LOSS OF FOREST RESERVES IN ANAMBRA STATE, NIGERIA: CAUSES, EFFECTS AND POLICY IMPLICATIONS

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Abstract
This study investigated causes, effects and policy implications of forest reserve loss in Anambra State. The objectives of the study were to: determine the causes and effects of forest reserve loss, examine the factors for implementation of 2006 forest policy act and develop a model for sustainable forest management in Anambra State. Apkaka Forest Reserve in Onitsha North Local Government Area was used as a case study. Questionnaire survey, field observation and oral/in-depth interviews were used for this study. Findings showed that weak governance, corrupt practices, Ignorance, Insecurity, Population growth, urban expansion, excessive consumption among others are the causes of loss of forest reserves in the State. Again, findings Shows that effects of this loss includes erosion, flooding, change in local climatic condition, siltation of streams, extinction of plants and animal species. Another finding of this study was that the 2006 forest policy act is not implemented at both State and Local Government levels. They exist only on Paper. From results obtained through data analysis, a model for sustainable forest management in Anambra State was developed. Some forest management factors in the model includes community participation, awareness creation; adequate implementation of forest policy, staff training among others. Forest reserve loss in Anambra State was also categorised into 3 phases which include input (human actions that led to the loss of forest reserves), through put (the forest reserve loss itself), output (environmental consequences of the loss).

Keywords: Forest reserve, Forest reserve loss, Environment, Sustainable management, Climate change

Introduction
Loss of forest resources is changing our climate, harming people and the natural world, humans can and must reverse the trend to save our future and the planet Earth. If we continue to lose our forests, we lose the fight against climate change. It is time to begin to cut our greed and not our trees. According to World Resource Institute (WRI,2017), studies reveal that about 30% of global forest cover have been cleared. In Nigeria, forest estate which is about 10 million hectares is declining at a rate of 3.5% annually due to encroachment, excisions, and outright de-reservations (UNHS report, 2010). According to Obioha (2009), Nigeria is at the moment losing about 351,000 km² of its land mass to the desert, which is advancing southwards again at the rate of 0.6 km annually. Reduced rainfall has decreased the ability of forest resource to regenerate, this has resulted to extreme pressure on Forest Reserves (Onyeizugbe and Nnodu, 2021). Government have attempted to control loss of forest reserves using policies but evidently, these policies have failed to protect forest

reserves in Nigeria. Onyeizugbe and Nnodu (2020) attributed this failure to excessive emulation of developed countries during policy formations without minding the inhomogeneous factor. The displacement and loss of forest reserves have resulted in significant climate change.

It is sad to note that lands under forest reserve have been decreasing steadily since 1979. In Ondo State, 107.36km square of forest reserve in Ore has been converted to casual land, in Kano State, 70km square of forest reserve has been cleared for a dam project (Tiga dam) while in Kogi State 183.89km square of forest reserve in Ajaokuta has been used for the establishment of a steel complex, (Egwumah, 2009). In Cross River state, 20% of forest reserves was lost between 1972 and 1992, (Bunn,1994). The situation in Anambra is worse as Forest reserves are being replaced with new human settlements estates, logging sites and other human activities steadily (Onyeizugbe and Nnodu 2021). Among the Forest reserves that have been invaded by humans in Anambra state include Akpaka, Nkissi, Aguagba, Ossamala, Mamu and Achalla Forest Reserves. In view of this dismal trend in our forest reserves, the need to manage the forests of Anambra and Nigeria in general on a sustained yield basis is very vital now. The growth rate of the natural forests is low, about 1.5-meter square of round wood per hectare per annum (Mujiri, 2007) and this is a serious constraint. According to Sustainable Development Goals 15, we have to "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss''. To achieve this, there is therefore need to re-examine forest reserve loss as a whole and ways of achieving a sustainable forest management in other to safeguard our environment for both present and future generations.

The aim of this research work is to Investigate forest reserve loss in Anambra State. The Objectives are to: determine the causes of forest reserve loss in Anambra State; Effects of Forest reserve loss in Anambra state, examine the factors for implementation of 2006 forest policy act in Anambra state and finally to develop a model for sustainable forest reserve management in Anambra state. Three hypotheses were posited for this study:

Ho: There is no significant difference in implementation of factors of forest policy as stipulated in 2006 forest policy act for states in SDF Anambra state.

Ho: There is no significant difference in implementation of factors of forest policy as stipulated in 2006 forest policy act for LGAs in Onitsha North LGA

Ho: The causes of forest reserve loss in AFR are not significantly different within AFR.

