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ASSESSMENT OF ENVIRONMENTAL INTEGRATION APPROACH IN DISTRIBUTION OF SOCIAL INFRASTRUCTURE (SCHOOLS) IN OTUKPO LOCAL GOVERNMENT AREA, BENUE STATE, NIGERIA.

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ABSTRACT

This study evaluates environmental integration approach in distribution of schools in Otukpo Local Government Area, Benue State, Nigeria. Its objectives were to analyse the distribution pattern of schools in Otukpo LGA and identify community that have 'shortfall' or 'surplus' social infrastructures; determine whether environmental features were considered before implementing the schools facilities and to evaluate environmental monitoring of school infrastructures in Otukpo LGA. The study used mapping, questionnaire survey and observation in its methodology to collect data which were sourced from both primary and secondary sources. Data collected were analysed using statistical tools such as Nearest Neighbour Analysis, Location Quotients and Z- Scores. The results were presented in tables and figures. The result of Nearest Neighbour Analysis was 0.91 which mean that distribution pattern of schools in Otukpo Local Government Area, Benue State is a cluster pattern. Location Quotients for schools in all the communities ranged from 0.35 to 3.53. Location quotients for most of the communities are less than one (< 1). This imply that majority of the communities has 'shortfall' of school

infrastructure. Only seven (7) communities out of twenty- four (24) (Otukpo, Akpegede, Aokwu, Odu-Daje, Obojuipoko Ifeyi, OtadaUpu and Amla-Icho) have Location Quotients more than one (>1). Results also showed poor environmental considerations in siting school infrastructure. It shows firstly that none (0%) of the respondents who are owners of school infrastructures carried out environmental impact assessment of their infrastructure. Secondly environmental features such as geology/soil, relief, vegetation, temperature, rainfall and wind were largely neglected in the planning and implementation of school infrastructures and that artisans, architects and land surveyor are the most(100%) professionals involved in school infrastructure construction while geotechnical and structural engineers are not (0%) involved. There is also poor monitoring of social infrastructure impact on the environment in the study area as it shows that only twelve (12) respondents representing 20.7% of the respondents monitor the impact of their structure on the environment. It was concluded that school infrastructure distributions in Otukpo have lapses, such as inadequacy, lack of environmental integration approach and thus are unsustainable.

1. Introduction

Since the 1990s, activist/environmentalist approach to planning has grown into the Smart Growth movement, characterized by the focus on more sustainable and less environmentally damaging forms of development. It is becoming more widely understood that any sector of land has a certain capacity for supporting human, animal, and vegetative life in harmony, and that upsetting this balance has dire consequences on the environment(Walters, 2007). Thus,

increasing interest among architects and planners in designing environmental friendly buildings has generate concepts like Green Infrastructure (GI), Integrated Infrastructure and others (Islam *et al,* 2013).

Social infrastructures like school form an important and integral part of life of any community, either rural or urban but they are unequally distributed over space. Many empirical findings have shown that facilities are unequally distributed in our communities such that the vast majority of the people are caught in a never ending struggle to gain access to these infrastructures in order to improve their quality of life (Eyles, 1996).

Ilhamdaniah (2017) explained that low quality or absence of social infrastructure has a direct impact on living conditions, health and potential for economic development for large parts of the population in rapidly growing cities in developing countries. Therefore, designing good quality social infrastructure is the first and foremost step to achieve sustainability and create healthy living conditions in our cities.

Spatial planning of school facilities in an urbanizing area in addition to population should consider environmental factors in the identification of suitable locations for a given number of social facilities in a defined territory, in such a way that the needs of a spatially dispersed population are served in an optimal and sustainable way. The spatial variation in the distribution and access to infrastructure results in spatial disparities in living standards both within and between regions (Madu, 2007).

Negligence for environmental sustainability in both location and architectural designs of school infrastructure on its own poses severe impairment for urban development, living conditions and a great challenge for urban ecosystem sustainability. According to Adedeji *et*

al, (2010), urban environmental problems are mostly due to developmental processes and are of local, regional and global effects (Adedeji *et al*, 2010). To sustain urban environment, amidst infrastructural development, integration of environmental factors is crucial especially in combating climate change effects on social infrastructures and the entire environment. This is because, infrastructure is sensitive to weather and climate change. It can cause significant damage, with high cost implications, and should be incorporated early into infrastructure. Environmental considerations *i*n siting Social infrastructure (building) include but not limited to geology/Soil, relief, vegetation and climatic elements such as wind, temperature and rainfall.

