Climate Change, Human Security and Communal Clashes in Nigeria

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Abstract

The debate on climatic change and variability as it is now concentrate more on likely global and regional futuristic occurrences which may be triggered off by the climatic anomalies of the past and present. Much as this is valid, the vulnerability and (likely) adjustments or coping mechanisms of people to the vagaries of climate is best understood at micro and meso levels. More importantly, the global chain-effects of macro climate variability may not give clue to how climate change affects human security at individual and communal levels. Struggle for diminishing resources has increased as a result of climate variability. communal and ethic clashes over who owns the land and the struggle for control of exploitation of mineral resources has indeed increase especially in the highly populated countries of the developing world.

In Nigeria, many communal clashes (often mis-interpreted or mis-represented as ethnic and religious clashes) are actually struggle over either the control of land or mineral resources or both. In the northern and middle parts of the country, the cereal-productive Sudan savannah ecology is transiting to pure Sahel and the influence of the Sahara is increasing southwards. In the same vein, the root and tuber productive ecology of the Guinea Savannah is giving way to Sudan Savannah grassland. The predominant Fulani herdsman of the lower Sahel and Sudan savannah ecologies is now moving South - to the Guinea Savannah and Forest belt of the South - to find greener pasture for his herds. This is not acceptable to the root and tuber farmers of the Guinea Savannah that is already farming close to the climatic margin of cultivation. He has the fears that Fulani herds will destroy his farmlands. The natural result is clash over right to the lands. The Southern Nigeria scenario is a little different but plays out the same. By nature, 50% of the lands in the Niger Delta are not workable due to the edaphic and physiographic limitations imposed by drainage. Secondly, all the lands in the south including the 50% agriculturally productive lands have been parceled to Multinational Oil Corporations as Oil Mining Leases (OML) and/or Oil Prospecting Leases (OPL) by the government. By implication, the real owners - the natives - are only farming on the lands for a moment. Oil exploration activities on productive lands coupled with widespread depletion of resources from both natural and anthropogenic factors drive the people to the margin of survival. Hence, the recourse to communal clashes over who owns the lands yet to be taken over and then arm struggle with oil companies and the government for a better deal.

This paper presented a picture of rainfall changes (which is a critical element of climate and climatic changes in tropical Africa) in the guinea-sudan-sahel (GSS) zone of Nigeria. Virtually all the stations in the Sahel region recorded deficit (less than average) rainfall over a 6 decade (1940-2000) period. The decade 1950s recorded the highest rainfall while the decade 1980s had the least rainfall from the total decadal mean. The pattern of land cover changes between 1976 and 1995 strongly indicated loss of prime arable lands resulting from climate change, which is in turn leading to opening up of new virgin lands towards the south. This correlated with the pattern of communal clashes and conflicts over land resources which are more common in the guinea savannah zone, rainforest belt and the mangrove ecology. Of the 37 cases of communal clashes reviewed, 19 cases representing about 51% were basically crisis/clashes triggered by land resources. 13 of them were basically agricultural land related, 4 on oil and environment and 2 on urban lands. The spatial perspectives of these clashes show more cases around the guinea savannah zone, the rain forest belt and the mangrove ecology of the Niger Delta. No land related clashes occurred in the Sahel and upper Sudan savannah zone.
It is recommended that any policy aim at reducing ethnic conflicts and communal clashes in Nigeria must necessarily be imbued with programmes that have objectives of making more arable lands available through restoration of already degraded and impoverished lands. Alternative solution to the long and short range trans-humance agriculture of the cattle Fulanis in Nigeria through the development of intensive small area grazing which are equipped with facilities that can ensure quick re-growth and regeneration of grasses to ensure continuous feed for animals is also necessary. The spate of oil and environment related crisis which is endemic to the mangrove ecology of the Niger Delta can be reduced through sound proactive land use and resource planning with the view to locate local coastal resources that will provide alternative viable income and livelihood sources to the inhabitants in areas where less oil related ecological risks are involved

1. BACKGROUND

It is now clear that most adverse climatic and environmental impacts that occur today are manifestations of man's inadvertent modifications to climate on local and to a limited extent, regional scale in some activities of the distant past. Natural and human induced global environmental change belongs to the class of risk with high probability of occurrence and damage potential but in such a remote future that for the time being no one is willing to perceive the threat. Although the probability of occurrence and the damage potential are well known and clear, there is always a time lag between trigger and consequence which create a fallacious impression of security (German Advisory Council on Global Change, 1998). Most disasters (including flood, droughts, desertification, land degradation, subsidence, etc) are not random events without underlying causes; they are sudden manifestations of slow but continuous degradation processes (UNEP/GRID-Arendal, 2005). Climate and environmental change processes lead to changes in the biophysical life support system including land surface (vegetation), water resources, soil and atmosphere which constitute the elements that support the long term sustainability of life on earth. It also affects the social and economic structure and framework, and by implication survival, of people. These changes are driven by combination of both natural and anthropogenic causes. Until recently, the effects of man's activities on climate variation was perceived as negligible and so climate was generally taken for granted and there was little thought that the climate could be a problem with severe impacts (Ojo, 1987) but today, because climate and environmental change affects the very basis of human existence the connection between environmental changes and human security has become very strong.