Study Area

Akpaka Forest Reserve is located in Onitsha North Local Government Area (L.G.A) of Anambra state (Figure 1). Anambra State is one of the 36 states in Nigeria which is located in South-East geopolitical zone. In Onitsha North L.G.A is a Forest Reserve known as Akpaka Forest Reserve (Fig 2.1). The Reserve is on the eastern bank of River Niger and administered under Onitsha North L.G.A Authority. It is located between latitudes $6^0$11'20'' N and $6^0$7'40''N and longitudes $6^0$47'10'' E and $6^0$49'55'' E. In the past, the forest was officially designated as a Forest Reserve by government authority but now much of the natural vegetation in the Reserve has been felled and the land utilized for other purposes especially residential. To the North, the study area is bounded by Anambra east and Anambra west LGAs, to the south it is bounded by Onitsha south L.G.A. and to the east it is also bounded by Onitsha south L.G.A and Onitsha North L.G.A which the study area is a part of. To the west it is bounded by the River Niger.

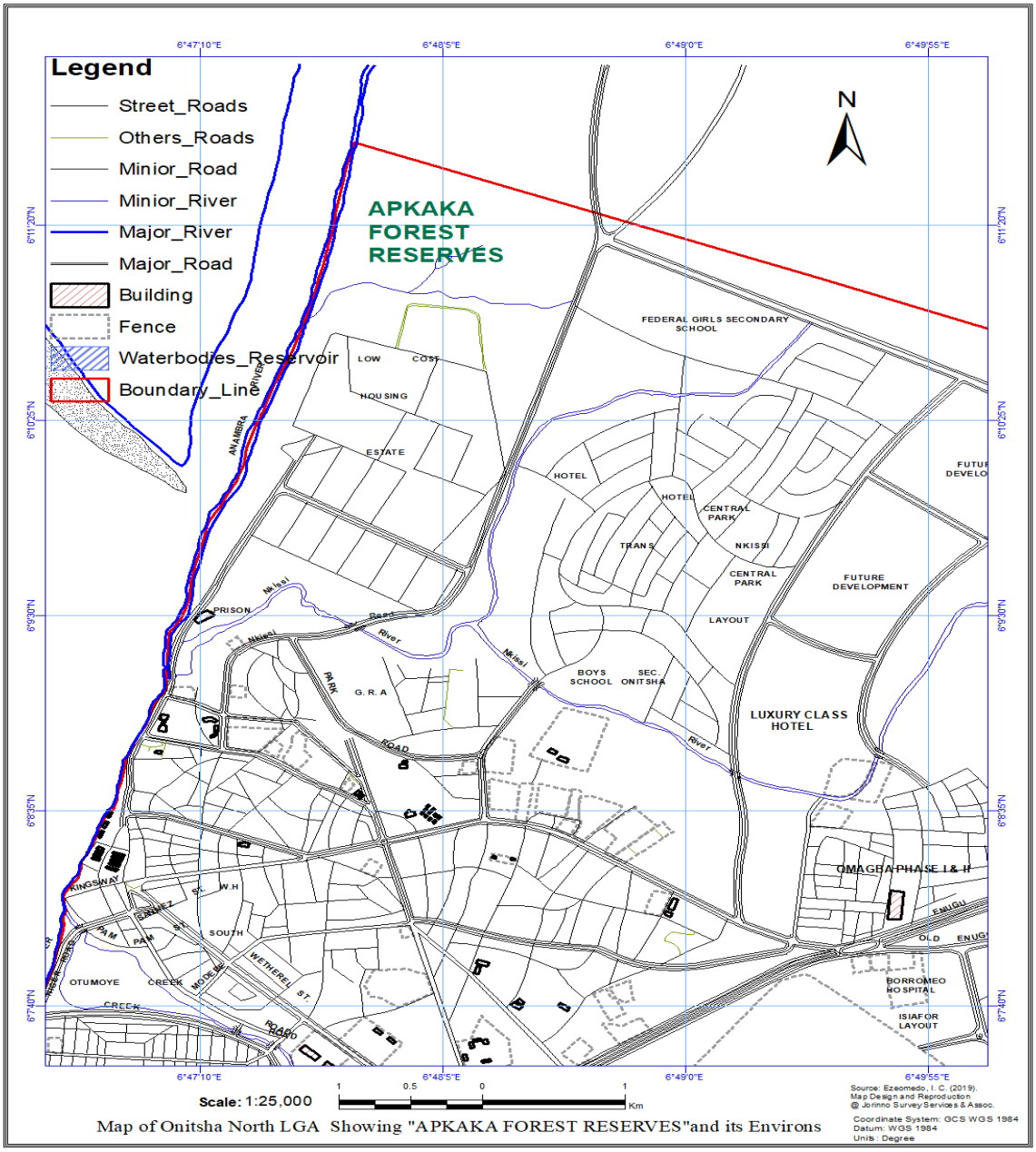


Figure 1: Map of Onitsha North LGA showing Akpaka Forest Reserve

Akpaka Forest Reserve occupies part of the eastern part of the River Niger. The predominant land use in the reserve is residential. Majority of the development in Akpaka community are housing development with exception of very few plots that are used for schools, hospitals, churches, recreation centres and late-rite mining. The settlement pattern in Akpaka community is linear and compact in nature. That is, the houses are in lines, touching each other at the sides. The area has 1161 buildings with 43 streets.