In addition to taking cognizance of these environmental features, Green Infrastructure (GI) approach has been seen as smart, strategic and proactive measures to mitigate environmental effects of urban infrastructural development and enhance sustainable development. It also offers potential ways of effectively integrating biodiversity into spatial planning and sectoral considerations (Sustainable Development Council SDC, 2010).

There is growing awareness on integrating environmental sustainability in infrastructural development. Green infrastructure is becoming a major approach to sustain urban development.

Research has shown that green infrastructure like trees and green spaces helps to maintain a healthy urban environment by providing clean air, improving the urban climate, preserving the natural balance of the city and even providing clean water and fertile soil (Baycan-Levent and Nijkamp, 2009). The positive health effects of urban green infrastructure have further been discussed in a range of literatures including landscape architecture, environmental psychology, descriptive epidemiology and public health (Bell et al,. 2008; Dipeolu and

Fadamiro, 2013; Hartig et al., 2003; Maas et al., 2006; Orsega-Smith et al., 2004) and proximity to green areas has been found to be associated with soundness of body health systems (DeVries et al., 2003; Morita et al., 2007; Nielsen and Hansen, 2007).

Numerous studies confirmed that urban green spaces improves the environmental quality, promoting public health and provides valuable ecosystem services, urban tourism, active and passive recreations to urban dwellers (Haq, 2011; John, 2011 and Martin, *et al.*, 2013).

However, in spite of this level of awareness on environmental integration and its role in balancing environment and infrastructure development (Mell, 2008) indicates that "only a small number have attempted to link the theory with the practices." Thus, this study in bite to bridge this gap intends to evaluate environmental integration approach in social infrastructure distribution in Otukpo Local Government Area of Benue State Nigeria. In order to, advocate environmental integration approach in infrastructure development in Otukpo Local Government Area. Environmental integration approach in social infrastructure distribution is highly required to facilitate development and reduce impact of built environment.

2. Methodology

Mixed data were applied to this study; data were both quantitative and qualitative. Quantitative data were generated by counting points, measuring and recording distance among points distribution of schools on a generated map. The mean distance and number of points were quantified to qualify the distribution of schools as random, even or cluster. Moreover, records of respondents' affirmation of options in the research questionnaire. The frequency of each option was quantified to qualify the level of environmental integration like consideration of

environmental features, professional involvement and environmental monitoring of educational facilities in Otukpo. Data were sourced from both primary and secondary sources.

Technique that were employed in this study include Otukpo Local Government Area base map, telephone that has Geographic Positioning System (GPS) software, phone camera, writing materials. Using these techniques and methods (questionnaire, observation and mapping), dada collection proceeded as follows:

Firstly, the base map was produced using Global Coordinate System (GCS84) and subsequently by geo-referencing, map of social infrastructure (schools and health care facilities) location were produced. Point locations of these infrastructures were collected from the produced map. This included number of points, distance between each nearest points after which the mean distance were calculated to achieve the first and second objectives which are to analyze the distribution of social infrastructures in Otukpo LGA and identify wards that have dense and those that have sparse social infrastructures. Secondly, questionnaire and observation were used to collect data on the integration of environment in social infrastructure in Otukpo LGA.

One set of structured closed ended questionnaire was prepared to collect data on environmental integration. A total of fifty-eight copies of questionnaires were administered orally (direct interview method) with stakeholders (school facilities in Otukpo LGA). The objective of the questionnaire survey was to evaluate the level of integration of environment in infrastructure in Otukpo LGA. The administration of questionnaire took place in meeting venues for Otukpo Proprietors/ Proprietress Association at Saint Francis College in Otukpo Urban. Purposive/accidental samplings were employed in the distribution of questionnaire during stakeholders meeting. This sampling techniques were adopted so that the respondents had the

same chance of been sampled. It was based on who is available and willing to respond at the time of questionnaire administration.

Field observations were undertaken to independently assess the integration of environmental approaches in Otukpo LGA school facilities. Observations of striking features were made at the various school infrastructures visited. Evidence of integration or non- integration were portrayed with photograph.

