

EFFECT OF FLOOD RISK ON PROPERTY VALUE IN KADUNA, METROPOLIS, NIGERIA

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Abstract

The study aimed at determining the effect of flood risk on property investment across four predominant flood areas in Kaduna by examining the trend in rental values vis-a-vis relative distances of flood risk zone from residential properties investment. The study randomly selected 200 residential properties within 300m radius of flood risk zone across the study areas and relative distances were measured using geographical information system (GPS). Data on historical rental trends (2010-2015) across the study areas were sought directly from registered estate firms in Kaduna through systematic random sampling. The study employed descriptive graph to analyse the trend in rental values and relative distances of selected properties from flood risk zone. The result of descriptive analysis revealed that after 2012 flood, the rental of 1B/R, 2B/R and 3B/R dropped by between 16.7%-20%, 16.7%-13% and 11%-25% respectively in 2013 in Kigo and Rafin Guza areas but the rental value in Ungwan Rimi and Banawa areas were unaffected after the 2012 flood. Furthermore, the result of correlation showed a positive significant relationship between rental values and relative distances of flood risk zone from residential properties at 0.893 and 0.908 in Kigo and Rafin Guza respectively, and the result of regression analysis showed that 79.8% and 82.5% variation in rental values of Kigo and Rafin Guza were significantly influenced by relative distances of flood risk zone from residential properties, Angwan Rimi and Banawa were insignificant. Study concludes that the high land value in Ungwan Rimi and Banawa has provided an edge against the influence of flood and therefore they are not affected significantly by the flood. The study recommends that an investor who wishes to invest in Kigo and Rafin Guza should locate such investment far away from flood risk zone at minimum distance of 300m.

Introduction

Flood is an environmental damage caused by overflow of water body. Since the time immemorial especially in biblical days, the effect of flood has always caused devastating impact on the environment (Eves, 2004). Urban flood is concerned with overland flow of water over the street that is sufficient to cause significant property damage, traffic defections, health hazard and loss of valuable assets (Bin *et al.*, 2008). Any form of overflow of water from river and other water body that is capable of causing severe damage to life and property value in any urban setting is called urban flood (Bin & Polasky, 2004). Flood impacted negatively on environment and capable of causing an extinction of life and it is a disaster that leaves a lasting damage on both human and non-human. Flood can be seen as predictable natural environmental hazard that can be mitigated (Bohnsack *et al.*, 2008). The damaging effect of flood cannot be overemphasised across the continent. In Yuba, California experienced flooding in 1997, where over 38,000 inhabitants were evacuated; 322 homes were destroyed; close to 1000 acre, 15,500 acres and 1700 acres of residential, farmland and industrial land were flooded respectively (Dunstan, 1997). According to

the UK Environment Agency (2001) over 10% of the population is directly at risk from flooding, with a greater percentage of the population being indirectly affected by flooding due to road closures, service disruption and the loss of goods and produce. Also in Nigeria, especially in Northern Nigeria more than two million people were displaced by flood, and Kaduna, Niger, Sokoto, plateau, Bornu and Yobe have recorded frequent occurrence of flood (Osowe, 2010). Flood recorded in 2012 in Kaduna has caused irreparable loss in value of real investment by many property investors and developers. The lesser the distance of the property to flood area, the more the impact of floor risk on the properties. Also due to high land value in Kaduna metropolis, the value of residential property increases outwardly from River Kaduna. In other word, the value of landed property increases as the relative distances of the properties to flood prone area increases. The aim of the paper is to determine the influence of distances of the flood prone area on property values of residential property. The objectives are to examine the trend in rental values of property in relation to distances of properties away from flood pruned area and to determine the amount of variation in rental values that can be attributed to effect of flood.

