Valuation of the Impact of Sawmill Industry on Ambient Air Quality in Ikot Ekpene, Nigeria [1]

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Abstract

The major problem in most towns and cities in Nigeria is that of ambient air pollution. Therefore, this work valued the impact of sawmill industry on ambient air quality in Ikot Ekpene Local Government Area of Akwa Ibom State. Nigeria. The methodology involved the collection of detailed property information from housing units randomly selected in the study area. The major areas covered are Utu Ikpe, Utu EdemUsung, Nsiak, AbiakpoEdemIdim, Ikot Ekpene Main Town, Nkap, Ukana Ikot Ntuen. Moreover, a control point – Utu Ikot Ekpenyong, about 900m away from the study area was chosen. Ten (10) properties were sampled from each of the villages. For the purpose of this research, the average rental values per annum of the sampled properties were obtained using the current rental value. Findings revealed that a sawmill located in Utu community generates a lot of waste including saw dusts, wood barks, palm shavings, among others; which are disposed of through in-situ burning. In addition, activities and processes in the industry produce various gaseous pollutants that are continuously emitted into the atmosphere. The results obtained in this study are not only useful in providing information on the prevailing air quality but also justify the need for epidemiological research in the area to value the impact of continuous gaseous emissions from the sawmill on the populace.

Keywords: Valuation, Sawmill, Industry, Ambient Air Quality, Ikot Ekpene

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1.0 Introduction

The contribution of industry to local and national economy in all facets is not in doubt. The impact of industrial activities is felt in a variety of ways. Presence of any industry in any community has recorded substantial impact on the economy in the area of employment generation, infrastructural provision and boost in the residents' socio-economic status. On the other hand, concerns have been expressed over the years on the negative impacts of industries, most especially on the host communities (Needham and Louw, 2003; Louw et al., 2004, Olaleye and Oluyemi, 2009). Due to the fast growth recorded in the building construction sector, there has been high increase in the establishment of sawmills in different parts of the country to satisfy the growth demand for wood (Aroofor, 2000). Sawmills accounted for 93.32% of total number of wood-based industries in Nigeria in 2001 (Fawupe, 2003). These industries are mainly located in the wood producing rain forest areas of the country with largest concentrations in Lagos, Ekiti, Osun, Cross River, Akwa Ibom, Ogun and Delta States, accounting for 90% of all sawmills in the country (Dosunmu and Ajayi, 2002). The activities and processes in the sawmill industry produce known and unknown gaseous pollutants that are emitted into the atmosphere that may be hazardous to humans. Studies have shown that nasal cancer and asthma are highly associated with continuous exposure to wood dust and other substances that are used in the wood industry (Anavberokhai, 2008). The increased activities in these sawmills as well as the continuous emissions of these pollutants in the South-South Nigeria over the years have not been properly examined especially in the context of their impact on the ambient air quality. It is in this context that this study was carried out.

1.1 Aim:

This work valued the impact of sawmill industry on ambient air quality in Ikot Ekpene with a view to providing information on environmental pollution in the study area and Nigeria at large. In order to achieve the stated aim, the following objectives were set;

1.2 Objectives:

(a) To explore the various methods of valuing environmental goods and services.

(b) To examine the Challenges and opportunities of using the identified methods

(c) To demonstrate the use of one of the methods so identified to value the impact of sawmill industry on ambient air quality in the study area.

(d) To develop a model for determining Rental Values of properties in the Study area.

2.0 Literature Review

Biodiversity is a contraction of biological diversity and it connotes variety or diversity within the biological world. In its widest sense, biodiversity is virtually synonymous with "life on earth". The word was coined in 1985 and during the 1990s and has become very widely used in the popular media and in government and scientific circles (Encarta, 2009). Biodiversity is recognised as important but can be often overlooked or given a lower weight among other issues and this is partly because decision making involves weighing costs and benefits and it is difficult to include biodiversity in this because its value is not usually quantified; thus biodiversity can better be protected by determining their economic values. Habermas (1993) noted that only humans can participate in debates about morality so the interests on non-human or of the biosphere itself are represented only to the extent that humans speak for them. Valuation becomes very necessary therefore to illustrate the importance of biodiversity. Valuation of biodiversity requires an understanding of the range of benefits it provides. Although biodiversity might well have substantial economic value, compared with alternative consumptive resource uses, economic value does not tell us everything we need to know about the value of biodiversity, it mainly helps in the prioritizing policies in decision making.