Methodology

Sample frame, sample size and sampling techniques

The sample size for the study was 298. This was determined through Taro Yamani formula (2001) given in Equ. 1.

$$S = \frac{N}{1+N(e)^2} \qquad \text{Equ. 1}$$

Where S = Sample size
N=Population
e = Constant (0.05)

People living in a building and share meals or eat from the same pot regardless of biological relation were classified as a household. The A household head was eligible for the study if he or she was the person who bought the land, cleared it and developed it and if they agreed to participate whole heartedly. Where a household head did not meet these criteria, the next house that meets the criteria was sampled. Total number of questionnaire distributed for this study was 298 and the entire 298 questionnaires were returned, because the researcher followed-up on the respondents to ensure they returned the questionnaire. Rate of return was 100% (Table 1). The 298 questionnaires were divided among the 43 streets that make up Akpaka community proportionate to the number of buildings in each street. Purposive sampling technique was used to determine the 298 buildings to be sampled. The number of questionnaire that was assigned to a street was determined by the number of buildings in the street. For example, Sir Arthur Ewuzie Drive got a total number of 13 (thirteen) questionnaires that was distributed in the street because it had large number of buildings. Stratified sampling method was used for this study. The 43 streets in Apkaka community formed the strata. Questionnaires were distributed in each street proportional to total number of houses in the street. The population of Akpaka was not published after 2006 census report. Therefore, for the purpose of this study, the population size of Akpaka was determined by the number of house each street had. The value obtained for each street was used to determine the number of questionnaire that were distributed in the street. At the end, 20 questionnaires remained, which were distributed one each in the first 20 streets in the study area as shown in Table 2. Stratified sampling method was used for this study because it provided a frame for the entire Akpaka community and it gave every house equal opportunity of being sampled without bias.

Table 1: Questionnaire Response Rate

Questionnaire	Number of Questionnaire	% of total distributed and returned
Distributed	298	100
Returned	298	100
Valid	298	100
Invalid	0	0

Method of Data Collection

Construction of Questionnaire

Three categories of questionnaire schedules were distributed for this research. Each one in Akpaka Forest Community (AFC), State Department of Forestry(SDF) and Onitsha North LGA(ONLGA). The schedule distributed in AFC was divided into two sections A and B. Section A contained question items which sought information on personal data of the respondents in terms of level of education, occupation and ownership of building. This information was necessary in determining the eligibility of the respondent to participate in the exercise. Section B of the schedule solicited information on the causes of forest loss in the study area as they see it happen there. The questionnaires distributed in SDF and ONLGA had two sections each, section A and B. Section A contained personal information of the respondents which included level of education, rank of staff and year of employment. This information is helpful in determining the eligibility of the respondents. Section B sought information on implementation of 2006 forest policy act in the study area.

Methods of data analysis

Data obtained for this study were analysed using descriptive and inferential statistics. Tables, and percentages were used to represent data and results of this study. Hypotheses 1, 2 and 3 were tested using principal component analysis(PCA). PCA is a method of analysis which involves finding the linear combination of a set of variables that has maximum variance and removing its effect, repeating this successively. PCA was chosen for this study because it is suitable to analyse the multi-

dimensionality of data for each of the 3 hypotheses stated for this study.

Table 2: Table showing the number of questionnaires distributed in each street according to number of buildings in the street.

S/No	Street	Number of houses per street	Number of households (questionnaire)
1	Osundu Close	37	9+1
2	Hon. Idemobi Crescent	26	6+1
3	Eze Bishop Avenue	34	8+1
4	Bar Iheanyichukwu Uba Drive	11	2+1
5	Clem Close	28	7+1
6	Clement Agbodike street	17	4+1
7	Prince Charles Ifezue Close	29	7+1
8	Sir Sam Ezeofia Drive	16	4+1
9	B. Adilieje Mission Close	36	9+1
10	Ifeanyi Ezediugwu Crescent	35	8+1
11	Bonny Anene street	13	3+1
12	Nwachinemelu Vino Close	30	7+1
13	Ezeanioba Ojoto crescent	25	6+1
14	Edochie Okafor street	13	3+1
15	Iseke street	33	8+1
16	Ezego Ojoto street	14	3+1
17	Igwilo Chris Avenue	13	3+1
18	Sundyco street	12	3+1
19	Austin Chuks close	31	7+1
20	Lady Virginia Ayoluba cresent	15	3+1
21	Transfiguration church Drive	32	8
22	Dona Odogwu Lane	39	10
23	Sir Gab Anakwe Avenue	18	4
24	Ejelue street	38	9
25	Dr Mike Areh close	10	2
26	Jehova Jireh close	19	4
27	Golden Nwabueze Avenue	24	6
28	Prince Chinedu Akwaka crescent	10	2
29	Obi Onyeka close	27	6
30	Izuchukwu Abadibe Crescent	43	11
31	Danco Akanonu Ojoto Crescent	14	3
32	Madonna Crescent	44	11
33	Amaehi Meg Crescent	22	5
34	Okey Okons Avenue	50	12
35	Primus Crescent	47	12
36	Sir Leo Anyika Crescent	48	12
37	Chinedu Chinaekwe Crescent	49	12
38	Ekwerekwu Crescent	12	3
39	Sir Arthur Ewuzie Drive	51	13
40	Chief Omeogo A.C Anachuna street	21	5
41	Pharm Alloysuis Nsonwu Drive	45	11
42	V.V.I Okoye Drive	18	4
43	Agha Crescent	12	3
		1161	298