The world's vegetation can be described as the renewable green gold (Odeyemi, 1998) on which the long term sustainability of life on earth rests. It is the single source of primary biological production that sustains the human population and animal species. The objectives of the world conservation strategy (WCS) which include: maintenance of essential ecological processes and life support systems, preservation of genetic diversity and sustainable development of species and the ecosystems revolve around the land and vegetation. Landcover change has been described as the most significant regional anthropogenic disturbance to the environment (Roberts, et al, 1998). In essence both landuse and landcover changes are products of prevailing interacting natural and anthropogenic processes by human activities (the use to which land is put). Landuse and cover change and land degradation are therefore driven by the same set of proximate and underlying factor

elements. Landuse and cover change is therefore central to environmental processes, environmental change and environmental management through its influence on biodiversity, water budget, radiation budget, trace gas emissions, carbon cycling, livelihoods (Verburg, et al 2002; Verburg, et al, 2000), and a wide range of socio-economic and ecological processes (Desanker, et al, 1997), which on the aggregate affects global environmental change and the biosphere. A cause-effect relationship has been established between landuse and cover change and land degradation.

Landcover changes sometimes result from interaction of demographic, social and economic processes. These factors have been summarized by Eyre (1990) and Population Reference Bureau (PRB, 2001) to be the 4Ps: People, Poverty, Plunder and Policy. The PRB reports that: *forests now cover about 27% of the world's land areas, compared to roughly 50% some 10,000 years ago. In Europe and South America, forests extend over roughly half the land, compared to less than one-fourth in Africa, Asia and Oceania. Of the forested land that remains today, 55% is found in less developed countries. During the 1990s, human activities resulted in the gross deforestation of an area roughly the size of Colombia and Ecuador combined (146m.ha). During that same time period 52m.ha were regained due to reforestation efforts and natural regrowth. Rates of net deforestation were highest in South America and Africa, while high rates of gross deforestation in Asia were offset by expanding forest plantations. In general, the 1990s saw forest cover expand in temperate less developed countries, decline in tropical less developed countries and remain relatively stable in more developed countries* (PRB, 2001).

Land degradation is both a part and consequence of environmental changes on land leading to loss of valuable land resources. Loss of productive agricultural lands in some parts of the world where livelihood is contingent upon subsistence farming pushes existence to the margin of cultivation. This sets in motion the survival of the fittest principle. The natural result is the struggle for, and clashes on, land.

The debate on climatic change and variability as it is now concentrates more on likely global and regional futuristic occurrences which may be triggered off by the climatic anomalies of the past and present. Much as this is valid, the vulnerability and (likely) adjustments or coping mechanisms of people to the vagaries of climate may best be understood at micro and meso levels. More importantly, the global chain-effects of macro climate variability may not give clue to how climate change affects human security at communal levels and even family levels. Struggle for diminishing resources has increased as a result of climate variability. Communal and ethnic clashes over who owns the land and the

struggle for control of exploitation of mineral resources has indeed increased especially in the highly populated countries of the developing world including Nigeria.

The aim of this paper therefore is to present an overview of climate and climate change effects in Nigeria. The specific objectives are:

- To present an analysis of rainfall patterns and rainfall changes for 6 decades (1940-2000) in the savannah ecology of Nigeria comprising the Guinea, Sudan and Sahel (GSS) ecological zones, and how this has affected agriculture and landuse in the different zones and present new trajectories of landuse and cover changes.
- To investigate some key landcover changes and examine their contributions to the emerging patterns of agricultural landuse, pressure on land and human conflict.
- To analyze data on human crisis/communal clashes and investigate how emerging spatial patterns of clashes relate to emerging climate-change driven landuse trajectories.

2. THE STUDY AREA

2.1 Location

The 923,000km^2 landmass of Nigeria runs from about longitude $2^0\,40^1$ to $14^0\,45^1$ east of the Greenwich meridian and from latitude $4^0\,15^1$ to $13^0\,55^1$ north of the equator. Nigeria shares boundaries with Benin Republic, Niger Republic and Cameroon Republics in the west, north and east respectively, and Chad Republic through Lake Chad in the northeast. The Atlantic Ocean forms the southern boundary. Nigeria is indeed a unique tropical country that cut across all tropical ecological zones. From the Atlantic down to the edge of the Sahara (a latitudinal distance of about 1500km), all tropical ecozones are found. These include: the southern zone of Mangrove swamp located between latitude 4 and $6^0 30^1$N, the Tropical rainforest found around latitude $6^0 30^1$ to $7^0 45^1$ stretching from the southwest to the southeast, the Guinea Savannah belt around latitude $7^0 45^1$ N to 10^0N, the Sudan Savannah belt around 10^0N to 12^0N and the Sahel Savannah in areas above latitude 12^0N (fig 2).

The unique location characteristic of Nigeria made the country vulnerable to climatic change and environmental externalities resulting from both natural and anthropogenic driving factors. In terms of climate change driven land degradation, Nigeria is being 'attacked' in all fronts - serious coastline erosion, the pervasive gully erosion in eastern parts of the rain forest zone and central guinea savannah zone, and the ferocious wind erosion and desertification in the sudano-sahelian zone. Nigeria is yearly loosing an increasing amount of

prime agricultural and grazing lands which results in ecological migration and intensification of trans-humance among the northern cattle rearers.