Data collected were analyzed based on the objectives as follows:

To determine the pattern of distribution of school infrastructures in Otukpo LGA-The spatial distribution of school infrastructures in Otukpo LGA was analyzed using Nearest Neighbour Analysis (Rn) .

i. To identify communities that have 'shortfall' or 'surplus' school infrastructures-The concentration of school infrastructures in each ward were analysed using Location Quotients (L.Q).
ii. To determine whether environmental features were considered before implementing the social infrastructures- This was analysed using frequency distribution table and pie charts.
iii. To evaluate environmental monitoring of school infrastructures in Otukpo LGA- This was analysed using frequency distribution table and pie charts.

3. Results and Discussion

Figure 1 is a map showing the distribution of school infrastructure in Otukpo local Government of Benue State. Table 4.1 present the frequency distribution of school infrastructure among the twenty-four communities in Otukpo Local Government Area,

Benue State. Nearest Neighbour statistics for schools was calculated to ascertain the pattern of distribution of these infrastructures.

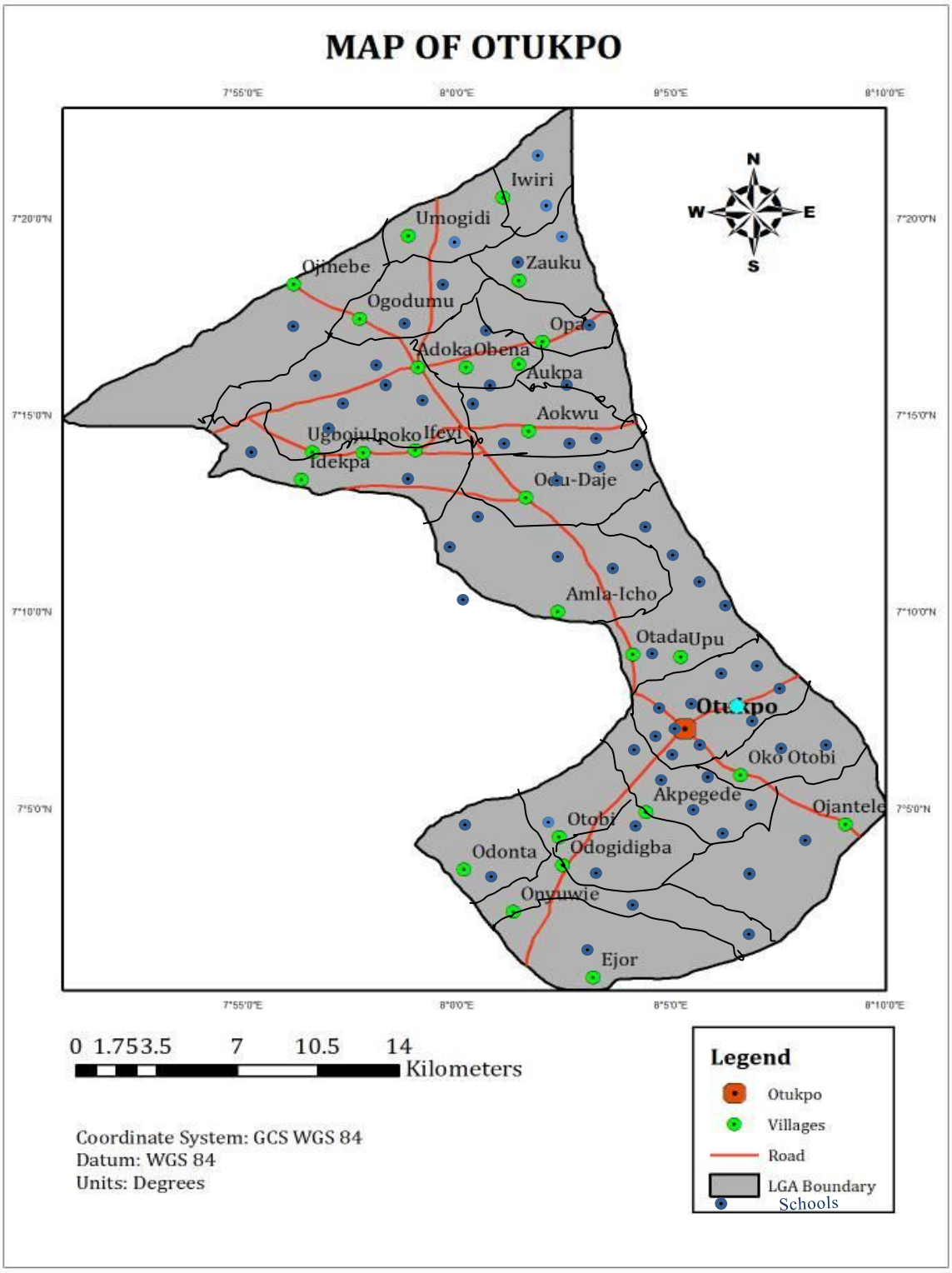

Figure 1: Distribution of Schools in Otukpo LGA

Source: Coordinate System (GCS WGS 88)

Table 4.1: Frequency Distribution of School Infrastructure in Otukpo LGA

Communities	No of Schools
Iwiri	2
Umogidi	1
Zauku	2
Oginebe	1
Ogodumu	2
Opa	2
Adokaobena	1
Aukpa	2
Aokwu	4
Obojuipoko Ifeyi	5
Idekpa	2
Odu-Daje	4
Amla-Icho	5

OtadaUpu	5
Otukpo	10
Oko-Otobi	2
Otobi	1
Akpegede	6
Ojantele	2
Odogidigba	1
Odonta	2
Onyuwie	2
Ejor	1
Total	65
Average	2.83

Using nearest neighbour analysis, the pattern of distribution of Schools in Otukpo Local Government of Benue State was determined as follows:

$$Rn = 0.5 \text{ X } \frac{\overline{D}}{\frac{1}{\sqrt{N/A}}}$$

Where Rn = value of the nearest neighbour statistic, $\overline{D}$ = mean distance between nearest neighbours, A = total area under study and N = number of points in the map.

D= 0.78

N = 65

A = (5 x 6.5) 32.5cm^2

Therefore

