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VALUATION OF RESIDENTIAL PROPERTIES AFFECTED BY POLLUTION IN EKET, NIGER DELTA USING THE GROWTH EXPLICIT DISCOUNTED CASH FLOW MODEL

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ABSTRACT

This paper examines the application of growth explicit discounted cash flow model to the valuation of residential properties affected by environmental pollution from the activities of oil and gas firms in Eket area of the Niger Delta Region. Data for the study were obtained from 178 residential properties affected by environmental pollution in the study area, selected randomly for the study. In the valuation of residential properties affected by environmental pollution in the study area, it was found that the value obtained using growth explicit discounted cash flow model was 15.41% higher than that obtained using the conventional valuation technique. This result is due to the ability of the growth explicit discounted cash flow model to incorporate rental growth and rent review frequency in its computation. The paper recommends that in the valuation of residential properties with complex rental gearing, affected by environmental pollution from oil industry activities as is the case with the properties under study, growth explicit discounted cash flow models are necessary if accurate, sound and logical valuation must be achieved.

1.0 INTRODUCTION

Environmental pollution is an undesirable change in physical, chemical or biological characteristics of water, air and soil that may harmfully affect natural and built environmental assets (World Bank, 1978; Umeh and Uchegbu, 1997 and NOUN, 2009). Of all environmental degradation factors, it is one of the greatest factors affecting property value (Aina, 1992).In Nigeria, the Niger Delta region has been the centre for most of the oil exploration and exploitation activities in the country since crude oil was discovered in commercial quantity in the region in 1956(UNEP, 2011). It has also been discovered that environmental pollution in the region is associated with oil exploration and exploitation activities in the area. This pollution mainly takes the form of oil spillage and gas flaring (UNEP, 2011). According to the statistics from Nigeria's Federal Ministry of Environment, about 68% of the associated gas production in the Niger Delta is flared. Besides, Nigeria accounts for 19% of the total amount of natural gas flared globally. The rest of Africa accounts for another 19% while the rest of the world accounts for the remaining 62%. However, most of the gas flares in Nigeria is directly associated with the activities of the oil companies and related firms operating in the Niger Delta region of the country. Gas flare has major adverse socio – economic and other impact on the Nigerian environment in general and that of the Niger Delta in particular. In a study on the state of the Nigerian environment conducted in 1991 by the Ibadan – based Nigerian Environmental Study

Action Team (NEST,1991), the adverse impact of gas flare in Nigeria were identified to include atmospheric pollution by combustion contaminants; thermal pollution of air, land and water; destruction of vegetation and associated wildlife; damage to buildings and other structures; damage to soil and crops by heat released by the flare, among others. This paper examines the valuation of residential properties affected by environmental pollution in Eket area of the Niger Delta region, using growth explicit discounted cash flow model.

2.0 METHODS OF VALUATION OF REAL PROPERTIES AFFECTED BY ENVIRONMENTAL POLLUTION

After a thorough review of existing literature on valuation methods, valuation techniques suitable for the valuation of real properties affected by environmental pollution were identified to include the contingent valuation technique, hedonic valuation approach, cost approach to valuation and the income approach to valuation. These are briefly examined as follows:

2.1 CONTINGENT VALUATION TECHNIQUE

This is a non-market based method of environmental valuation that elicits information concerning environmental preferences from individuals through the use of surveys, questionnaires and interviews (NOAA, 2007). In deploying the contingent valuation technique, the appraiser constructs a scenario involving an improvement or decline in environmental quality. The scenario is then posed to a random sample of the population to estimate their willingness to pay for the improvement or their willingness to accept monetary compensation for the decline in environmental quality. The primary disadvantage of contingent valuation technique is that it may not yield accurate results due to biases that may be introduced in the survey through respondents' behaviour or inability of the respondents to respond to the questions due to illiteracy or lack of understanding (NOAA, 2007). As argued by Roddewig and Frey (2006), contingent valuation technique cannot be considered an appropriate approach to valuation of real estate unless in situations involving special- purpose or limited-market properties for which there are few real sale transactions that can be analysed.