2.2 Relief and Climate

Nigeria's landscape exhibits great variety of relief features encompassing the uplands with elevation ranges between 600m and 2200m and basins/low lands with elevation as low as 0m in some places in the extensive Niger Delta Basin (fig 1). Generally, the relief region of Nigeria is classified into:

- The Western uplands
- The Northeastern Highlands and Eastern scarplands
- The North central Plateau and Highlands
- The Plains – the great plains of northern Nigeria
- The inland basins – the Niger-Benue trough and the Niger Delta Basin

The western uplands are characterized by massive ridges and isolated dome-shaped inselbergs. It is an extensive mountain range that runs across southwestern Nigeria for a distance of about 450km. The relief composed of extinct volcanic rocks and dissected metamorphic intrusions with elevation ranges between 400m and 600m. The western upland reached its peak around Idanre hills with considerable steep slope, high gradient and an elevation of about 900m.The north-eastern highlands are found around the north-eastern border with Cameroon Republic. It is a north-south ranges which runs for a distance of 850km starting from the Obudu ranges in Cross River state to the Mubi hills in Adamawa state. It also consists of the Adamawa, Mandara, Bamenda, Alantika and Shebshi mountains with elevation about 2200km forming the highest peak in Nigeria. The eastern scarp lands consist of metamorphic formations ranging between 600-800m and with peak at the Udi hills and Nsukka escarpments in the east central area of Nigeria.

The North Central Plateau and Highlands consists of the extensive plateau that runs from Kaduna-Zaria axis to Jos area. Elevation ranges between 700m-1300m and peaked with bold basaltic intrusions around Jos area at an altitude of about 1500m. The plateau covers an estimated area of 8000km^2. It also consists of isolated inselbergs that dotted the otherwise flat landscape. The plains cover parts of the Northwest and Northeast regions of Nigeria. It consists of elevation ranges between 200m and 400m over basement complex geological formations with sedimentary and metamorphic rocks. The basins comprise mainly the Niger-Benue trough and the extensive coastal lowlands and Niger Delta valley. It is dissected by the

Niger-Benue River system which forms the waters of the Niger. Elevation ranges is between 0-200m and it covers an estimated area of over 100,000 km^2.

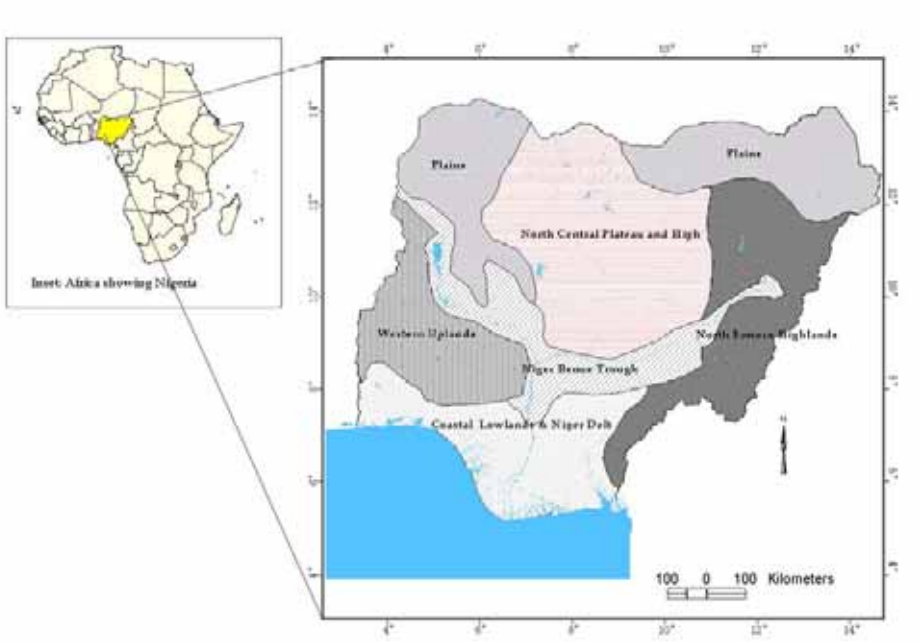


Fig 1: Physiographic Regions of Nigeria

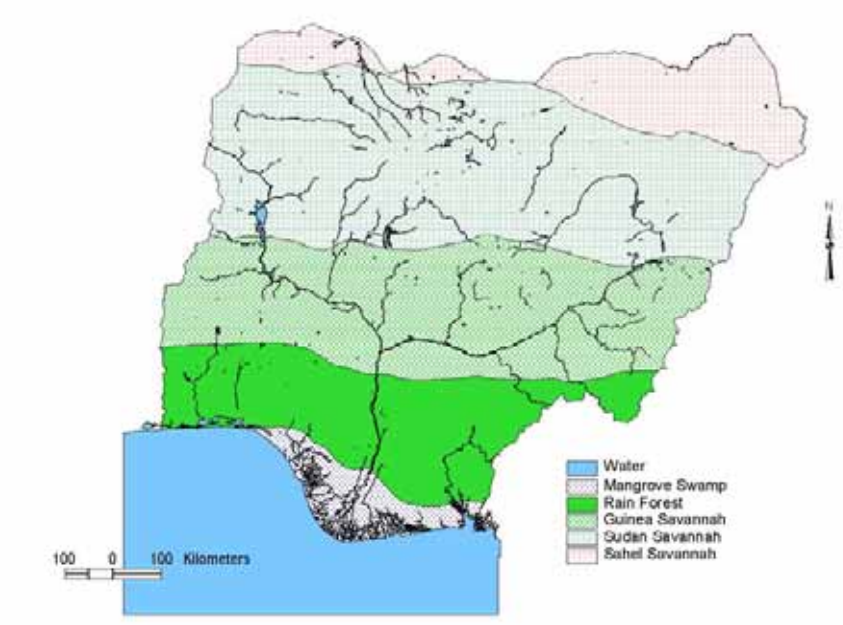


Fig 2: Ecological Regions of Nigeria

The characteristics of the Nigerian geomorphologic regions go a long way to affect its overall climate and ecology. Rainfall decreases from the coast to the interior with some exceptions in areas with orographic influences such as the Jos Plateau area of the north central plateau and highlands. Mean annual rainfall varies from about 2500mm to above 4000mm in the southern mangrove swamp near the coast, 1500mm to 2500mm in the rainforest zone, 1200mm-