$$Rn = 0.5 \frac{0.78}{\frac{1}{\sqrt{65}/32.5}}$$

$$= 0.91$$

The result of Nearest Neighbour Analysis is 0,91; This shows that the distribution pattern of schools in Otukpo Local Government Area, Benue State is clustering (Figure1). Thus, Ho "There is no significant difference between the distributions of school infrastructures and a random pattern is rejected. Therefore, the distribution of schools in Benue State has a cluster pattern and is not evenly distributed. Thus, there is tendency that some communities have higher concentration than others. This is in line with previous findings from Hazrin *et al*.(2013) which reported that there is uneven distribution of the different urban amenities particularly in the developing countries. The distribution of educational facilities in most part of Nigeria has been observed to be politically biased to the extent that a facility is over utilized while others are underutilized in an area (Mustapha *et al*, 2016).

Having seen a clustering pattern in location of school infrastructure, Location Quotient (L.Q) was used to determine area that has 'shortfall' or 'Surplus' in schools facilities (Table 2).

Table 2 Location Quotients for Schools facilities in Each Community

Communities	Location Quotients (School)
Iwiri	0.71
Umogidi	0.35
Zauku	0.71
Oginebe	0.35
Ogodumu	0.71
Opa	0.71
Adokaobena	0.35
Aukpa	0.71
Aokwu	1.41
Obojuipoko Ifeyi	1.77
Idekpa	0.71
Odu-Daje	1.41
Amla-Icho	1.77
OtadaUpu	1.77
Otukpo	3.53
Oko-Otobi	0.75
Otobi	0.35

Akpegede	2.12
Ojantele	0.75
Odogidigba	0.35
Odonta	0.75
Onyuwie	0.75
Ejor	0.35

Decision

Location Quotients for schools in all the communities ranged from 0.35 to 3.53 and the Location Quotients for most of the communities are less than one (< 1). This imply that majority of the communities has 'shortfall' of school infrastructure. Few communities (Otukpo, Akpegede, Aokwu, Odu-Daje, Obojuipoko Ifeyi, Otada Upu and Amla-Icho) have Location Quotients more than one (>1). This corresponds with the clustering pattern of school infrastructure in Otukpo Local Government Area as most of the school infrastructures are located within Otukpa the local government headquarters.