LITERATURE REVIEW

The effect of flood on property value has been examined in several dimensions with different outcome; various studies carried out both home and abroad have found negative result of flood in the environment. In the study carried out by Montz (1992) on the relationship between flooding and residential property values in three New Zealand communities: TePaeroa, TeAroha and Thames. The study utilized repeat sales techniques to analyse 300 transactions' data collected through random sampling techniques. The study find out that TePaeroa community experienced flood-free properties and experienced a significant increase in prices following the flood event while TeAroha communities experienced a decline in property values following the event of flood, and in Thames there was no decline in property value. Bin and Polasky (2004) used 1999 Hurricane Floyd as a natural experiment to analyse property prices of 8,375 homes between 1992 and 2002. The study employed descriptive and repeated sale approaches to analysed the data. The study reported that houses located within the floodplain were worth on average 5.7% less than a comparable property located outside of the floodplain. The study further discovered that the price discount doubled after Hurricane Floyd. Eves (1999) studied the long-time impact of flood on residential property prices in Sydney, Australia. The result showed a definite price differential between similar types of properties that are flood-free compared to the same type of properties that are flood prone. The study further noted that the price differentials were not uniform but varied on an annual basis. The study concludes that flood liable property has a lower value than similar property that is not flood liable. Harrison *et al.* (2001) studied the influence of flooding on rental value in Florida, USA. The study utilized hedonic model to effect of flooding plain, real state investment. The result shows that floodplain result in to discount in real estate value from \$8.985 to \$2.100. Eves and Brown (2002) analysed the flood influence on rental value in California, USA. The result of hedonic model revealed that floodplain location lowers the property value by 4.2%. Hallstrom and Smith (2005) examined the effect of floodplain on housing prices in Florid, USA. The study utilized repeated sales approache to analyse the data. The study found that 19% decline in housing price is attributed to flood activities. Bin *et al.* (2008) modelled the influence of flood rate on housing prices in North Carolina, USA. The result of hedonic modelling and spatial data

analysis showed that house prices discount depends on the rate of flood and flood discounts house price between 6.2%- 7.8%. Lamond *et al.*, (2009) analyse the effect of floodplain in UK. The study adopted repeated sale approach to analyse the spatial data. The finding showed temporary impact of flood on property values after 3years.

Ajibola *et al.* (2012) assessing the effect of flood on residential property value in Lagos, Nigeria. The study analysed 126 properties through descriptive and inferential analytical method. The study found that drainage and rise in sea level were the major cause of flood and result of paired sample test revealed that the impact of flood across the properties are significantly related. Oyediran et al (2015) examined the effect of the 2012 flooding on residential rental values in Kaduna, Nigeria. The data for the study was selected using systematic random sampling. The study discovered that there was fall in rental rental value between 2012 and 2013 but later rose again due to some mitigating measures taken by the government. Elvis *et al.* (2016) analysed the nexus between urban flood and residential value in Kumasi Ghana, the study analysed flood and non-flood areas using repeated sale approach (multiple regression analysis) to create market indices. The result showed that rental values of non-flooded area were higher than flooded area. The result further showed a negative impact of flood on rental value is significantly varied across residential property types.

Therefore having examined the various incidences of flood and its effect in property market from various international, national and local studies, it was discovered that flood has adverse influence on property values. But these aforementioned studies have not been able to establish how the rental values of residential properties move or trend as distances of properties increase further away from flood risk zones. The study also estimate the amount of decrease in rent after the adverse effect of flood in 2012 and finally estimate influence of flood risk zones on rental value.

METHODOLOGY

The population study comprises of residential properties around 300m radius from the flood setback area (flood risk zones). The study randomly selected 200 residential properties solely held as an investment. Geographical information system (GPS) was utilized to determine relative distances of the properties from flood setback area across the study areas. Data on historical rental values of residential properties between (2010-2015) were sought directly from registered estate surveyors and valuers firms in Kaduna through systematic random sampling across the study areas (Kigo road, Rafin Guza, Banawa road off Kaduna Garden, and Ungwa Rimi), and choice of the study period was based on time of occurrence of flood. Also current rental values were also sourced from occupants of selected properties during the field survey. The study utilized linear graph to examine the trend in rental value before and after the floor occurrence of flood in 2012.

STUDY AREA

Kaduna state is in the Northwestern region of Nigeria and formal capital of Northern region of Nigeria. Kaduna shares common borders with Katsina, Zamfara, Kano, Niger, Bauchi and Plateau States. The State also shares border with the Federal Capital Territory Abuja to the South-West. Kaduna metropolis is located between latitude 10°31”N and Longitude 7°26’ 25”E (see Figure 1). The State occupies an area of approximately 48,473.2 square kilometres. The river Kaduna takes its source from the Kujama hills in the Jos plateau and flows for 210 km before reaching Kaduna town. It crosses the city dividing it into North and South area. Beyond Kaduna, the river flows about 100km into the Shiroro dam areas. The river is joined on its course by three tributaries which include river SarkiPawa, Tubo/ Damari and Dinya, the Shiroro. It continues to flow for 200 km and finally discharges into the river Niger on the Northern shores of Pategi.