Source: Researchers Field Work 2019

Results and Discussions

Causes of forest reserve loss in the study area

The result of the questionnaire survey that determined causes of forest loss in AFR is shown in Table 3. The respondents gave their answers on causes of forest loss as they see it happen in the study area. From Table 3, 100% agreed that urban expansion was a driver of forest loss in AFR. This is true because Akpaka community is an overflow of the city Onitsha, the residents moved from Onitsha city into Akpaka community. All establishments like schools, malls, churches, hospitals and other outlets have their major branches inside Onitsha city. For commercial activities, 82.51% agreed that land for commercial activities was a cause of forest loss in AFR, this can also be said to be true because one of the biggest international markets (Main market) in west Africa is located close to the study area and most of Akpaka residents are traders in main market who converted ground floor of their buildings to warehouse/packing store for storage of their commercial goods. Again, 88.93% agreed that excavation of red earth was a cause of forest loss.

During data collection, the researcher observed that excavation of red earth was going on at the inner part of Akpaka community. They cleared forests so as to access enough red earth. White sand was also drilled in the part of River Niger that extended behind the reserve. The drillers cleared forests in order to create a path way for their heavy weight machines and tippers used in conveying the drilled sand. For cattle grazing, 62.41% agreed that it was a cause of forest loss. Herders usual come into the remaining part of the reserve with their cattle in search of green pastures. 100% of the population sampled agreed that construction work was a cause of forest loss in the study area, 100% also agreed that population growth was a cause of forest loss in the study area. On weak governance and ignorance, 76.84% and 97.65% agreed respectively that they were causes of forest loss in the study area. Most of the respondents do not know the importance of forest resources to man and his environment. They were also of the opinion that if there were strong government opposition, they would not have been able to invade the reserve as no single individual or group is greater than a strong government force. For corrupt practises, 88.92% agreed, 10.06% agreed that excessive consumption was a cause of forest loss, 18.12% agreed that insecurity was a cause of forest loss in AFR. Those that said insecurity was a cause of forest loss in the area believed that criminal elements used the forest as hideout and that motivated the first human presence in the reserve which later culminated to other forms of developments that started in the reserve.

From the data in Table 3, it can be deduced from the majority that urban expansion, land for commercial activities, excavation of red earth, cattle grazing, construction work, population growth, weak governance, ignorance, corrupt practises and excessive consumption are the causes of forest loss in the study area. The respondents gave their answers as they see it happen there.

Table 3: Response of the Respondents on Drivers of Forest loss in AFR

Causes	Percentage
Urban Expansion	100
Commercial activities	82.51
Excavation of red earth	88.93
Cattle grazing	62.41
Construction work	100
Population growth	100
Weak governance	76.84
Ignorance	97.65
Corrupt Practises	88.92
Excessive consumption	10.06

Source: Researchers Field Work 2020

Effects of Forest Reserve Loss

From results obtained during field observations, all forest reserves cleared and turned into built-up areas had similar environmental problems. Prominent among them is Akpaka Forest Reserve which had loss of soil quality, degradation of land through erosion, flooding, change in climate condition, siltation of the famous Nkissi

River (The River has disappeared), extinction of both plant and animal species. Tree species like palm tree (E*laeis guineensis)*, African plum (A*dacryodes edulis)*, mango tree *(Mangifera indica)*, raphia palm *(Raphia spp)*, gmelinea or beech wood tree *(Gmelinaarborea)*, coast almond/black afara *(Terminalia ivorensis)* have been lost in the course of unsustainable development that is ongoing in Akpaka Forest Reserve. Human interference on Akpaka Forest Reserve has brought about a total destabilization of ecological system that once existed there. The Forest Reserve can no longer play its vital role to the environment, rather, several other environmental problems emanated as a result of clearing the forest. The Forest Reserve used to serve as a carbon sink to the ancient Onitsha city, but today, the Reserve has become a shadow of itself. Onitsha has become warmer than it used to be in the 80s and early 2000s.

Factors for implementation of the 2006 Forest Policy Act

Table 4: Response of the Respondents on Implementation of the Factors of 2006 Forest Policy Act at State and L.G. levels.