Effort was made during the survey to investigate the functionality of these infrastructures, it was found that most of the school facilities are not functional and are in dilapidated conditions (Plate 1& 2).

Plate 1: Non Functional Primary school in Idekpa, Otukpo LGA

Plate 2: Dilapidated primary school in Aukpa Otukpo LGA

Consideration of Environmental Features before Implementation of Social Infrastructures in Otukpo LGA.

Using some indices such as professional involvement, environmental features (geology, soil, relief, vegetation, temperature, rainfall and wind). Questions were raised to assess the environmental considerations in siting school infrastructure (building) and distributed to owners and managers of schools. Table 4.3 present the response for environmental considerations in siting social infrastructure.

Table 3: Response for Environmental Considerations in Siting School Infrastructure.

Question	Options	Affirmation of option (N = 58)	Percentage
Carried EIA	Yes	0	0
	No	58	100
Professional involved in Building social Infrastructure	Builder	8	13
	Geotechnical engineer	0	0
	Architect	58	100
	Land Surveyor	50	86
	Structural Engineer	0	0
	Building Service Engineers (Mechanical and Electrical Engineers)	23	40
	Artisans(masons, carpenters, electricians, iron fixers, tillers, and	58	100

	plumbers)		
	Quantity Surveyor	4	6.9
Environmental features considered before sitting infrastructure	Geology/soil	15	25.9
	Temperature	0	0
	Wind direction/speed	0	0
	Vegetation	0	0
	Relief	29	50
Baseline data collected before construction	Soil	0	0
	Flora and fauna	0	0
	Temperature	0	0
	Population	45	77.6
	Existing structures	52	89.7

Table 4.3 shows poor environmental considerations in siting social infrastructure base on respondents' affirmation of options. It shows firstly that none of the respondents who are owners of social infrastructures carried out environmental impact assessment of their infrastructure. Secondly environmental features such as geology/soil, relief, vegetation, temperature, rainfall and wind were largely neglected in the planning and implementation of

social infrastructures. Most the school infrastructures owners only considered the population and existing structures in sitting their school infrastructures. Thirdly, there is poor involvement of professionals in infrastructure construction (Figure 2).

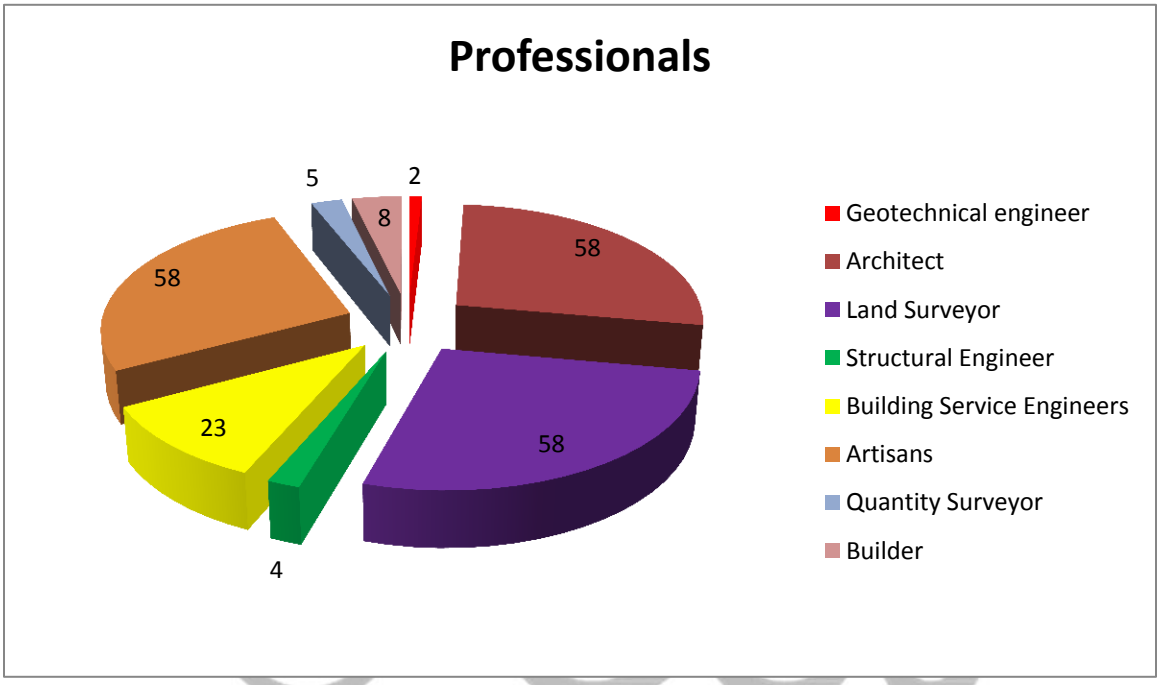

Figure 2: Affirmation of Professional involvement in Social Infrastructure Construction.