2.2 HEDONIC VALUATION APPROACH

This method of environmental valuation uses surrogate markets for placing value on environmental quality (NOAA, 2007).According to Rosen (1974) and Bajic (1983), hedonic price refers to the value of a set of attributes or characteristics of a product that consumers are willing to pay due to its benefit or utility. The hedonic valuation model was originally developed by Rosen (1974) for commodities in general. It is an advanced form of ex-post models that estimate the marginal contribution or implicit prices of property characteristics to their total value by comparative analysis using past sale transactions (Roubi and Littlejohn, 2004). A major problem in utilizing hedonic models is lack of data (Barlowe, 1986; Roubi and Littlejohn, 2004), reliance on highly developed property markets and difficulty in isolating the explanatory variables (Davies and Richards, 1998).

2.3 COST APPROACH TO VALUATION

The cost approach is based on the assumption that cost and value are related. The cost method of valuation is a method of determining the value of property by reference to the cost of replacing it or procuring an acceptable substitute (Ifediora, 1993).The cost approach was originally designed for the valuation of properties for which no market is found and rental evidence is non – existent (Millington, 1982). Like other valuation techniques, valuation scholars have questioned the validity and reliability of the cost valuation approach. Cost in the investment sense is not value (Babcock, 1932 and Ifediora, 2000) and value is not necessarily related to cost, although a layman might sometimes be tempted to think it is (Millington, 1982). But there are valuation problems that unavoidably demand the adoption and application of the cost approach to value. Typical among these valuation problems are insurance valuation and assessment of direct environmental damage to building components. These valuation problems inevitably require cost – based estimates of value. They are specialised valuation problems and as recommended by Akinyode (1987), the use of cost approach should be strictly restricted to specialised valuation problems.

2.4 INCOME APPROACH TO VALUATION

The income approach to valuation is a method of determining the present worth of the right to future income or benefits to be derived from the ownership of a specific interest in a specific property under given market conditions (Ifediora, 1993).This valuation technique is based on the principle that a property's income and its capital value are related and that given the income a property produces or its annual value, the capital value can be found. It entails the capitalisation of the income produced by a property by a factor known as the Years' Purchase. In the context of valuation of real properties affected by environmental pollution, this involves the discounting of the estimated lost incomes to its present value at an appropriate rate of return. Growth explicit discounted cash flow models are variants of the income approach to valuation (Baum and Mackmin, 1989; Baum and Crosby, 1995; Ajayi, 1998; Kalu, 2001; Udo, 2003; Wyatt, 2007; Udoekanem, 2009).

2.4 REVIEW OF GROWTH EXPLICIT DISCOUNTED CASH FLOW MODELS

The strongest criticisms of the conventional valuation models are that it fails to specify explicitly the income flows and patterns assumed by the valuer, and that it applies growth implicit all risks yield to fixed contracted tranches of income (Baum and Mackmin, 1989; Udo, 1989; Udoekanem, 2010). Growth explicit discounted cash flow models are built to address to a great extent, the criticisms trailing the conventional valuation models. As explained by Baum and Crosby (1995); Ajayi (1998); Udo (2003), Ogunba and Ojo (2007) and Wyatt (2007), the usefulness of growth explicit discounted cash flow models, over conventional valuation models includes; specific assumptions affecting the cash flows are made explicit; the yield used for the valuation may be compared with the yield expected from other competitive investments; and more information are provided for future analysis. Growth explicit valuation models are based on the underlying assumptions that there is growth in future rental over present rental values; that rents are not fixed but are reviewed at periodic intervals (review dates) and that the capitalisation rate depends on the preconceived level of growth in the future. Growth explicit discounted cash flow valuation models include the Real Value Model