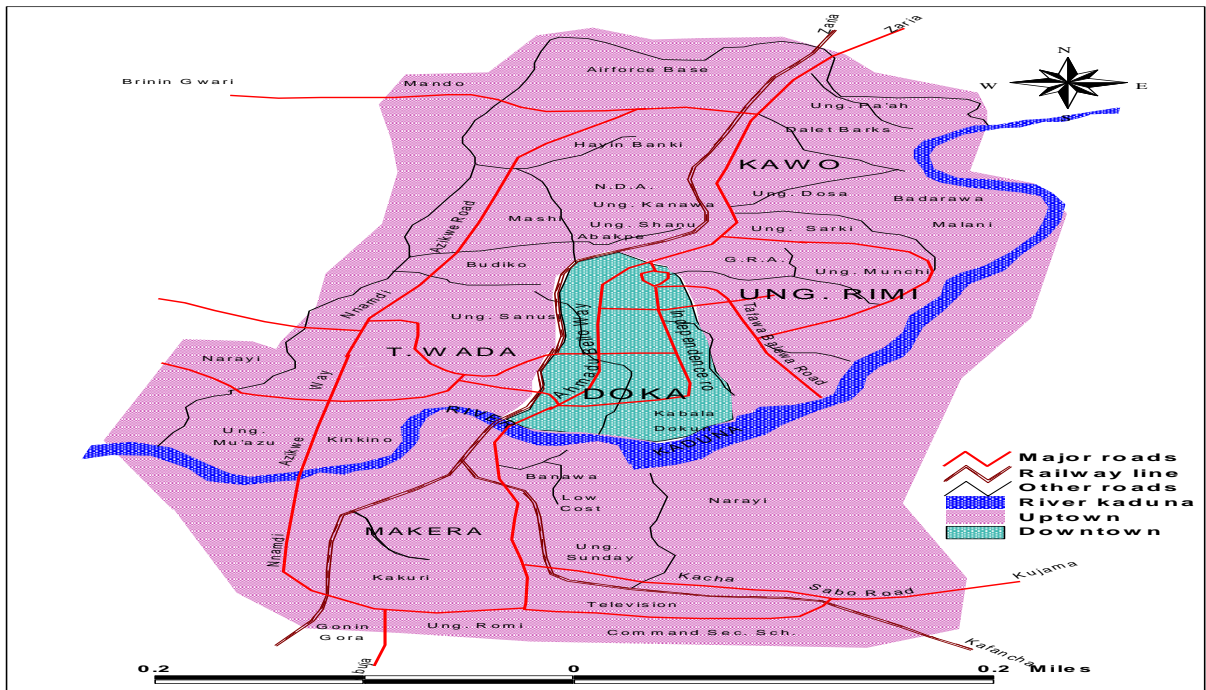


Figure 1: Map of Kaduna Showing River Kaduna

RESULTS

Figure 1 shows the rental trend of the residential properties in Kigo flooded area over the period of 2010 to 2015. Basically, the rental value of 1B/R, 2B/R and 3B/R residential properties in Kigo road showed a progressive, steady and slight increase respectively from 2010 to 2012, but due effect of flooding in 2012, the rental value of 3B/R, 2B/R and 1B/R dropped by 20%(250,000-200,000), 13%(150,000-130,000) and 25%(75,000-50,000) respectively in 2013. After the effect flood in the market in 2013, there was gradual increase in rent due to increase in population and demand for residential space, and the rent rose from 2013 by 37.5% (275,000-200,000), 53.8%(200,000-130,000) and 80%(90,000-50,000) in 2015. This indicates the effect of flood in residential market in 2012 was not prolonged beyond 2013 in Kigo area in Kaduna.

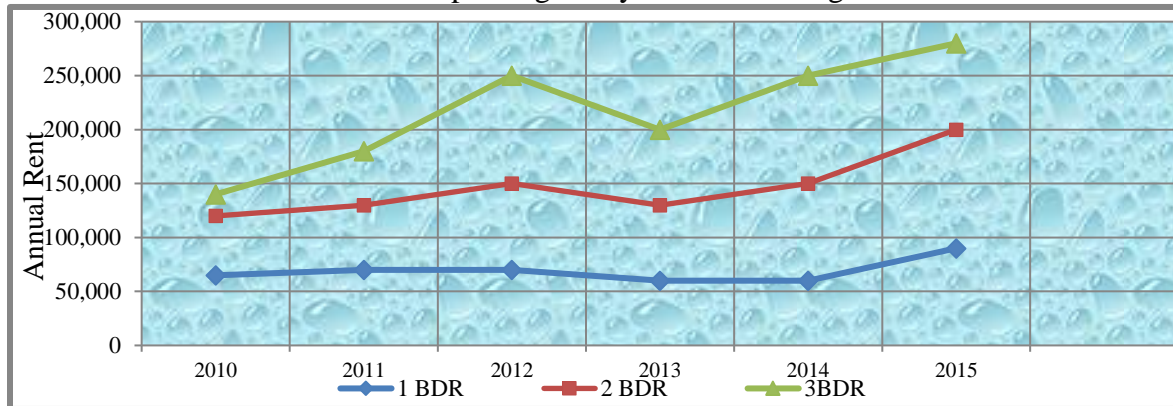


Figure 1: Rental Trend in Kigo of Flood, Kaduna.