Figure 2 shows that artisans, architects and land surveyor are the most (100%) professionals involved in social infrastructure construction while geotechnical and structural engineers are not (0%) involved. According to an article by Fame pyramids in 2013 "the building construction industry is a wide industry that encompasses many professionals. Most of the building defects like cracks on walls, inadequate and non-functional facilities, flooding and dampness, poor drainage, poor safety design, poor staircases and even collapse to mention a few could be avoided". Thus, the poor involvement of professional such as geotechnical and structural engineers contributed to poor conditions of school infrastructures and environmental degradation witnessed around social infrastructures in Otukpo Local Government, Benue State (Plate 3 &4).

Plate 3: Poor Conditions of Social Infrastructures and Environmental Degradation in Otukpo, Otukpo LGA

Plate 4: Environmental Degradation in Secondary School in Amla-Icho, Otukpo LGA

Environmental Monitoring of Social Infrastructures in Otukpo LGA

Respondents were asked questions on environmental monitoring of their social infrastructures using parameter such as soil (erosion and flood), waste generation and management, (Table).

Table 4: Respondents' Affirmation on Environmental Monitoring of their Social Infrastructures

Questions	Options	Affirmation	Percentage (%)
Do you monitor the impact of the structure on the environment?	Yes	12	20.7
	No	46	79.3
If yes above, what do you monitor?			
Erosion	Yes	10	17.2
	No	48	82.7
Flood	Yes	12	20.7
	No	46	79.3
Waste	Yes	8	13.7
	No	50	86.2
If yes above, how often?	Monthly	0	0
	Quarterly	0	0
	Twice yearly	3	25
	Annually	9	75
If no above, why?	Time factor	12	20.7
	Financial factors	14	24.1
	Negligence	30	51.7

Table 4 portray poor monitoring of social infrastructure impact on the environment in the study area as it shows that only twelve (12) respondents representing 20.7% of the respondents monitor the impacts (erosion, flood and waste) of their structure on the environment (Figure 3).