Summary of data obtained at State Dept of Forestry	**SD**	**D**	**Undecided**	**Agree**	**SA**
1. There are programmes/efforts aimed at consolidating the remaining part of Akpaka Forest Reserve(AFR) as stipulated in 2006 forest policy Act.	26	24	0	0	0
2. There are collaborations btw State Dept of Forestry(SDF) and ONLGA, NGOs, local community and civil society to protect other parts of the AFR	18	14	9	5	4
3. As a staff you usually go for training to update your skills and knowledge	18	23	9	0	0
4. Inventories of resources in AFR are taken	22	19	7	1	1
5. Awareness and public enlightenment are created on the need to conserve the remaining part of AFR	26	20	4	0	0
6. Forest laws and regulations are enforced in AFR	28	20	4	0	0
7. SDF goes for monitoring and evaluation in AFR	21	21	4	2	2
Summary of data obtained at Onitsha North Local Government Authority (ONLGA)	**SD**	**D**	**Undecided**	**Agree**	**SA**
1. The LG Authority engage in community mobilization to prevent further encroachment upon the remaining part of AFR	20	30	0	0	0
2. The LG Authority engage in local land use planning and ecosystem planning to ensure sustainable forest mgt in the LGA.	30	18	0	2	0
3. There are efforts by the LGA to protect the remaining forests in AFR	18	16	10	6	0
4. The LG Authority enforces forestry and bye-laws in the study area	12	31	7	0	0
5. The LGA conducts monitoring, evaluation, coordination and review in the study area	21	14	5	7	3
6. The LG Authority embarks on community awareness campaigns aimed at preventing further deforestation in AFR	19	16	5	7	3
7. There are cooperative groups whose role are to protect the remaining part of AFR	14	31	5	0	0
8. There are group efforts aimed at creating awareness among members on the need to preserve the remaining part of AFR.	22	21	1	3	3
9. Akpaka community participates in the mgt and protection of the remaining part of AFR	21	14	10	5	0
Summary of data obtained on causes of forest loss in AFR	**SD**	**D**	**Undecided**	**Agree**	**SA**
1. Urban Expansion				3	295
2. Land for commercial activities		52	59	187	
3. Excavation of red earth		33		157	108
4. Cattle ranching		19	93	108	78
5. Construction work				291	7
6. Population growth					298

7. Weak governance		60	9	126	103
8. Ignorance			7	64	227
9. Excessive consumption	152	96	20	25	5
10. Insecurity	171	61	12	54	
11. Corrupt practices			33	86	179

Source: Researchers Field Work 2021

For operation/implementation of 2006 forest policy act in AFR, Table 4 revealed that all the respondents agreed that there were no programs/ efforts aimed at consolidating the remaining parts of Akpaka forest Reserve in the state as stipulated in 2006 forest policy Act, 24% of the respondents agreed that the staff members don't always go for training, while 76% agreed that the staff members don't go for training at all. All the respondents also agreed that inventories of resources in the other sections/parts of A.F.R are not taken, they also agreed 100% that the forest laws and regulations are not enforced, and the state forestry department SFD does not go for monitoring of evaluation in the study area. For implementation and operation of forest Policy in A. F.R**,** all the respondents agreed that the L.G Authority does not engage in local land use planning and ecosystem planning to ensure substantial forest management in the L.G.A, they also agreed that there haven't been any efforts by the L.G. Authority to protect the remaining forest in A.F.R and that the L.G.A Authority does not engage in community mobilization to prevent further encroachment upon the remaining part of A.F.R.

From the results obtained, it is obvious that the factors of 2006 forest policy act which formed the base of the questions in the questionnaire are not implemented in the study area. This can be the reason the forest reserve was de-reserved. If the officials of the S.D.F and L.G. Authority were living up to their responsibility by implementing the factors of the 2006 forest policy act in the study area, the forest reserve would not have been lost to this extent.

Test of Hypotheses

Three hypotheses were posited for this study:

1. There is no significant difference in the implementation of factors of forest policy as stipulated in 2006 forest policy act for Local Governments, within AFR.
2. There is no significant difference in the implementation of factors of forest policy as stipulated in 2006 Forest Policy Act for States, within AFR.
3. The causes of forest loss in AFR are not significantly different within AFR.

Hypothesis 1

Ho: There is no significant difference in the implementation of factors of forest policy as stipulated in 2006 forest policy act for Local Governments, within AFR.

Table 5: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.870
Bartlett's Test of Sphericity	Approx. Chi-Square	775.250
	df	36
	Sig.	.000

Table 5 showed the result of the KMO and Bartlett's Test; these are preconditions for carrying out PCA. The KMO needs a minimum value of 0.70 for a PCA to be conducted while the Bartlett's test needs a p–value less than 0.05 to show that the test can be performed. From the table, it could be seen that the KMO has a value of 0.870 while the Bartlett's test has a p–value of 0.000; these show that the data are fit to be used to perform PCA, implying that the conditions have been met.

