceedings of the 1st International Conferences of CIB W107 – Creating a Sustainable Construction Industry in Developing Countries*, 305–315.
- Babatunde, O. K., & Low, S. P. (2013). Chinese construction firms in the Nigerian construction industry. *Habitat International*, 40, 18–24.
- Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.
- Doloi, H., Sawhney, A., Iyer, K. C., & Rentala, S. (2012). Analysing factors affecting delays in Indian construction projects. *International Journal of Project Management*, 30(4), 479–489.
- Eastman, C. M., Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). *BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors*. John Wiley & Son.s.
- Esin, T., & Cosgun, N. (2007). A study conducted to reduce construction waste generation in Turkey. *Building and Environment*, 42(4), 1667–1674. <https://doi.org/10.1016/j.buildenv.2006.02.008>
- Haufler, V. (2013). *A public role for the private sector: Industry self-regulation in a global economy*. Carnegie Endowment.
- Igbinomwanhia, D. I. B. I. (2014). A Study of the Constraint to Formulation and Implementation of Waste Management Policies in Benin Metropolis , Nigeria. *Journal of a Pplied S Cience and E Nvironmental*, 18(2) 197-, 202.
- Joro, A. S. (2015). *A Thesis Submitted to School of Graduate Studies in Partial fulfillment of Doctoral Degree in Construction Management*. ADDIS ABABA UNIVERSITY.
- Mudi, A., Bioku, J. ., & Kolawole, O. . (2015). Assessing the Characteristics of Nigerian Construction Industry in Infrastructure Development. *International Journal of Engineering Research & Technology (IJERT)*, 4(11), 546–555.
- Nagapan, S., Rahman, I. A., Asmi, A., Memon, A. H., & Latif, I. (2012). Issues on construction waste: The need for sustainable waste management. *CHUSER 2012 - 2012 IEEE Colloquium on Humanities, Science and Engineering Research, Chuser*, 325–330. <https://doi.org/10.1109/CHUSER.2012.6504333>
- Odediran, S. J., Adeyinka, B. F., Opatunji, O. A., & Morakinyo, K. O. (2012). Business structure of indigenous firm in the Nigerian construction industry. *International Journal of Business Research and Management*, 3(5), 255–264.
- Ola-adisa, E., Sati, Y. C., & Ojonugwa, I. I. (2015). *An Architectural Approach to Solid Waste Management on Selected Building Construction Sites in Bauchi Metropolis*. 3(12), 67–77.

- Oyedepo, S. O. (2014). Towards achieving energy for sustainable development in Nigeria.. *Renewable and Sustainable Energy Reviews*, 34, 255–272.
- Rao, P. B. P., & Field, W. (2014). Waste Minimisation in Construction Industry. *Indian Journal of Applied Research*, 4(6), 174–177.
- Sulala M.Z.F. Al-Hamadani, ZENG Xiao-lan, M.M.Mian, Z. L. (2014). Material waste in the China construction industry: Minimization strategies and benefits of recognition. *INTERNATIONAL JOURNAL OF ENERGY AND ENVIRONMENT*, 5(6), 717–722.
- Wahab, A., & Lawal, A. (2011). An evaluation of waste control measures in construction industry in Nigeria. *African Journal of Environmental Science and ...*, 5(March), 246–254. <https://doi.org/10.5897/AJEST10.314>