Figure 2 shows the rental trend of the residential properties in Rafin Guza flooded area over the period of 2010 to 2015. Basically, the rental value of 1B/R, 2B/R and 3B/R residential properties in Rafin Guza road showed a steady and slight increase from 2010 to 2012, but due to the effect of flood in 2012, the rental value of 3B/R, 2B/R and 1B/R dropped by 16.7%(180,000-150,000), 16.7%(120,000-100,000) and 11%(90,000-80,000) respectively in 2013. After the effect of flood in the market in 2013, there was gradual increase in rent due to increase in population and demand for residential space and the rent rose from 2013 by 26.7% (190,000-150,000), 30%(130,000-100,000) and 25%(100,000-80,000) in 2015. This indicates that the effect of flood in residential market in 2012 was not prolonged beyond 2013 in Rafin Guza area.

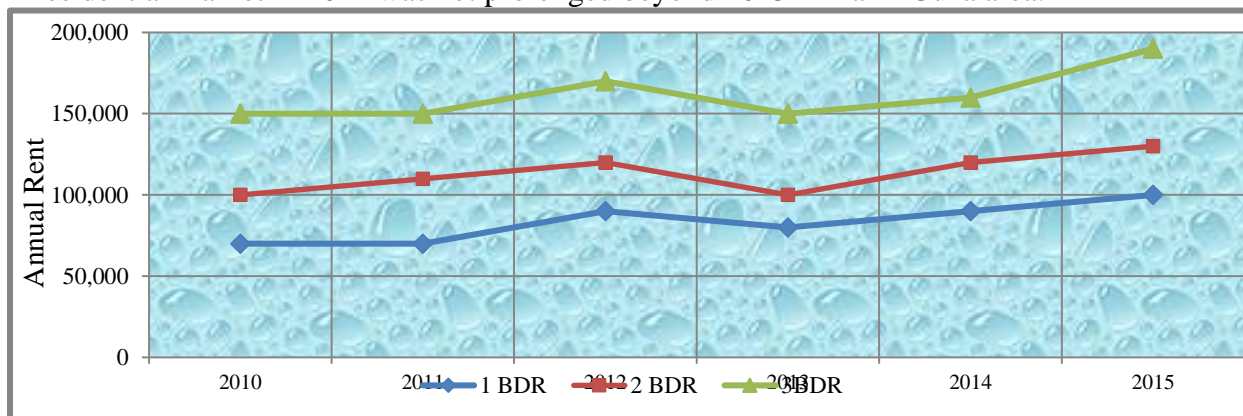


Figure 2: Rental Trend in Rafin Guza area of flood, Kaduna.

Figure 4 shows the rental trend of the residential properties in Banawa flood area over the period of 2010 to 2015. The rental value of 1B/R, 2B/R and 3B/R residential properties showed a steady and slight increase from 2010 to 2015, but the effect of flood in 2012 on the rental value of 3B/R, 2B/R and 1B/R was not pronounced in 2013. The reason is that there is high land value and high competitive demand for land in Banawa has swallowed the pronounced effect of flood risk in 2013. Therefore instead of dropping in rental value due effect of flood, rental value maintained a constant trend between 2012 and 2013 after which there is slight increase in rent.