Table 6 contains the total variance explained, which shows the number of components that the PCA has extracted (that is the number of possible groups of classification). From the table 5.3, it can be seen that only one component was extracted by the PCA

explaining a total of 83.862 percent of the total variation in the PCA

Table 6: Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.548	83.862	83.862	7.548	83.862	83.862
2	.543	6.034	89.895	.543	6.034	89.895
3	.402	4.461	94.357	.402	4.461	94.357
4	.198	2.196	96.553	.198	2.196	96.553
5	.118	1.308	97.861	.118	1.308	97.861
6	.100	1.108	98.969	.100	1.108	98.969
7	.054	.601	99.570	.054	.601	99.570
8	.034	.374	99.944	.034	.374	99.944
9	.005	.056	100.000	.005	.056	100.000

Table 7: Component Matrix[a]

	Component
	1
Akpaka community participates in the mgt and protection of the remaining part of AFR	.974
There are efforts by the LGA to protect the remaining forests in AFR	.973
The LG Authority embarks on community awareness campaigns aimed at preventing further deforestation in AFR	.968
The LGA conducts monitoring, evaluation, coordination and review in the study area	.965
There are group efforts aimed at creating awareness among members on the need to preserve the remaining part of AFR.	.924
There are cooperative groups whose role are to protect the remaining part of AFR	.875
The LG enforces forest by-laws in AFR	.872
The LG Authority engage in local land use planning and ecosystem planning to ensure sustainable forest mgt in the LGA.	.862
The LG Authority engage in community mobilization to prevent further encroachment upon the remaining part of AFR	.813

Table 7 shows the loadings of the PCA, indicating the various weights of the factors being studied. From table 5.4, all the factors are significantly loaded with a minimum of 0.813 and maximum of 0.974. The factor with the highest loading has the highest impact while the factor with the least loading has the least impact.

Therefore, we can reject the null hypothesis and accept the alternative hypothesis thereby concluding that the implementation of factors of forest policy as stipulated by 2006 forest policy for Local Governments within AFR are significantly different since the loadings are not equal.

1. Akpaka community participates in the mgt and protection of the remaining part of AFR was 0.974.
2. There are efforts by the LGA to protect the remaining forests in AFR was 0.973.
3. The LG Authority embarks on community awareness campaigns aimed at preventing further deforestation in AFR was 0.968.
4. The LGA conducts monitoring, evaluation, coordination and review in the study area was 0.965
5. There are group efforts aimed at creating awareness among members on the need to preserve the remaining part of AFR was 0.924.
6. There are cooperative groups whose role are to protect the remaining part of AFR was 0.875

7. The LG enforces forest by-laws in AFR was 0.872
8. The LG Authority engage in local land use planning and ecosystem planning to ensure sustainable forest management in the LGA was 0.862
9. The LG Authority engage in community mobilization to prevent further encroachment upon the remaining part of AFR was 0.813

Hypothesis 2
There is no significant difference in the implementation of factors of forest policy as stipulated in 2006 forest policy act for States, within AFR.

From Table 8, the KMO and Bartlett's tests show that the PCA can be conducted since the KMO has a value of 0.750 which is greater than the minimum while the Bartlett's test has a p–value of 0.000 which is less than the 0.05.

Table 8: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.750
Bartlett's Test of Sphericity	Approx. Chi-Square	488.855
	df	21
	Sig.	.000

It can be seen from Table 9 that two components were extracted from the PCA; the first component explained 67.062 percent of the total variance while the second component explained 23.616 percent of the total variance, and the cumulative (total) variance explained is 90.678 percent. All the factors that loaded in the first component has higher impact than all that loaded in the second component.

Table 9: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.694	67.062	67.062	4.694	67.062	67.062
2	1.653	23.616	90.678	1.653	23.616	90.678
3	.379	5.417	96.095	.379	5.417	96.095
4	151	2.164	98.258	.151	2.164	98.258
5	.061	.871	99.129	.061	.871	99.129
6	.039	.555	99.684	.039	.555	99.684
7	.022	.316	100.000	.022	.316	100.000

Table 10: Rotated Component Matrix[a]

	Component	
	1	2
There are collaborations btw State Dept of Forestry(SDF) and ONLGA, NGOs, local community and civil society to protect other parts of the AFR	.973	
Awareness and public enlightenment are created on the need to conserve the remaining part of AFR	.946	
Inventories of resources in AFR are taken	.942	
As a staff you usually go for training to update your skills and knowledge	.940	
There are programmes/efforts aimed at consolidating the remaining part of Akpaka Forest Reserve (AFR) as stipulated in 2006 forest policy Act.	.880	
SDF goes for monitoring and evaluation in AFR		.879
Forest laws and regulations are enforced in AFR		.868

Component One (Institutional strength)**:** This component has the following loadings in the descending order:

1. There are collaborations between State Departmentt of Forestry (SDF) and ONLGA, NGOs, local community and civil society to protect other parts of the AFR was .973
2. Awareness and public enlightenment are created on the need to conserve the remaining part of AFR was .946

3. Inventories of resources in AFR are taken was .942
4. As a staff you usually go for training to update your skills and knowledge was .940
5. There are programmes/efforts aimed at consolidating the remaining part of Akpaka Forest Reserve (AFR) as stipulated in 2006 forest policy Act was .880

Component Two (Policy implementation): This component has these loadings in descending order:

1. SDF goes for monitoring and evaluation in AFR was .879
2. Forest laws and regulations are enforced in the study area was .868

Since the PCA loadings are not equal, we therefore reject the null hypothesis and accept the alternative hypothesis. This implies that there is significant difference in implementation of factors of forest policy as stipulated in 2006 forest policy Act for states, within AFR

Hypothesis 3
Ho: The causes of forest loss in AFR are not significantly different within AFR

Table 11: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.780
Bartlett's Test of Sphericity2	Approx. Chi-Square	3.832E3
	df	55
	Sig.	.000

From Table 11, the KMO and Bartlett's tests show that PCA can be conducted since the KMO has a value of 0.780 which is greater than the minimum 0.70 while the Bartlett's test has a p–value of 0.000 which is less than 0.05.

It can be seen from Table 12 that three components were extracted from the PCA; the first component explained 59.396 percent of the total variance while the second component explained 14.643 percent of the total variance, and the third component explained 10.008 percent of the total variance, the cumulative (total) variance explained is 84.047 percent. All the factors that loaded in the first component has higher impact than all that loaded in the second and third component.

Table 13: Rotated Component Matrix[a]

	Component		
	1	2	3
Weak governance	.937		
Land for commercial activities	.930		
Corrupt practices	.917		
Cattle grazing	.894		
Excavation of red earth	.856		
Ignorance	.818		
Insecurity	.786		
Urban Expansion		.888	
Population growth		.863	
Construction work			.904
Excessive consumption			.655

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 6 iterations.

Component 1 (bad governance): these components have the following loadings in descending order

1. Weak governance has .937
2. Land for commercial activities has .930
3. Corrupt practice has .917
4. Cattle grazing has .894
5. Excavation of red earth has .856
6. Ignorance has .818
7. Insecurity has .786

Component 2 (population issues): these components have the following loadings in descending order

1. Urban expansion .888
2. Population growth .863

Component 3 (livelihood): these components have the following loadings in descending order

1. Construction work has .904

2. Excessive consumption has .665

Since the PCA loadings are not equal, we therefore reject the null hypothesis Ho and accept the alternative hypothesis H_1. This implies that the drivers of forest loss in AFR are significantly different within AFR

Framework for Sustainable Forest Management

For the last objective, the study sought "to develop a model for Sustainable Forest Management (SFM) (Figure 2)". This was achieved using data obtained in objectives 1, 2 and 3.

The SFM model was developed from analysis of result obtained in objective 1 2 and 3 through questionnaire survey and Principal Component Analysis (PCA) and field observation.

Table 12: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.534	59.396	59.396	6.534	59.396	59.396
2	1.611	14.643	74.040	1.611	14.643	74.040
3	1.101	10.008	84.047	1.101	10.008	84.047
4	.544	4.950	88.997			
5	.378	3.434	92.431			
6	.338	3.068	95.499			
7	.233	2.122	97.621			
8	.109	.993	98.614			
9	.079	.714	99.328			
10	.047	.426	99.754			
11	.027	.246	100.000			

Extraction Method: Principal Component Analysis.

Rotation Sums of Squared Loadings		
Total	% of Variance	Cumulative %
5.880	53.453	53.453
1.814	16.490	69.943
1.552	14.105	84.047