(Wood, 1973), Rational Model (Sykes, 1981), Equated Yield Model (Marshall, 1976), Real Value/Equated Yield Hybrid Model (Crosby, 1986, Baum and Crosby, 1995). The basic inputs of growth explicit models are initial yield, rent review pattern, equated yield, implied annual rental growth rate and inflation risk free yield. In the valuation of residential properties affected by environmental pollution in Eket area of the Niger Delta region, the valuation is undertaken on Before and After Basis(Iniama, 1997; Alli, 2001 and Udia, 2001) such that:

$$V_c - V_d = D$$

where V_c = Value Clean (Value Before Pollution)

V_d = Value Dirty (Value After Pollution)

D = Damage

The rationale for the use of income approach to valuation and specifically, growth explicit discounted cash flow models for the valuation of the properties under study is based on the fact that these properties are investment properties with geared rental incomes which are subject to review at periodic intervals.

3.0 METHODOLOGY

3.1 THE STUDY AREA

The study area for this research is Eket as shown in Plate 1. Eket is a town, South of the Niger Delta region. The town experiences the tropical climate with two distinct seasons; the dry and the wet seasons. The mean annual rainfall is about 191.5mm with temperature ranges from 23.4°C to 31.3°C (NBS, 2009). The economic base of the town is that of civil service, although private enterprises in the town have increased in the past four decades due to the oil exploration and exploitation activities in the area. Apart from being a major oil producing town in the Niger Delta, Eket is the major political nerve centre of Akwa Ibom South Senatorial District. The people of Eket are predominantly the Ibibio- speaking people of the Niger Delta, although other peoples and tribes inhabit the area in considerable numbers. The vegetation of the area is mangrove. The town is a cosmopolitan one, with ExxonMobil as the major multinational oil company operating in the area. The major land uses are residential and commercial land uses even though there are some light manufacturing and oil servicing firms within the town.

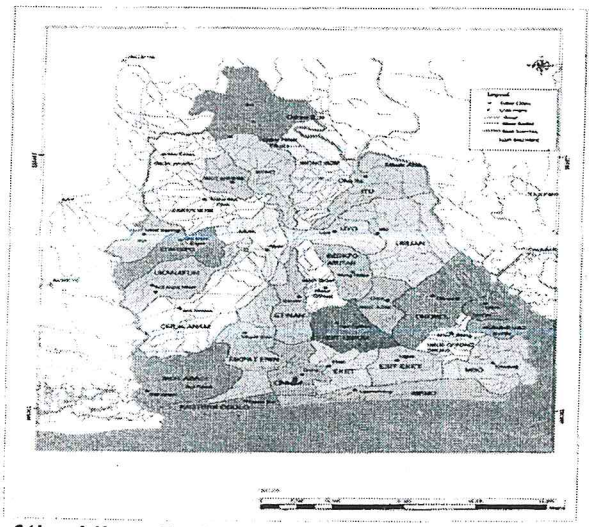

Plate 1: *Parts of the Niger Delta Region showing the study area*

3.2 DATA SOURCES AND METHODS OF ANALYSES

The population for the study consists of residential properties (rented and owner occupied) affected by environmental pollution in the Eket area of the Niger Delta region. These residential investment properties are mainly flats which have been let, but were temporarily vacated by the sitting tenants who were unable to bear the hazards resulting from the release of harmful industrial pollutants into the environment by some oil and gas firms operating in the area. Only residential properties are used for this study due to data availability. Commercial properties were also affected by the pollution but data on them could not be obtained as their owners refused to release information concerning their rental values. Questionnaire was designed for the owners of the affected properties to complete and submit same for the purpose of the study. A total of 400 residential investment properties were randomly selected for the study. Out of 400 questionnaires administered to the property owners, only 178 questionnaires were returned, representing about 44.5% of the total questionnaires administered. The small size of the sample is due to the refusal of some property owners to complete the questionnaire, apparently for fear of the unknown. Data collected comprised rental values of the properties before and after the pollution, amount spent on repairs before and after the pollution, rent review frequency and nature of facilities provided in the properties. Data on rental values and repairing liability for the first 10 residential flats are presented in Table 1.