1500mm in the Guinea savannah, 760mm-1020mm in the Sudan savannah and between 380mm and 700mm in the Sahel. The mean daily relative humidity and number of rainy days also decrease from the coast to the interior. However, temperature surface over Nigeria is not evenly distributed as rainfall, and influence of altitude is more pronounced here. Mean annual temperature (between 27^0c and 29^0c) is generally higher around the plains of northern Nigeria, the north-eastern highlands and the Niger-Benue trough than the western upland, coastal lowland of the Niger Delta and the north central plateau and highlands with mean annual temperature of between 22^0c and 27^0c. The highland of Jos plateau has the lowest mean annual temperature of about 21^0C. The mean daily hours of bright sunshine generally increases from the coast to the hinterland.

2.3 Ecology and the People

Nigeria is a vast country with over 70% of the about 120 million population dwelling in the rural areas and their occupation is directly connected to the land. More than 65% of population is engaged in agriculture at subsistence levels. Cash crops (mainly cocoa and rubber) and tubers dominate agriculture in the rain forest zone; the guinea savannah zone is the food basket of the nation with much of the root and tuber crops coming from this zone. The upper guinea and lower Sudan savannah ecology produces much of the cereal (mainly millet and guinea corn) for both human and animal consumption. The upper Sudan and Sahel ecology used to be the main zone of animal grazing. Crop production in this zone is localized around the wetland areas (locally referred to as Fadamas). To increase vegetable and cereal crop production, most wetlands in this zone are equipped with irrigation infrastructure.

The southern mangrove swamp zone presents a different picture. It consists of permanently flooded wetlands. Hence agriculture is localized around the main river channels during the dry seasons. Fishing is the major occupation in this zone. This region is also a zone of commercial oil exploration of crude oil and bitumen deposits. So this greatly hampers the chances of utilizing available lands for agriculture. Local fishing and subsistence is also impaired by externalities in form of oil spills, dredging of canals and excavation of lands resulting from oil exploration.

3. METHODOLOGY

3.1 Data and data sources

The thrust of this work is to portray the spatial perspectives of climate and environmental change over Nigeria and to show to what extent this is directly related to the survival and security of the people. A geographic information system (GIS) approach that permits overlay and analysis of multiple data layers is therefore used.

The data utilized for this research are shown on table 1.

Table 1: Data and Data sources

S/n	Data	Year	Source
1	Rainfall data over 22 stations in Nigeria	1940-2000	Nigerian Meteorological Agency (NIMET)
2	Administrative data of Nigeria at local government level	2000	Geography Dept, University of Lagos
2	Landuse data for Nigeria	1976 &1995	Geography Dept, University of Lagos
4	Schedule of some crisis/clashes over land resources	1991-2005	Compiled from newspaper clippings

Rainfall data for 22 stations over the guinea-sudan-sahel zones (GSSZ) of Nigeria for 60 years period (1940 -2000) was collated from the archive of the Nigerian Meteorological Agency (NIMET). Administrative data for Nigeria at local government area (LGA) levels and digital land use data for 1976 and 1995 were soured from the Geography Department, University of Lagos. The schedule of crisis/clashes over land and land resources were collated from past newspaper clippings.

3.2 Procedure

Using simple statistics, rainfall data was summarized for annual means, decadal means, total decadal means, mean of the decadal means and the mean of total decadal mean (which produces point estimation for the 60 year period) for each station. The point estimator (grand mean - the mean of all decadal means) for the 60 years period was subtracted from the mean of decadal means for each station to generate the deviation from the mean. Correspondingly, mean deviation for each decade was computed by subtracting the grand mean (mean of all decadal means) from the mean of total means for each decade.

Using 3D and GRID tools within Arcview GIS 3.3, the values for decadal means for each station was converted into rainfall surface using a 1km grid over the GSSZ of Nigeria for each of the 6 decades. A rainfall change map over the study area between 1940 and year 2000 was also generated.

From the digital static land use and cover data, 7 key landuse and landcover classes (out of the mapped 35 classes) that indicate significant ecological changes in Nigeria generally and the GSSZ in particular were selected and there areas in 1976 compared with 1995. To attempt to establish a link between global/regional environmental changes and local vulnerability effects and consequences, a survey of crisis and communal clashes over Nigeria was collated from newspaper clippings. The earliest account included was 1991 while the latest was in February 2005. The reports were coded and tabulated according to the locality (spatially represented by LGAs) where they occur, the principal underlying causes (trigger) and other proximate causes. The table was structured, formatted and attached to the spatial database of LGAs in Nigeria and spatial analysis was performed to show relationships between rainfall pattern and landuse and cover changes (i.e. diminishing land resources) on one hand, and the pattern of communal clashes (struggle over resources) on the other. The results are presented in the following sections.

4. DATA ANALYSIS AND PRESENTATION OF RESULTS.

4.1 Climate Change and Pattern of Rainfall in the GSSZ of Nigeria

Rainfall as one of the elements of climate controls the rhythm of life and livelihood in the tropics to a very large extent. Agriculture (both crop cultivation and animal grazing) in the GSSZ of Nigeria is to a large extent conditioned by the pattern of rainfall. The upper Sudan and the Sahelian zone receive less rainfall than the guinea and lower Sudan savannah, so the dates of onset and cessation of rain is critical to crop cultivation. Before the onset and after cessation of rains, crop cultivation are localized in the Fadamas, the other areas (Tudu) are only put to cultivation during the rainy season. So in general, there are more equipped wetlands (irrigated farmlands) scattered in the Sudan and Sahel savannahs of northern Nigeria than in the rainforest and guinea savannah belt. The trend and pattern of rainfall for 22 stations located within the GSSZ of Nigeria for a 6 decade period shows that there have been significant reduction in rainfall received over the area.