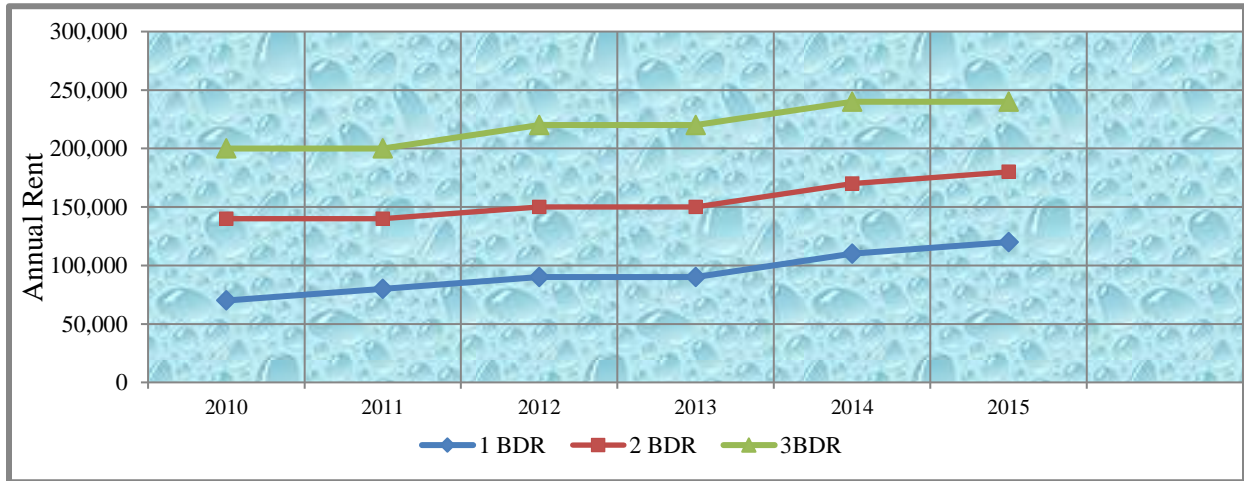


Figure 3 Rental Trend in Banawa Flood Area, Kaduna

Figure 4 shows the rental trend of the residential properties in Ungwa Rimi flood area over the period of 2010 to 2015. The rental value of 1B/R, 2B/R and 3B/R residential properties showed a steady and slight increase from 2010 to 2015, but the effect of flood in 2012 on the rental value of 3B/R, 2B/R and 1B/R was not pronounced in 2013. The reason is that the high land value and high competitive demand for land in Ungwa Rimi has swallowed the pronounced effect of flood risk in 2013. Instead of dropping in rental value in 2013 due to effect of flood in 2012, 3B/R rental value continue increasing. 1B/R and 2B/R rental values maintained a constant trend between 2012 and 2013 after which there is slight continue increase in rent.

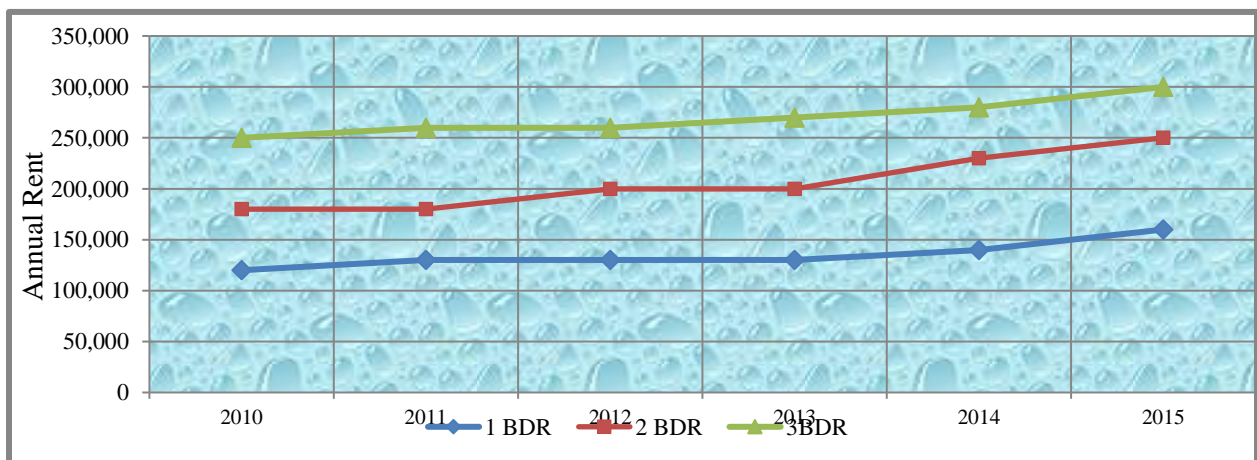


Figure 4 Rental Trend in Ungwa Rimi Flood Area, Kaduna

Figure 5 showed the relative distances of flooding source to the residential properties' investment. It is observed from the graphic analysis that all the residential properties development were located 100m away from the flooding source. The graph further showed upward progression of rental value as properties' distance from flooding source increased. It is important to note that variation in rental values within the range of distance is a function of different values of property unit types included. Therefore the bulk of residential properties with average rent between ₦125000-- ₦200000 falls within 120m-157m