Table 1: Rental Values and repairs in some of the properties before and after pollution

Residential Property	Rental Value Before Pollution in ₦'Million	Rental Value After Pollution in ₦'Million	Repairs Before Pollution in ₦'Million	Repairs After Pollution in ₦'Million
F_1	1.20	0.80	0.180	0.120
F_2	1.00	0.70	0.165	0.105
F_3	1.20	0.75	0.170	0.150
F_4	0.85	0.70	0.140	0.100
F_5	1.50	1.20	0.250	0.220
F_6	1.00	0.80	0.200	0.160
F_7	0.75	0.60	0.100	0.085
F_8	0.80	0.60	0.120	0.110
F_9	1.50	1.25	0.230	0.190
F_{10}	0.95	0.95	0.185	0.155

Table 2: Rent Review Pattern for the properties under study

Rent Review Pattern (in years)	Frequency	% occurrence	Probability	Expected Rent Review Pattern
2 years	52	29.2	0.292	0.584
3 years	78	43.8	0.438	1.314
4 years	29	16.3	0.163	0.652
5 years	19	10.7	0.107	0.535
TOTAL	178	100	1.000	3.085

say 3 years

Source: *Field Data (2008)*

4.0 RESULTS AND DISCUSSION

Residential flats selected for the study were designated $F_1 - F_{178}$. Data on the rental values and repairing liability are presented here only for the first 10 flats, that is, $F_1 - F_{10}$ as presented in Table 1. The expected rent review pattern for the properties as presented in Table 2 is 3 years. The short rent review frequency is due to the anticipation of future value change and the possibility of growth in future rental value over present rental value, an indication of the effect of inflation on real property incomes in the Niger Delta region. Based on the data collected for the study, the predominant rent review pattern is 2 – 3 years, representing about 73% of the interval observed. In the valuation of damage to these properties due to pollution, the investment valuation methodology was adopted. An initial problem encountered during the valuation was the treatment of future value change, resulting in rental growth as evidenced by the rent review intervals. The conventional valuation model could not handle this problem because it cannot incorporate rent reviews and rental growth in its computation. Besides, rents paid in the Niger Delta property market are gross rents. Adjusting these rents to a net basis, given the growth prospects of the gross rents and repairs made the use of growth explicit discounted cash flow valuation model inevitable. For the purpose of this study, the growth explicit discounted cash flow model was adopted. This is because the model allows for the modelling of individual property interests. Based on the data from the study, the valuation is undertaken on Before and After basis as demonstrated based on the valuation case adopted for the study.

Data on F_1, the first property listed in Table 1 is used here for the application of growth explicit discounted cash flow models to the valuation of the residential properties affected by environmental pollution in the study area.

Thus, F_1 is a freehold residential investment property in Eket, South of Niger Delta region of Nigeria. The property has been severely affected by the sudden release of hazardous pollutants from the gas treatment plants of an oil firm operating nearby. Rent payable on the property and repairs before the pollution were ₦1,200,000 p.a and ₦180,000 p.a respectively. Repairing liability on the property increased at a rate of 10% p.a before the property was contaminated by the pollution. The property was vacated by the tenants who could no longer bear the hazards of the pollution. The eventual repair of the treatment plants brought an end to the pollution. Current rent payable on the property and the repairs after the incident are ₦800,000 p.a and ₦120,000 p.a respectively, with the repairs now increasing at 12% p.a. Yield on similar freehold residential investment properties in the neighbourhood before contamination was 5%. Current yield on similar contaminated properties in the area is 7%. Rental history shows that rent review for the property is at 5 years interval. Redemption Yield on gilt-edged stock is 15.8%. Determine in monetary terms, the extent of damage caused by the pollution.