The significant negative impact of toxic waste sites on housing prices was validated by Kohlhase (1991) and Ketkar (1992). Chattopadhyay (1999), who conducted a study to gauge the willingness of buyers to pay for reduced air pollution, found that residents in Chicago were willing to pay for a reduction in the pollution level. Furthermore, Bakare (2006) in her work, found the effects of industrial pollution on adjoining property in Ikeja, Lagos, to include pollution of water, land and air; increase in building maintenance cost and depreciation in property value. Schuur, (2001); Needham and Louw (2003); Louw et al (2004) and Blaauw (2007) have worked on the possible and negative external effects of industrial activities on other firms, on nature and in particular on households. Considering the benefits of improved air quality on property value, Kim, Phipps and Anselin (2003) measures the benefits of improved air quality on housing prices in Seoul, Korea. It was discovered that improved air quality boosts property values. Using inferential statistics, Espy and Lopez (2000) also found that there is a statistically significant negative relationship between air pollution and prices of properties.

The problem of air pollution is a serious threat to environmental health in many cities of the world (Kan et al 2009; Wong et al., 2008; McCarthy et al., 2007; Cramer, 2002). High concentration levels of air pollutants have been shown to have general adverse adverse effects on human health (Allen et al., 2009; Moshammer et al., 2006). Ambient air pollution has been particularly associated with cardio-respiratory diseases (Miller et al., 2007). Farber (1998) provides a survey of the literature on the impact of undesirable facilities on house values due to perceived disamenities, such concerns range from concerns about health risks to the public image of the community. They can manifest themselves in property markets since it is most

likely that people are willing to pay more to reside in locations further located from perceived disamenities.

The survey confirms that undesirable facilities examples landfills, waste sites, hazardous manufacturing facilities, reduce property values in their direct vicinity. These adverse effects diminish with distance, resulting in increased property values as distance from these sites increases. Furthermore, these adverse property value effects appear to be relatively localized. Other examples can be found in a number of studies which have shown effects on property values due to a contaminated site. Smolen et al (1991); Mendelsohn et al (1992) have reported adverse impacts on values ranging from as low as 0.24% to as high as 25%, depending on the extent of pollution and the location of the property. Although the concentration of major pollutants vary from city to city, the most important sources in Nigeria include fuel consumption for power generation, motorized vehicles, incineration of solid and industrial wastes. (Ahove, 2006, Obadina, 2002). A recent study contended that the greatest air pollution problem in the Nigerian environment is atmospheric dust arising from many industrial processes including sawmill industries (Farombi, 2008). Due to the fast growth recorded in the building construction sector, there has been increase in the establishment of sawmills in different parts of the country to satisfy the growing demand for wood (Aroofor, 2000). Sawmills accounted for 93.32% of total number of wood-based industries in Nigeria in 2001 (Fawupe, 2003). These industries are located mainly in the wood producing rainforest areas of the country with largest concentrations sited in Lagos, Ekiti, Osun, Cross River, Akwa Ibom, Imo states accounting for 90% of all sawmills in the country (Dosunmu and Ajayi, 2002). The activities and processes in the sawmill industries produce known and unknown gaseous pollutants that are emitted into the atmosphere that may be hazardous to humans. Studies have shown that nasal cancer and asthma are highly associated with continuous exposure to wood dust and other substances used in the wood industry (Anavberokhai, 2008). The increased activities in these sawmills as well as the continuous emissions of these pollutants into the atmosphere of the South-South Nigeria over the years have not been properly examined especially on the context of their impact on the ambient air quality. It was against this background that this study was executed.