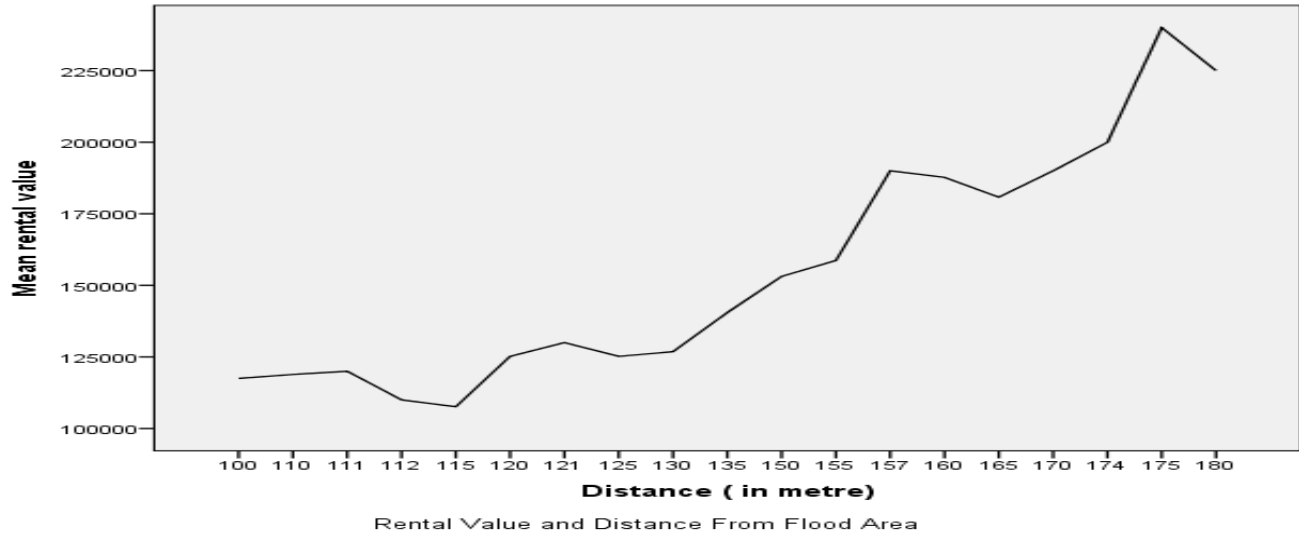


Figure 5: Relative Distances and Rental Values of Residential Properties Kigo Area

Figure 6 shows the relative distance of flooding source to the residential properties in Rafin Guza. It is observed from the analysis of the graph that all the residential properties development were located 100m away from the flooding source. The bulk residential properties with average rent between N120, 000- ₦210, 000 falls within the 120m- 155m. The graph further showed upward progression of rental value as distance from the flooding source increased. It is important to note that variation in rental value within the range of distance is a function of different property unit types included.

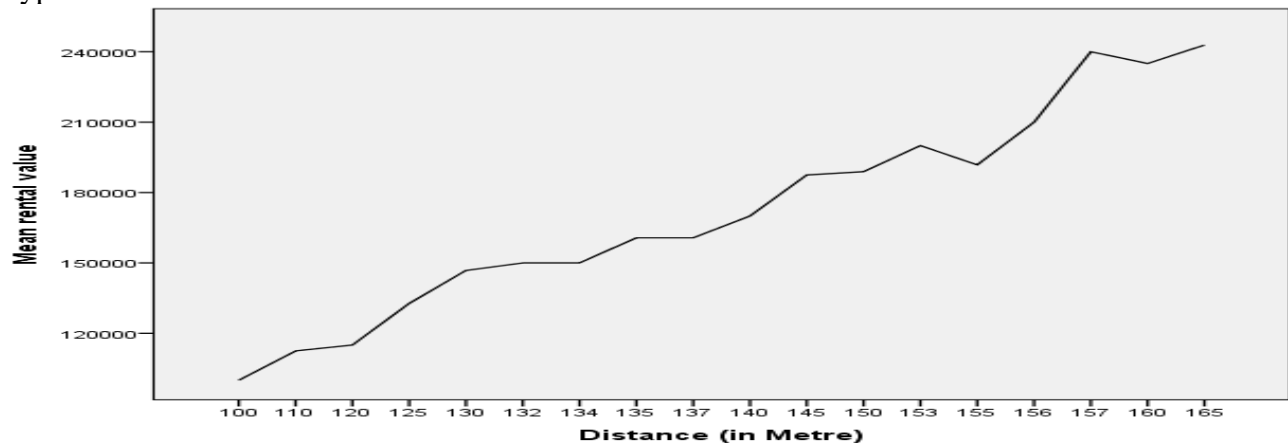


Figure 6: Relative Distances and Rental Values of Residential Properties Rafin Guza Area

Figure 7 showed the relative distance from the flooding source to the residential properties in Banawa. The graphic analysis shows that all the residential properties development is located 130m away from the flooding source. The bulk of residential property with average rent between N150, 000- N220,000 falls within the 134m- 157m. The graph further shows upward progression of rental value as distance from flooding source increased. It is important to note that variation in rental value within the range of distance is as a result of different property unit types included.