(a) Determination of Explicit DCF Valuation inputs for income capitalisation

(i) Implied Annual Rental Growth Rate Before Pollution

$(1+g)^t$ =

where k = initial yield before pollution
t = rent review pattern
e = equated yield
g = implied annual rental growth rate before pollution

$$(1+g)^5 = \frac{\text{YPPerp @ 5\% - YP5yrs @ 17.8\%}}{\text{YPPerp @ 5\% x PV5yrs @17.8\%}}$$

$$(1+g)^5 = \frac{20 - 3.1416}{20 \times 0.4408}$$

$$(1+g)^5 = \frac{16.8584}{8.8160}$$

$$(1+g)^5 = 1.9123$$

$$g = \sqrt[5]{1.9123} - 1$$

$$g = 13.8\% \text{ p.a}$$

(ii) *Implied Annual Rental Growth After pollution*

$(1+g)^t$ =

where k = initial yield after pollution
t = rent review pattern
e = equated yield
g = implied annual rental growth rate after pollution

$$(1+g)^5 = \frac{\text{YPPerp @ 7\% - YP5 yrs @ 17.8\%}}{\text{YPPerp @7\% x PV5yrs @17.8\%}}$$

$$(1+g)^5 = \frac{14.2857 - 3.1416}{14.2857 \times 0.4408}$$

$$(1+g)^5 = \frac{11.1441}{6.2971}$$

$$(1+g)^5 = 1.7697$$

$$g = \sqrt[5]{1.7697} - 1$$

$$g = \text{p.a}$$

(iii) Growth-Adjusted Yield (i.e. IRFY) Before Pollution

$$i = \frac{1+e}{1+g} - 1$$

where i = Inflation Risk Free Yield (IRFY) before Pollution
g = Implied annual rental growth rate before pollution
e = equated yield

$$i = \frac{1+0.178}{1+0.138} - 1$$

$$i = \frac{1.178}{1.138} - 1$$

$$i = 3.51\%$$

(iv) Growth-Adjusted Yield (i.e. IRFY) After Pollution

$$i = \frac{1+e}{1+g} - 1$$

where i = Inflation Risk Free Yield (IRFY) after Pollution
g = Implied annual rental growth rate after pollution
e = equated yield

$$i = \frac{1+0.178}{1+0.1209} - 1$$

$$i = \frac{1.178}{1.1209} - 1$$

$$i = 5.09\%$$

(b) Determination of inputs for the capitalisation of repairs

(i) Inflation Risk Free Yield Before Pollution

$$i = \frac{1+e}{1+g} - 1$$

where g = annual growth rate of repairing liability before pollution
e = equated yield

$$i = \frac{1+0.178}{1+0.1} - 1$$

$$i = \frac{1.178}{1.1} - 1$$

$$i = 7.09\%$$

(ii) *Inflation Risk Free Yield After Pollution*

$$i = \frac{1+e}{1+g} - 1$$

where g = annual growth rate of repairing liability after pollution
e = equated yield

$$i = \frac{1+0.178}{1+0.12} - 1$$

$$i = \frac{1.178}{1.12} - 1$$

$$i = 5.18\%$$

This analysis is summarised in Tables 3 and 4 below:

Table 3: Inputs of Real Value/Equated Yield model for Income Capitalisation based on Data on F_1

Valuation Inputs	k (%)	e (%)	t years	g (%)	i (%)
Before Pollution	5	17.8	5	13.8	3.51
After Pollution	7	17.8	5	12.09	5.09

Table 4: Inputs of Real Value/Equated Yield Model for the Capitalisation of Repairing liability based on Data on F_1

Valuation inputs	e (%)	g (%)	i(%)
Before Pollution	17.8	10	7.09
After Pollution	17.8	12	5.18