2.1 Importance of Biodiversity

The world's ecosystem provides a huge variety of goods and services. We are all familiar with the valuable commodities that natural ecosystems provide, such as edible plants and animals, medicinal products, materials for construction and clothing. Many of us likewise value the aesthetic and cultural benefits provided by natural ecosystems, including beautiful views and recreational opportunities. According to Daily (1997), human economies depend upon natural ecosystems for a range of biological and chemical processes. Examples of ecosystem services include the purification of air and water; regulation of rainwater runoff and drought, waste assimilation and detoxification, soil formation and maintenance, control of pests and disease, plant pollination, seed dispersal and nutrient cycling, maintaining biodiversity for agriculture,

pharmaceutical research and development and other industrial processes, protection from harmful ultraviolet radiation, climate stabilization and moderating extremes of temperature, wind and waves. Other benefits include contributions to biotechnology (the use of biological processes in industrial production; examples include the making of cheese, beer and wine as well as vaccine and insulin production and bioremediation (the use of biological methods to restore contaminated environment, especially the addition of bacteria and other organisms that consume or neutralize contaminants. On this note, the protection of biodiversity guards the health of the natural environment and this enables it to provide the services which people depend upon. (National Research Council, 1999).

2.2 The reason behind Biodiversity Valuation

Valuing biodiversity may seem an odd and very difficult thing to do. However, it is necessary in order to illustrate the importance of biodiversity. As there are competing uses of the natural environment, for farming, development or as a natural space, society needs to be able to choose which the best is. Environmental policies and conservation spending decisions are usually based on three sources of information: assessments of fact provided by scientists, biased assessments of values provided by special interests and objective assessment of values. As difficult and controversial as value-based research is, it is the only objective source of information that policy makers have about values. Often, it is the only credible basis for opposing the special interest spin on values, and the only way to discourage wasteful environmental investments that are not in the public interest.

Ecosystem valuation can be difficult and controversial task and economists have often been criticized to put a price tag on nature. However, agencies in charge of protecting and managing natural resources often make difficult spending decisions that involve trade-offs in allocating resources. These types of decisions are economic decisions, and thus are based either explicitly or implicitly, on society's values. Therefore, economic valuation can be useful, by providing ways to justify and set priorities for programmes, policies or actions that protect or restore ecosystems and their services. Economic valuation is an attempt to provide an empirical account of the value of services and amenities or of the benefits and costs of proposed actions (projects or policies) that would modify the flow of services and amenities. Economic valuation provides a utilitarian account, that is to say an account of contribution to the satisfaction of human preferences.

Unless these ecosystem products are valued to reflect the benefit they bring to people, preserving a natural space could be mistaken for an inferior option (Christie, 2004).

2.3 Monetary Measures of Ecosystem Value

Economic values are not the only useful measure of value for ecosystems or anything else. However, in conventional economics, it is generally accepted that a measure of value should be based on what people want and that people, not the government, scientists, or preachers should be the judges of what they want. Based on this individualistic notion of value, the amount of one thing a person is willing to give up to get more of something else is considered a fair measure of the relative value of the two things in the eyes of that person. Money is enormously useful and universally accepted basis for expressing and comparing economic values because the amount that people are willing to pay for something reflects how much of all other for-sale goods and services they are willing to give up to get it (Stanlake and Grant, 1999).

In the case of ecosystems, it is important that measuring the economic value of something based on this notion does not require that it be bought and sold in the markets. It only requires that someone estimate how much purchasing power (in monetary terms) people would be willing to give up to get it (or would need to be paid to give it up) if they were forced to make a choice. The three general approaches to estimating the economic value of ecosystem services outlined above and its essence shows that people can reveal the monetary value they place on some services by their purchasing decisions; people can express the monetary value they place on some services through "willingness to pay" surveys; and people's "willingness to pay" for some services can be imputed based on the costs they would incur if the services were not provided.