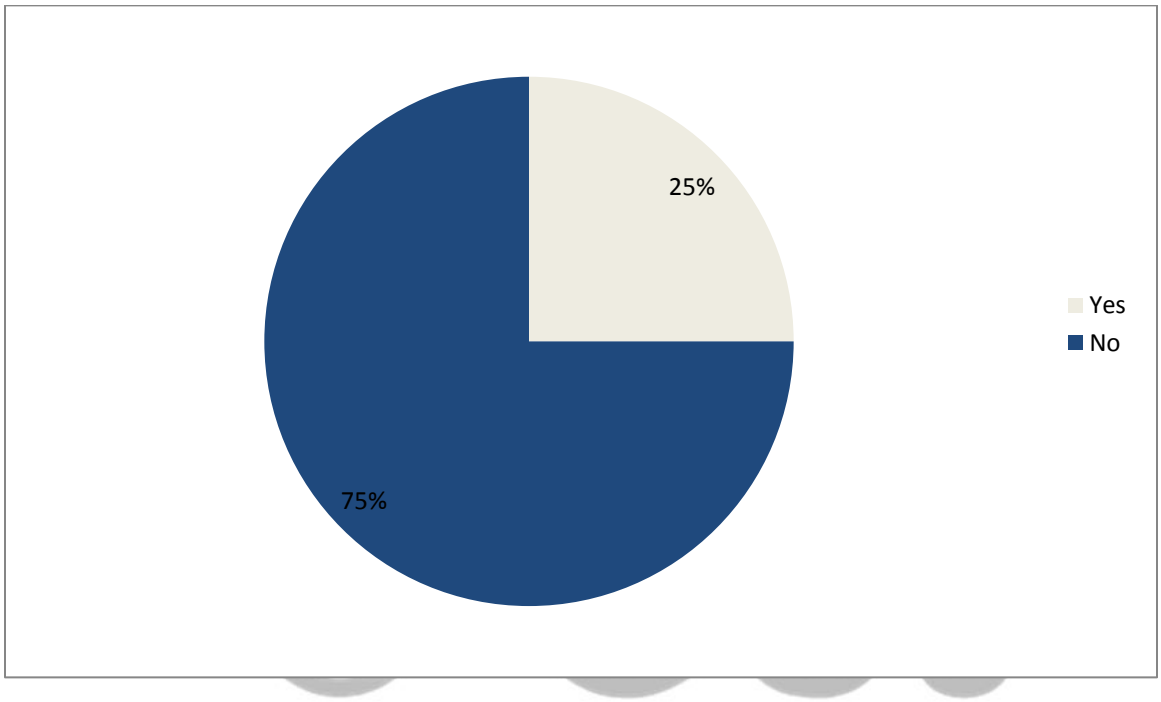

Figure 3: Percentage of Respondent that Monitors their Social Infrastructure Impact on the Environment

The monitoring interval for those that monitor was also high as majority seventy-five per cent (75%) monitor annually, twenty-five (25%) monitor twice in a year (biannual) and none monitor

monthly and quarterly (Figure 4).

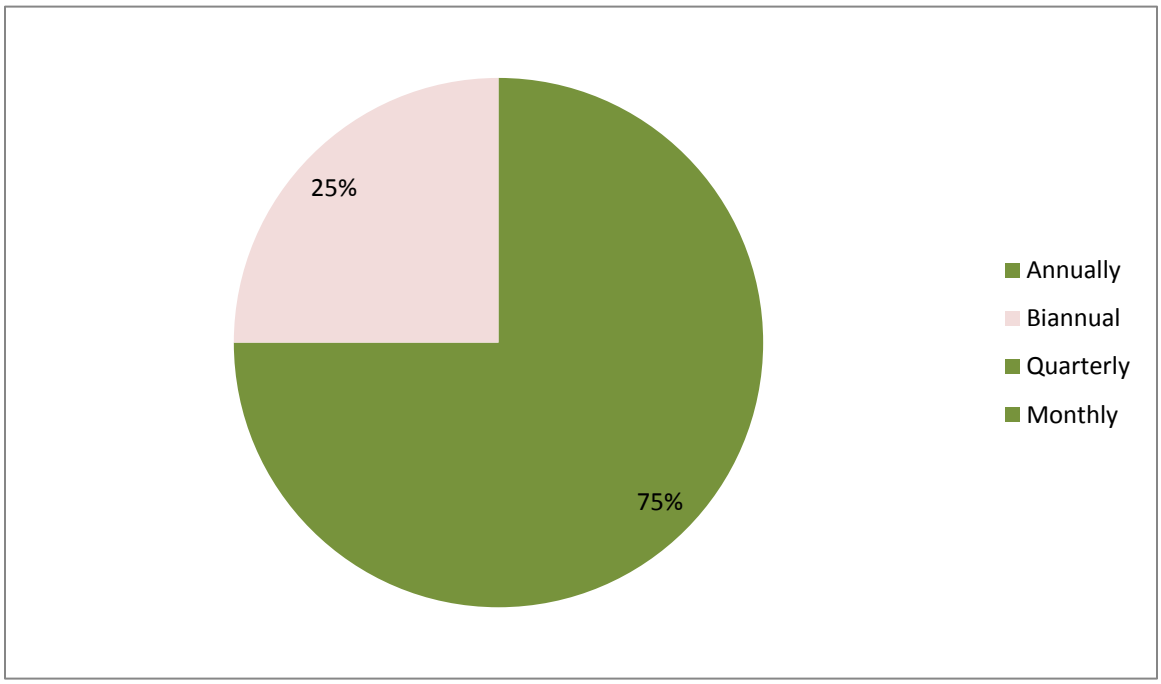

Figure 4: Monitoring Interval for Those That Monitor

Interaction with the respondents shows that most of them that do monitor, only do that during rainy season by simply observing environmental challenges such as wind storm, flood and erosion in order to react to this effects not necessarily to prevent this occurrences. On the reasons for not monitoring, majority (51.7%) are just for negligence, 21.7 and 24.1% affirmed time and financial factors respectively (Figure 5).