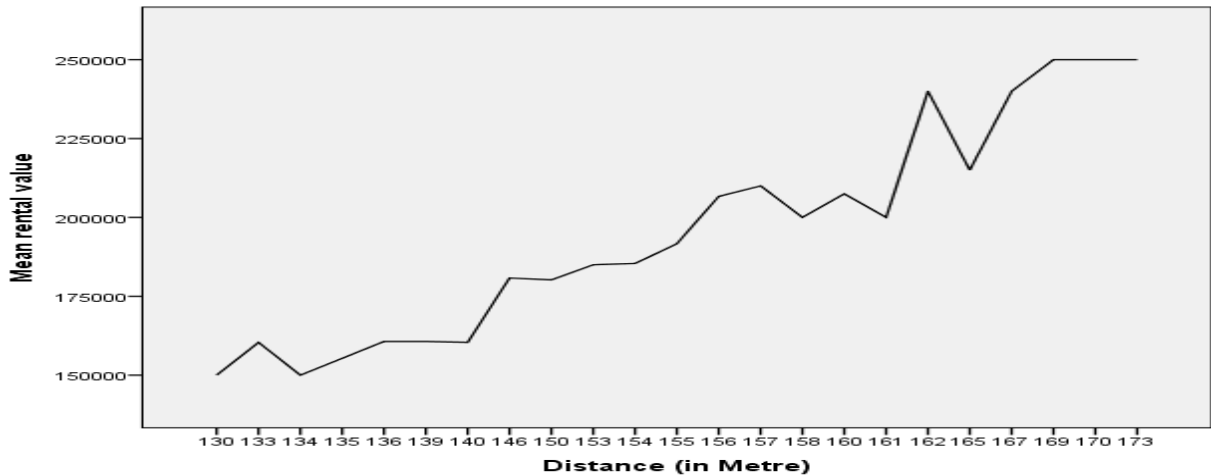


Figure 7: Relative Distances and Rental Values of Residential Properties Banawa Area

Figure 8 shows the relative distance from flooding source to the residential properties in Ungwa Rimi. The graphic analysis shows that all the residential properties development is located 140m away from flooding source. The bulk of residential properties with average rent between N200, 000- N222, 000 falls within the 149m- 160m. The graph further shows upward progression of rental value as distance from flooding source increased. It is important to note that variation in rental value within the range of distance is as a result of different property unit types included.

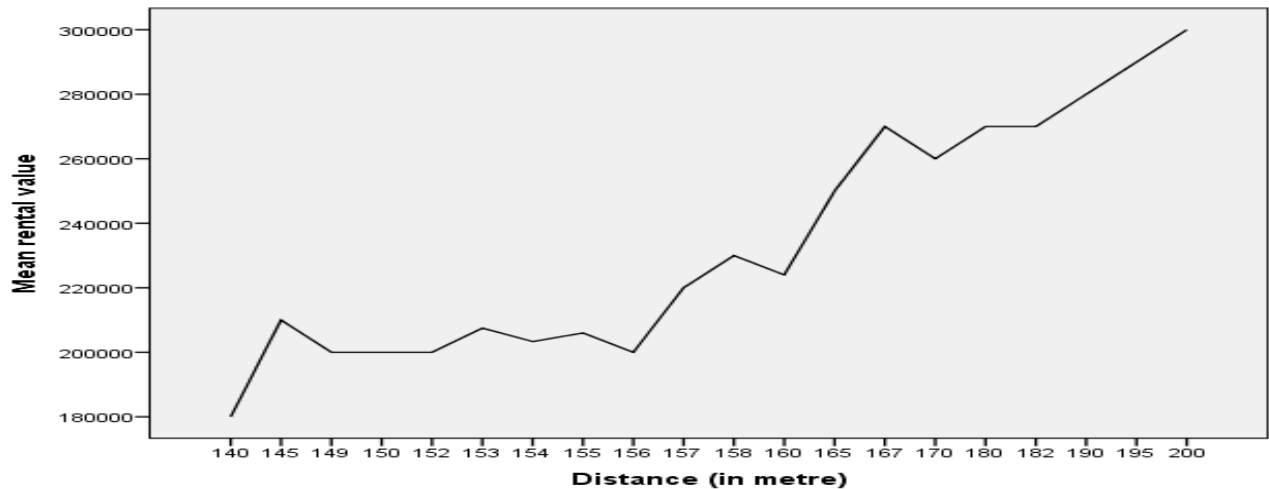


Figure 8: Relative Distances and Rental Values of Residential Properties Ungwan Rimi Area

The table 4.8 above revealed the analysis of variance in relative distances of residential properties from the flooding source across four study locations, the result showed that there is statistical significant difference in relative distances of residential properties from the flooding source across four location, the F-statistics (15.5154) is significant at p-value of 0.00028 ($p < 0.05$). Therefore, the result further suggests that distances of residential properties from flood source across fours study areas differed significantly, Ungwan Rimi and Banawa constitute the bulk of differences as observed in figure 7 and figure 8, this suggests that locational distances of residential properties in Ungwan Rimi and Banawa from flood source are higher, in other word, residential properties in Kigo and Rafin Guza are more closer to the flood source than Ungwan Rimi and Banawa.