2.4 How can Biodiversity be valued?

Even though biological resources are priceless, we often must attempt to assign some measurable value to biodiversity in order to attract the attention of government and commercial interests. It is difficult to put monetary values on the benefits people derive from the natural environment, but while this is a daunting task, several approaches can be taken in valuing biodiversity. Over the years, several other methods of valuation have been developed in attempts to give realistic value estimates of biodiversity. These include:

(a) **Market Price method:** This estimates economic values for ecosystem products or services that are bought and sold in commercial markets.

(b) **Productivity method:** This estimates economic values for ecosystem products or services that contribute to the production of commercially marketed goods.

(c) **Hedonic Pricing method:** This estimates economic values for ecosystem or environmental services that directly affect market prices of some other goods. Most commonly applied to variations in housing prices that reflect the value of local environmental attributes.

(d) **Travel Cost method:** This estimates economic values associated with ecosystems or sites that are used for recreation. This method assumes that the value of a site is reflected in how much people are willing to pay to travel to visit the site.

(e) **Contingent Valuation method:** This estimates the economic values for virtually any ecosystem or environmental service. It is the most widely used method for estimating non-use values. People are required to directly state their willingness to pay for specific environmental services, based on a hypothetical scenario.

(f) **Contingent Choice method:** This estimates economic values for virtually any ecosystem or environmental service. Based on asking people to make trade-offs among sets of ecosystem or environmental services or characteristics. It does not directly ask for willingness to pay, but it is inferred from trade-offs that include cost as an attribute.

(g) **Benefit Transfer method:** This estimates economic values by transferring existing benefits estimates from studies already completed for another location or issue.

3.0 Methodology

The study was carried out at the following communities where there are evidences of emissions of particulate matter into the environment as a result of the Sawmill industry sited in the community. They include; Utu Ikpe village, AbiakpoEdemIdim, Nsiak, Ukana Ikot Ntuen, AbiakpoNkap, ItuakAbang, AnwaUdo Akai and Utu EdemUsung; all in Ikot Ekpene Local Government Area of Akwa Ibom State. The area lies between Latitude 0508' and Longitude 0741' in the South-southern part of Nigeria. The climatic condition of the area is typical of the tropical rainforest eco-zone characterized by its distinct dry and rainy seasons. The wind direction was observed to be indicating an overall easterly movement. Thus the eastern part of the industry is the most impacted of the emissions. According to a Family Head in Utu Ikpe Village - Elder Ebong U. Ekpo, the sawmill industry popularly known as Utu Timber Market occupying about 108 plots of land, was established in 1980 in the area to satisfy the growing demand for wooden members of all types, for the fast growing building construction industry in the state and the Niger Delta region. This sawmill generates a lot of wastes including saw dusts, wood barks, palm shavings, among others; which are disposed of through in-situ burning. In addition, activities and processes in the industry produce various gaseous pollutants that are continuously emitted into the atmosphere which may be hazardous to human health and the environment.

The methodology also involved the collection of detailed property information from sixty (80) housing units randomly selected out of a total of one hundred and eighteen (118) residential units in the study area; which represents a sample ratio of about 67.79%. The major areas

covered are Utu Ikpe, Utu Edem Usung, Nsiak, Abiakpo Edem Idim, Ikot Ekpene Main Town, Nkap, Ukana Ikot Ntuen. For the purpose of this research, rental values per annum of the sampled properties were obtained using the current rental value. Similarly, Total Particulate Matter (TPM) was collected at various locations using Gillian BDX II Abatement Multi-flow air sampler with adjustable flow rate. Air was drawn into cassette which already had a pre-weighed filter. After a period of time, about one hour, the pre-weighed fibre glass filter was removed and re-weighed. The Total Particulate Matter (TPM) was calculated by dividing the difference in weight by the flow rate and the time spent in sampling. Thus the concentration of the particulate matter was determined using the following relationship:

$$\text{Particulate matter (PM in } \mu g/m^3) = \frac{1000 \times (W_2 - W_1)}{F \times T}$$

Where F = flow rate (L/min)
T = time
W_2 = weight of residue + filter
W_1 = initial weight of the filter

The rental value and pollution (TPM) were analysed using regression analysis with the aid of SPSS version 20.