Table 2: Mean decadal rainfall (1940-2000) for stations over the GSSZ of Nigeria

S/n	Station	Decad40_mean	Decad50_mean	Decad60_mean	Decad70_mean	Decad80_mean	Decad90_mean	Total_decad_mean	Mean_average for all decad	Deviation from mean
1	Abuja									
2	Bauchi	1121.02	1080.75	1039.29	1000.34	898.91	1112.54	6252.85	1042.14	70.8753
3	Birnin-Kebbi				715.557			715.55	715.557	-255.71
4	Gusau		1062.04	945.7	877.21	646.03	1069.29	4600.26	920.053	-51.213
5	Ibi		1139.43	1246.57	1083.57	1064.34	1174.02	5707.92	1141.59	170.319
6	Ilorin	1134.39	1406.85	1246.57	1182.72	1154.33	1264.56	7389.42	1231.57	260.303
7	Jos	1419.31	1430.07	1214.04	1325.69	1227.47	1186.55	7803.13	1300.52	329.255
8	Kaduna	1076.97	1469.57	1269.62	1020.09	1116.15	1202.02	7154.42	1192.4	221.137
9	Kano	781.39	909.51	837.444	706.16	613.98	1119.11	4967.59	827.932	-143.33
10	Lokoja	1030	1247.62	1245.39	1180.3	1100.83	1169.52	6973.66	1162.28	191.01
11	Maiduguri	592.5	723.49	658.07	582.97	419.17	601.3	3577.5	596.25	-375.02
12	Makurdi	1272.32	1298.94	1379.23	1231.44	1111.55	1232.71	7526.18	1254.36	283.098
13	Minna	1275.57	1271.35	1289.44	1265.62	1103.01	1267.03	7472.02	1245.34	274.07
14	Sokoto	657.01	779.54	693.64	597.8	538.23	673.6	3939.82	656.637	-314.63
15	Yelwa	878.7625	1076.9	1107.14	930.61	856.84	1164.18	6014.42	1002.4	31.1379
16	Yola	924.92	992.43	844.9	915.8	832.02	937.75	5447.82	907.97	-63.297
17	Nguru	554.16667	586.12	518.82	449.11	335.24	431.456	2874.91	479.152	-492.11
18	Potiskum	713.18	864.6	772.143	623.65	591.41	706.322	4271.30	711.884	-259.38
19	Bida	1110.97	1008.74	1246.86	1118.06	1111.19	1122.64	6718.46	1119.74	148.477
20	Katsina	682.25	786.31		584	482.73	360.144	2895.43	579.087	-392.18
21	Iseyin					1021.22	1188.64	2209.86	1104.93	133.663
22	Zaria	1087.075	1136.53	1056.47	1000.4	911.98	1087.01	6279.46	1046.58	75.3108
23	Shaki					1075.13	1183.85	2258.97	1129.49	158.223
								grand X for 22 stations	**971.27**	0

Source: Computed from rainfall data from NIMET

The pattern of rainfall over the last 60 years for all the stations in the GSSZ of Nigeria shown on table 2 is summarized on fig 3 and fig 5(a-f). It is clear from these figures that for most stations located in the upper Sudan and Sahel zone of Nigeria, the deviation of rainfall from the grand mean is negative. Such stations include Birnin Kebbi, Gusau, Kano, Maiduguri, Sokoto, Yola, Nguru, Potiskum and Katsina. Worst affected is Nguru, Maiduguri and Katsina that are located in the interior of the Sahel zone. This generally follows the rainfall characteristics of Nigeria as described in the study area.

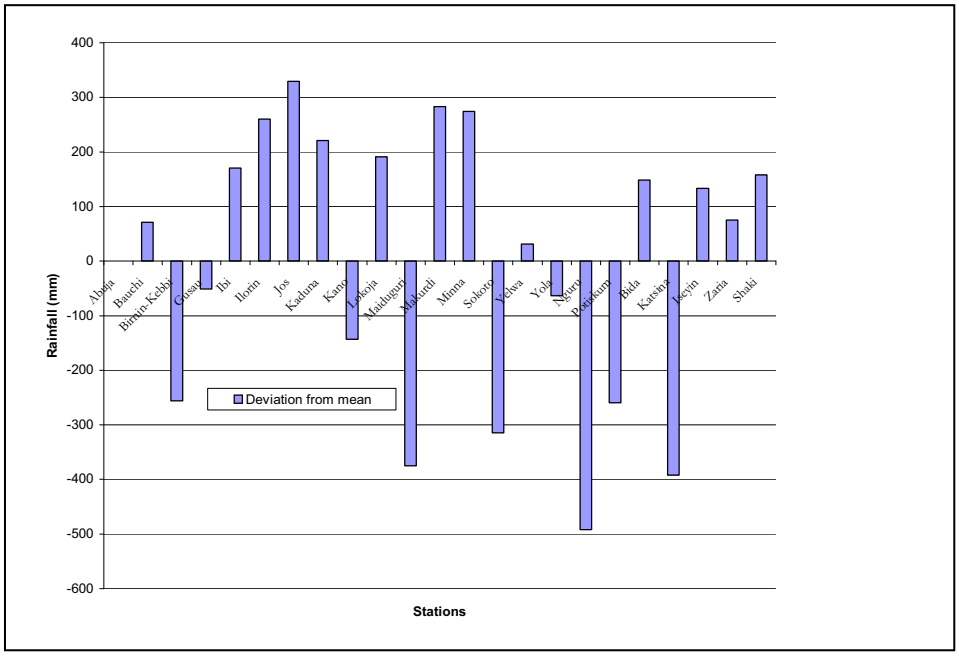


Fig 3: mean deviation of rainfall over stations in the GSSZ

A general picture of the inter-decadal rainfall changes is presented on table 3 and figure 4.