Table 1 Analysis Of Variance in Distances of Residential Properties from the Flood Source

Across Locations						
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	15502.9	3	5167.633	15.51544	0.00028	2.650677
Within Groups	65280.52	196	333.0639			
Total	80783.42	199				

Computed from figure 5, 6, 7 and 8

Table 2 shows strength of relationship between relative distance of the flood risk zone to residential property and rental value. The result of correlation revealed the significance relationship between relative distances of flood risk zone to properties and rental values in Kigo and Rafin Guza areas of flood at p-value 0.0001 and 0.0008 are less than 0.05 level of significance ($p < 0.05$ level of significance). The statistical of p_o indicates that the statistical evidence of strong positive relationship further indicates that location of properties in relation to flood risk zone is related value of the property such that the further the property from flood risk zone the higher the value of property and vice versa. Ungwa Rimi and Banawa, there is no evidence of significance relationship at p-value 0.482 and 0.161 is greater than 0.05 level of significance ($p\text{-value} > 0.05$ level of significance). This suggests there is high land value in the areas such that irrespective of the location of property to flood source, the relatives distances flood risk zone is not the factor determining the rental value in Ungwa Rimi and Banawa.

Table 2: The Result of correlation between Distance of residential properties from the flooding source and the Respective Rental values.

Study Areas	Coefficients	No. of Observation	Degree of Freedom	T-Statistics	P-value
Kigo area	0.893**	200	198	17.664	0.0001
RafinGuza	0.908**	200	198	11.705	0.0008
UngwaRimi	0.102	200	198	22.634	0.482
Barnawa	0.201	200	198	24.786	0.161

Computed from Figure 5, 6, 7 and 8

Table 3 shows the influence of relative distances of flood risk zone on property value. 79.8% and 82.5% variation in property value in Kigo and Rafin Guza are significantly influenced by relative distances of flood area respectively. the result further shows that as property distance increases away from flood zones by 1m in Kigo and Rafin Guza, the rental value increase by N4,343 and N4,623 respectively 10.2% and 14% variation in rental values in Ungwan Rimi and Barnawa were insignificantly influenced by relative distances of flood risk zone. The result further showed that as property distance increases away from flood risk zone by 1m, might not cause any change in rental values because the overall influence is insignificant to cause change.

Table 3 The Results of Regression Analysis

Model	Term	Coefficients	t-statistics	p-value	R ²	VIF
Kigo	Constant	-36365.093	-2.681	.010	.798	1.243
	Distance	4343.713	13.755	.000		
RafinGuza	Constant	-20575.05	-7.579	.0001	0.825	1.056
	Distance	4623.632	15.049	.0001		
UngwaRimi	Constant	14665.04	1.366	.178	.102	2.789
	Distance	192.704	.709	.482		
Barnawa	Constant	1556.90	4.905	.000	.140	1.893
	Distance	341.072	1.422	.161		

Computed from Figure 5, 6, 7 and 8

CONCLUSION AND IMPLICATION OF FINDINGS

Effect of flood after 2012 has caused great loss in real estate investment across the study areas. This loss of value begins to fade away as various measures were taken by the

government to prevent further occurrence. The rental values of properties were found to increase as distance from flood zone increases. The relationship between the distance and rental value in Rafin Gusa and Kigo were found to be significant in other words, relative distances away from flood zone significantly related to rental value and this might cause a change in property value. In Ungwan Rimi and Banawa, the relationships were not found significant, in other words, relative distance might not cause change in rental values. It has also been established that relative distance of flood risk zone influence rental value significantly in Rafin Gusa and Kigo. In Ungwan Rimi and Banawa, the influence of distance of flood on rental value is not significant. The implication of this study is that the high land value in Ungwan Rimi and Banawa has provided an edge against the influence of flood and therefore they are not affected significantly by the flood. In Kigo and Rafin Guza, for any prudent investor who wishes to invest in real estate should locate such investment far away from flood risk zone at minimum distance of 300m

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