The researchers conducted a research for a cleaner air in Ikot Ekpene and noticed many identical dwellings (precisely, 2-bedroom flats) around the town approximately at different distances from the Sawmill Industry located in Utu community. The only difference is the unwanted substances (particulate matter) into the environment. The following Rental Prices on 2-Bedroom flats and Air Pollution levels were found.

Table 1: The pollution level and average rent per annum

Village	Pollution level ($\mu g/m^3$)	Average Rent per annum (₦)
Abiakpo Edem Idim	283	140,000.00
Utu Ikpe	90	175,000.00
Nsiak	70	188,000.00
Ukana Ikot Ntuen	194	154,000.00
Abiakpo Nkap	120	165,000.00

Ituak Abang	50	185,000.00
AnwaUdo Akai	30	200,000.00
Utu Edem Usung	300	120,000.00

Source: Field Survey, 2017

Table 1 above shows the pollution level in µg/m^3 and the corresponding average rent per annum. It was observed that villages like Utu Edem Usung, where the Sawmill industry is located has the greatest pollution level (300µg/m^3), while Anwa Udo Akai, a village located some Kilometres away from the Sawmill Industry had the lowest pollution level (30µg/m^3).

Using SPSS 20.0 Version, the analysis goes thus:

Table 2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.974[a]	.949	.941	6517.80555

a. Predictors: (Constant), Pollution level

Table 3: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	201243.036	4057.688		49.595	.000
	Independent	-248.852	23.499	-.974	-10.590	.000

a. Dependent Variable: Annual Rent (₦)
b. Pollution level (µg/m^3)

From the above analysis,

Standard error = 651780555
R^2 = 0.949
Adjusted R^2 = .0941.
Therefore, by substituting in the equation $Y = a + b_1x_1 + e$, we have;

$$Y = 201{,}243.036 – 248.852x + 6517.80555$$

From the model derived, if a prospective investor wishes to develop in that particular neighbourhood, he/she will be able to know how much he/she is willing to pay when he/she determines the Total particulate matter of where he/she wishes to site his investment or live.

Total Particulate matter (TPM) in the Study area ranges from 30µg/m^3 to 300µg/m^3. The Federal Ministry of Environment standard is that Total particulate matter should not exceed 250µg/m^3. AnwaUdo Akai has the lowest level of dust (30µg/m^3). Other low dust areas are Nsiak village and ItuakAbang. On the contrary, Utu EdemUsung has the highest level of dust (300). The dust level is the main concern to the residents of the study area as over 85% of the respondents complained of the dust emitted from the sawmill industry. Relatedly, large percentage of the respondents dusts their furniture more than three times a day. This goes to say that areas with low level of dust still suffer the impact of the dust. Consequently, careful prospective tenants will prefer accommodation where dust is at the barest minimum.

4.0 Conclusion and recommendations

The study valued the impact of sawmill industry on ambient air quality in Utu Community in Ikot Ekpene Local Government Area of Akwa Ibom State. It also sought to establish the relationship between the air quality and rental Values of properties in the study area. Results revealed that air quality is vitiated by various activities in the sawmill such as open burning of wood wastes, and heavy consumption of fossil fuels to power various machines. However, the overall assessment of air quality in the area indicated a result that would be described as unhealthful; meaning that the general health of the workers in the sawmill industry, the local population and the surrounding environment is endangered by emissions from the sawmill. The level of emissions could be mitigated by adopting certain measures that are sustainable. Cottage industries can be set up to make use of huge volume of wastes generated from the sawmill as raw materials. For example, saw dusts can be used to produce chipboards and particle boards or moulded into smaller sizes and sold to households as fuels. The above would help reduce the level of emission. The results obtained in this study are not only useful in providing information on the prevailing air quality but also justify the need for epidemiological research in the area to ascertain the level of impact of continuous gaseous emissions from the sawmill on the populace.

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