(c)The Valuation

(i) Valuation of Property using the Real Value/Equated Yield Technique

(a) Value of Property Before Pollution

Rental Value (inclusive of repairs) ₦1,200,000 p.a

YP5yrs @ 17.8% x YP Perp @ 3.51%

YP 5yrs @ 3.51% 20.0 ₦24,000,000

Less Repairs

Repairing liability ₦180,000p.a

YP1yr@17.8% x YP Perp@7.09%

YP 1 yr @7.09 12.82 ₦2,307,600

Valuation ₦21,692,400

(b) Value of Property After Pollution

Rental Value (inclusive of repairs) ₦800,000.p.a

YP 5yrs @ 17.8% x YP Perp @ 5.09%

5yrs @ 5.09% 14.2857 ₦11,428,560

Less Repairs

Repairing liability ₦120,000p.a

YP1yr@17.8% x YP Perp@5.18%

YP 1 yr @5.18% 17.2414 ₦2,068,968

Valuation ₦9,359,592

Damage = Value of property before pollution – Value of property after pollution

= ₦21,692,400 – 9,359,592

= ₦12,332,808

(ii) Valuation of Property using the Conventional Technique

(a) *Value of Property Before Pollution*

Gross Rental Value	₦1,200,000 p.a
Less Repairs	₦180,000p.a
Net Rental Value	₦ 1,020,000 p.a
YP Perp@5%	20
Valuation	₦ 20, 400, 000

(b) *Value of Property After Pollution*

Gross Rental Value	₦ 800,000 p.a
Less Repairs	₦120,000p.a
Net Rental Value	₦ 680,000 p.a
YP Perp@5%	14.2857
Valuation	₦ 9,714,276

Damage = Value of property before pollution – Value of property after pollution

= ₦20,400,000 – 9,714,276

= ₦10,685,724

Table 5: Summary of Valuation in the case study

Valuation Technique	Valuation		
	Before Pollution (₦)	After Pollution (₦)	Damage (₦)
Real Value/ Equated Yield Technique	21,692,400	9,359,592	12,332,808
Conventional Technique	20,400,000	9,714,276	10,685,724

The extent of damage in monetary terms, caused by the pollution to the residential investment property is in the sum of ₦12,332,808 if the valuation is based on the Real Value/Equated Yield Technique and ₦ 10,685,724 if the valuation is based on the conventional technique. Thus, the value obtained using the Real Value/Equated Yield model is 15.41% higher than that obtained using the conventional valuation technique .Hence, the Real Value/Equated Yield Technique produces better compensation payable by the polluter to the owner of the affected property for the loss of income from the property, caused by pollution than the conventional technique.

Damage caused by environmental pollution to residential investment properties selected for this study is in the form of loss of rental incomes as a result of the temporary abandonment of the properties by the sitting tenants. The lost rental incomes have rental growth prospects which must be reflected in the valuation process if a fair compensation must be determined for the owners of these properties and other investment properties affected by environmental pollution in the Niger Delta region. The traditional or conventional method of property investment valuation cannot handle rent reviews and rental growth in its computation and as such cannot reflect the growth prospects of the lost incomes in the valuation process. On the other hand, growth explicit discounted

cash flow models can handle the issue of rental growth and rent reviews and the treatment of future value change in investment properties in an inflationary economy such as ours. In the determination of fair compensation to owners of investment properties affected by environmental pollution in the Niger Delta region, such compensation would be closer to reality if it is assessed using growth explicit discounted cash flow models. Such assessment should be undertaken on before and after basis as demonstrated in this paper

5.0 CONCLUSION

Growth explicit discounted cash flow valuation models can incorporate rent reviews and rental growth in their computation. The traditional valuation technique cannot handle rental gearing in its computation. The use of explicit discounted cash flow models in property investment valuation in Nigeria is very necessary, considering the inflationary nature of our economy. In the valuation of damage to investment properties in the Niger Delta, particularly those with complex rental gearing and provisions for growth in repairs, other techniques would at best produce misleading compensation claims, incapable of placing the owner of the affected property at a position that he was, immediately before the occurrence of the pollution.

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