Table 3: mean deviation of rainfall for the decades 1940s-1990s

Decade	mean of total mean	Dev_from_mean
deca_1941-50	959.517892	-17.024194
deca_1951-60	1066.88364	90.3415539
deca_1961-70	1033.96291	57.4208192
deca_1971-80	919.554815	-56.987271
deca_1981-90	867.226599	-109.31549
deca_91-2000	1012.10667	35.5645802
Mean of _mean total	976.542086	0

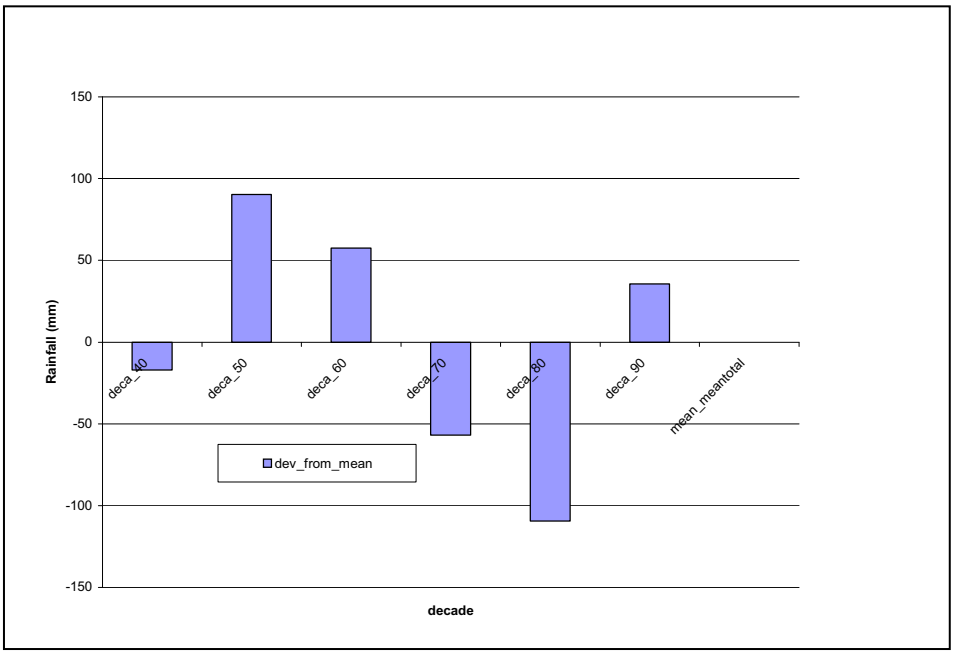
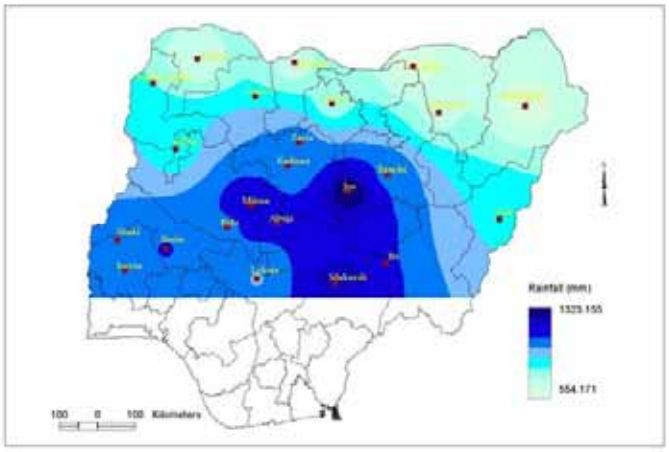
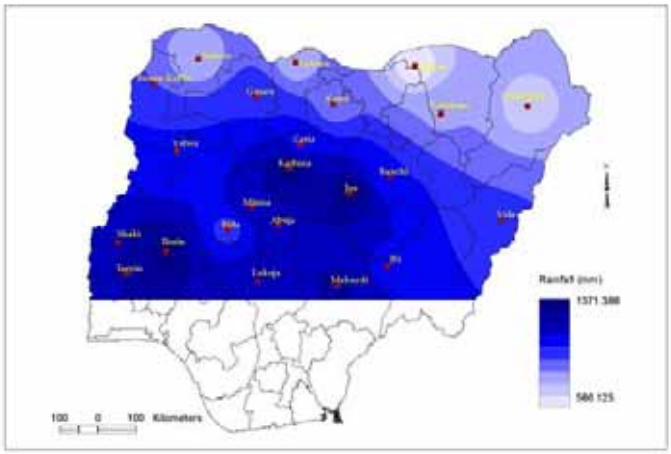