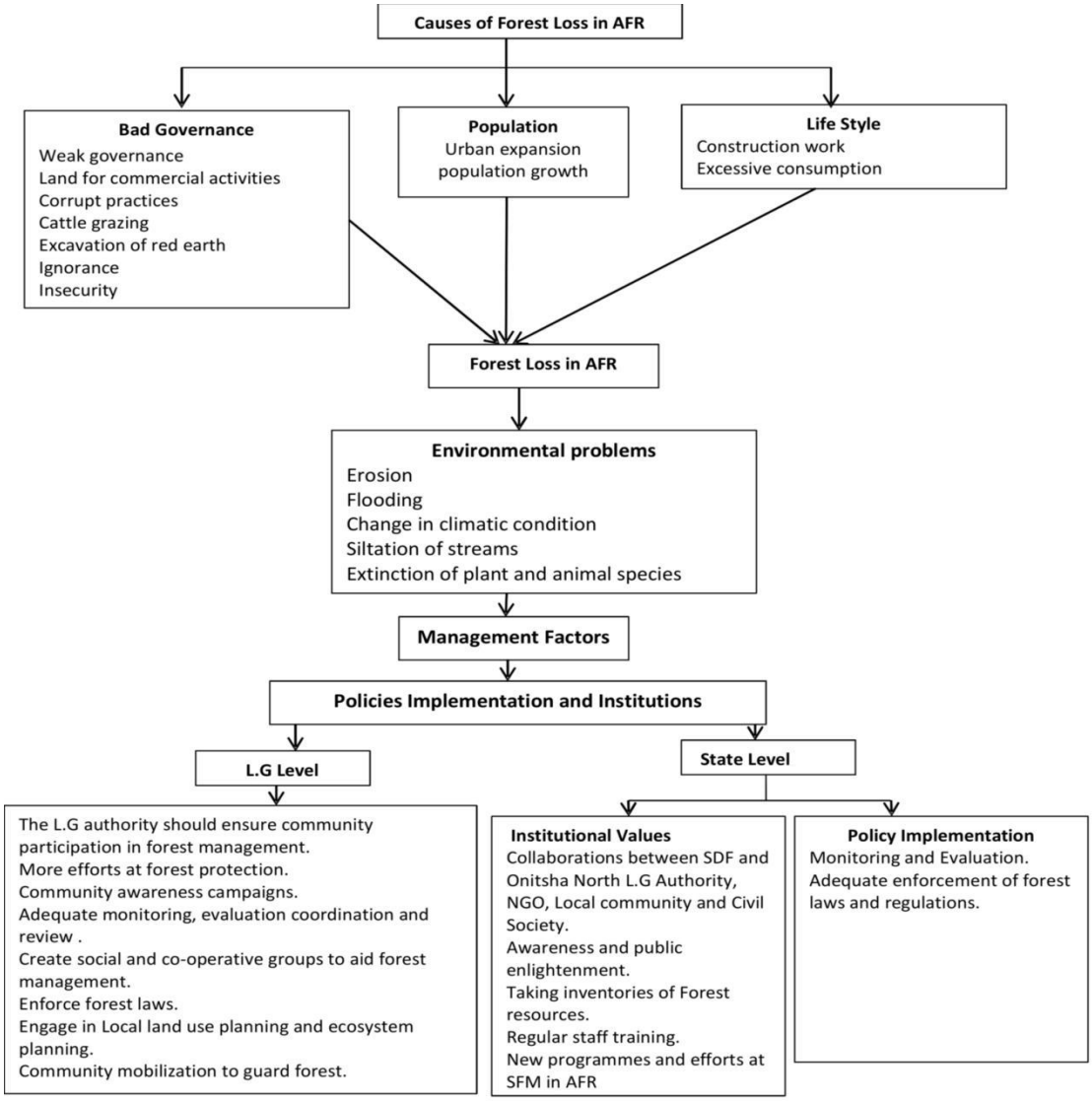


Fig 2.2: Sustainable Forest Management Model for Akpaka Forest Reserve, Onitsha North Local Government Area of Anambra State

Source: Modified after Corrine Nelson and Roj Miller (2000)

Figure 2: Sustainable forest management framework

A critical look at the forest loss system in Akpaka Reserve will reveal that all the systems that give rise to the complex situation in the area can be categorized as in Figure 3.



(Human activities) (Forest decline) (Environmental problems)

Figure 3: System of forest loss

Conclusion

From results obtained, the causes of forest loss in AFR were categorised into Bad governance, Population and Life style. Bad governance was resolved into corruption, insecurity, weak governance among others; while population was resolved into urban expansion and population growth; life style was also resolved into construction work and excessive consumption. These human activities that led to forest loss were termed 'Input' while the forest loss itself was termed 'Through put'. The consequences of the forest loss were termed 'Output'. The 'output' are the environmental problems that resulted from forest loss in the study area which includes erosion, flooding, change in local climate, siltation of streams among others.

Finally, management factors were highlighted according to obtained causes of forest loss in the study area and it was categorised under 'policy implementation and institutions' which was further resolved into Local government level and state level. All these are illustrated in SFM model developed.

Reference

Bunn, R. (1994). *Reconnaissance Inventory of High Forest and Swimming Forest Areas in Cross River State, Nigeria.*Working Paper for CRSEP (ODA Assisted).

Corrinne, N. and Roj, M (2000). *Deforestation and the Diffusion of New Innovations.* Sussex: Tropical Products Institute, Science Policy Research Unit, University of Sussex.

Egwuma, H. C. (2009). *Development of Community Forestry in Ghana.* Regional Community Forestry Training Center, RECOFTC Kwame Nkrumah University. paper No. 8 32p.

Mujiri, E. K. 2007. Deforestation and Afforestation, A world perspective: *A class paper for NRES 523, International Resource Management.*

Onyeizugbe, U. R. and Nnodu V. C. (2021). An Assessment of Forest Loss Using Remote Sensing in Akpaka Forest Reserve Onitsha North L.G.A of Anambra State Nigeria. *International Journal of Energy and Environmental Science,* 6(6), 143-150 doi:10.11648/ijees.20210606.11.

Onyeizugbe, U. R. and Nnodu, V. C. (2020). Assessment of Loss of Trees in Akpaka Forest Reserve Onitsha North LGA of Anambra State, Nigeria. *International Journal of Environmental Science*, 11(7), 28472-28474.

United Nations Human Settlement Report, (2010). History and Culture of the People of the Ancient city of Onitsha: The Human Settlement Perspective. *UNHS Report, No* 412.

World Resource Institute (WRI), (2017). Forest Resource Decline and Global Warming: *A report Presented by WRI at a Summit on Climate Change* in Seattle USA.