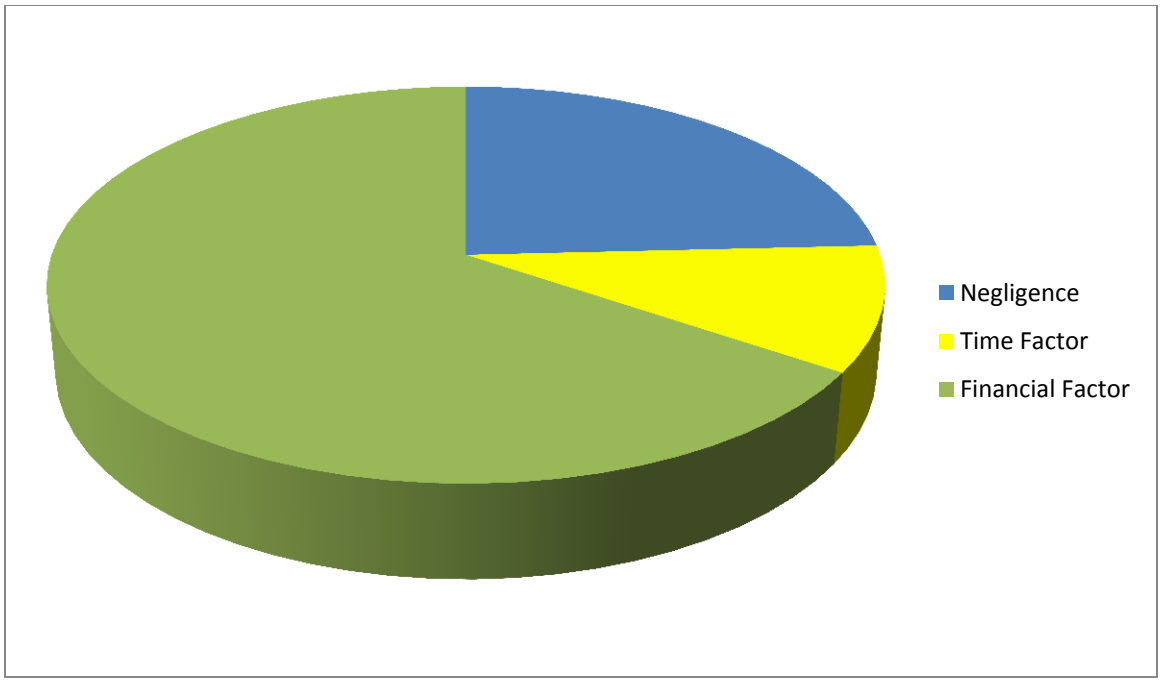

Figure 5: Reasons for not Monitoring Environmental Impact of Social Infrastructure

Though, the sizes of social infrastructure surveyed in Otukpo do not need detail EIA, monitoring of the impacts of an infrastructure project during its operation and maintenance should be an ongoing and regular process to accommodate variations in its function, new standards or best practice, improved knowledge, changing impacts, such as those associated with climate change. Thus, the infrastructure owner or operator needs to monitor and assess routinely the performance of the infrastructure. The key structures and tools for this continual monitoring process should be identified and implemented during the design phase and be used to review options as the infrastructure ages. The poor involvement of professionals and negligence for monitoring are major threat to sustainable social infrastructure in the study area.

Conclusion

To sustain social infrastructural development, adequate/even distribution and integration of environmental factors is crucial in developing countries. Negligence for environmental sustainability in both distribution and architectural designs of social infrastructure poses severe impairment for sustainable urban development.

Data from the survey show that distribution of school infrastructure in Otukpo LGA is not even. Pattern of social infrastructure (schools) in Otukpo Local Government Area, Benue State is a cluster pattern. Most communities in Otukpo Local Government Area has 'shortfall' of social infrastructure (schools); there is poor environmental considerations in siting social infrastructure and poor monitoring of social infrastructure impact on the environment in the study area.

Therefore, school infrastructure distributions in Otukpo have lapses, such as inadequacy, lack of environmental integration approach and thus are unsustainable.

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