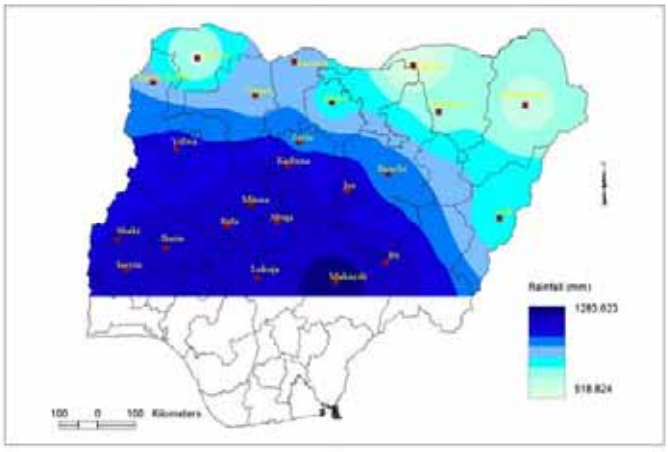
Fig 4: Decadal mean deviation of rainfall over the GSSZ (1940-2000)



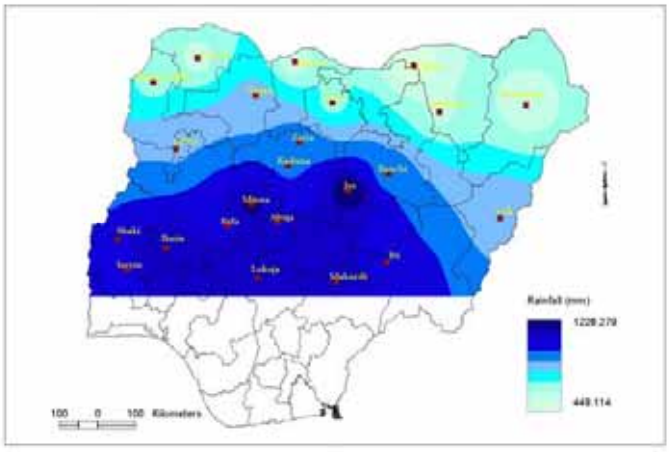
a: Decade 1940s



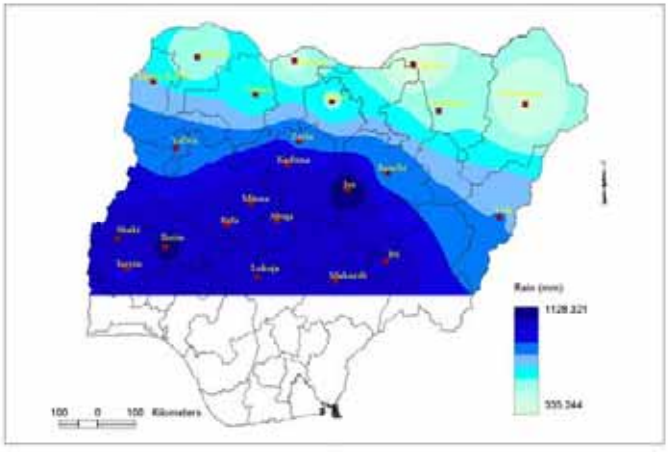
b: Decade 1950s



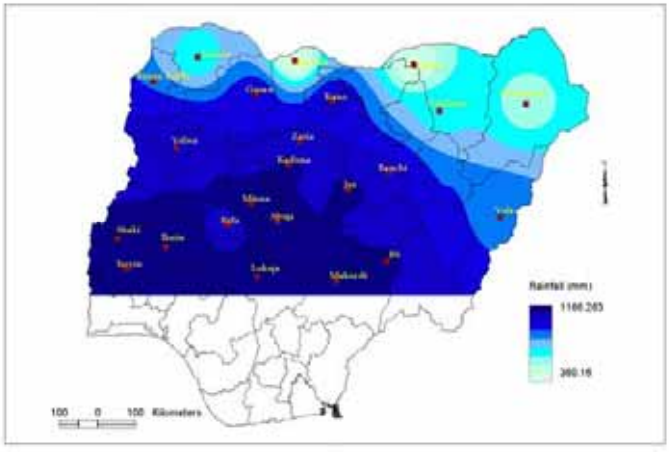
c: Decade 1960



d:Decade 1970s



e:Decade 1980s



f:Decade 1990s

Fig 5 (a-f) – Mean Decadal rainfall over the GSS Zone, (1940-2000)

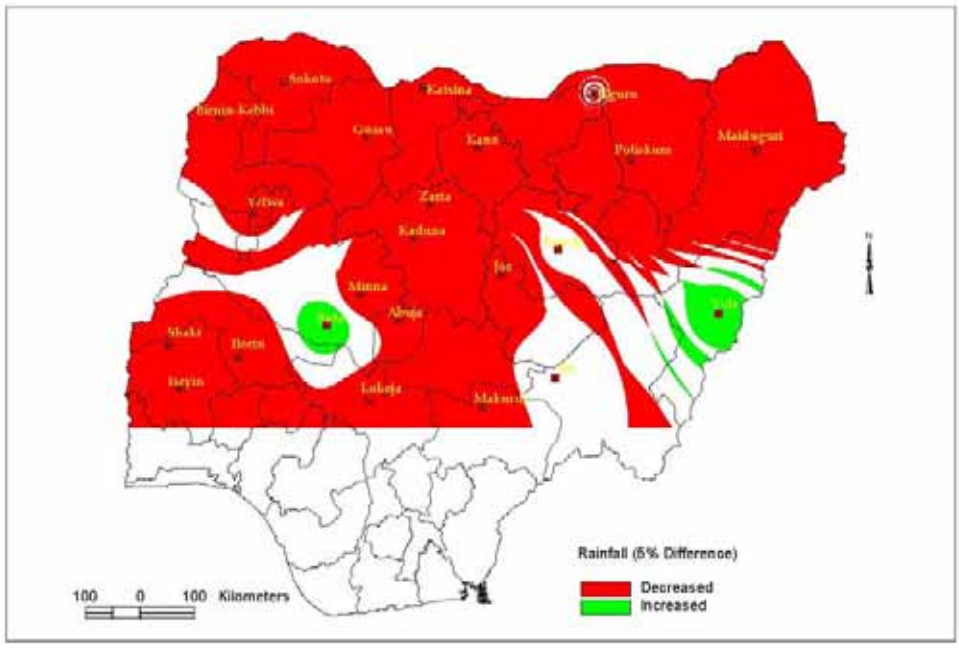


Fig 6: Rainfall Changes between the decade 1950s and 1980s in the GSSZ

Table 3 and figure 4 show the decadal mean deviation of rainfall in the decades 1940s to 2000. The wet decades 1950s and 60s that followed the drought of the 1940s was truncated by the droughts of the following two decades (1970s and 1980s). Fig 6 shows highlighted 5% difference in rainfall between the decade 1950s which represents the wettest decade and 1980s representing the driest decade. Except in those places with localized altitudinal effects on rainfall, all other areas experienced more than 5% decrease in rainfall between the two decades.

The sudano-sahelian drought of the decade 1971-80 spells great consequences for the people and their livelihoods in the savannah region of Nigeria (Ojo, 1987). Large herds of cattle were lost in the Sahel and Sudan savannah region. The natural result is ecological migration towards the south which translates to pressure on land and land resources of the guinea savannah and rainforest zone. Transhumance among the Sahel and Sudan dwelling Hausa-Fulani tribe was intensified with long range migration to the south, thus creating more pressure and friction resulting from landuse conflict in the southern guinea savannah and rainforest belt. Of course the moderately favorable rainfall regime of the decade 1990s - which has also been described as the warmest years since 1400 A.D - is not enough to reverse the trend, so the trouble continues.

4.2 Landcover Changes

Landcover changes are an important index of climate change. In the Nigerian environment just like in any other parts of the tropical world, landcover changes result mostly from combination of natural and anthropogenic influences. The main natural force is rainfall changes induced by climatic variability. This reduces the natural regeneration rate of land resources. This also presents a chain of causal reaction that makes people exploit more previously undisturbed lands. In Nigeria, the rate of human regeneration of natural resources through re-afforestation is very low. Hence, there is the tendency to abandon a piece of land once it's no longer productive or cannot produce enough to support grazing animals.

Table 4: Changes in some land cover classes in Nigeria between 1976 and 1995

S/n	Ecology	Area_km2 (1976)	Area_km2 (1995)	Change_1976-1995	Percent change
1	Agricultural Tree Crop Plantation	824.15	1,656.88	832.73	101.0
2	Alluvial	523.61	282.38	-241.23	-46.1
3	Discontinuous grassland dominated by grasses and bare surfaces	7,614.72	12,517.23	4,902.51	64.4
4	Disturbed Forest	14,677.70	19,491.29	4,813.59	32.8
5	Dominantly grasses with discontinuous shrubs and scattered trees	13,053.77	12,487.62	-566.15	-4.3
6	Dominantly shrubs and dense grasses with a minor tree component	118,529.55	85,020.98	-33,508.57	-28.3
7	Dominantly trees/woodlands/shrubs with a subdominant grass component	154,933.40	83,281.15	-71,652.25	-46.2
8	Extensive (grazing, minor row crops) Small Holder Rainfed Agriculture	170,837.55	192,892.33	22,054.77	12.9
9	Extensive Small Holder Rainfed Agriculture with Denuded Areas	4,417.88	10,118.47	5,700.58	129.0
10	Floodplain Agriculture	9,671.81	21,576.03	11,904.21	123.1
11	Forest Plantation	1,000.85	1,581.24	580.39	58.0
12	Forested Freshwater Swamp	18,564.71	16,696.51	-1,868.20	-10.1
13	Graminoid/Sedge Freshwater Marsh	5,882.74	1,136.51	-4,746.22	-80.7
14	Grassland	1,196.74	8,146.74	6,950.00	580.7
15	Gullies	125.35	19,070.48	18,945.13	15,113.2
16	Intensive (row crops	329,227.97	373,481.34	44,253.37	13.4
17	Irrigation Project	148.85	1,008.86	860.01	577.8
18	Livestock Project	51.02	139.65	88.63	173.7
19	Major Urban	1,102.58	1,362.37	259.79	23.6
20	Mangrove Forest	10,157.12	10,067.31	-89.81	-0.9
21	Minor Urban	958.69	4,022.98	3,064.29	319.6
22	Montane Forest	7,900.02	8,053.76	153.74	1.9
23	Montane grassland	2,502.27	3,898.15	1,395.88	55.8
24	Natural Waterbodies: Ocean	6,766.53	15,588.36	8,821.83	130.4
25	Rainfed Arable Crop Plantation	15.92	521.38	505.46	3,174.9
26	Reservoir	1,331.41	2,901.16	1,569.75	117.9
27	Riparian Forest	7,506.46	5,330.46	-2,176.01	-29.0
28	Rock Outcrop	1,445.15	2,647.96	1,202.81	83.2
29	Saltmarsh/Tidal Flat	18.84	596.92	578.08	3,067.5
30	Sand Dunes/Aeolian	1,032.77	5,428.30	4,395.53	425.6
31	Shrub/Sedge/Graminoid Freshwater Marsh/Swamp	17,749.63	10,251.68	-7,497.95	-42.2
32	Teak/Gmelina Plantation	624.44	1,156.43	531.99	85.2
33	Undisturbed Forest	28,022.42	13,477.90	-14,544.52	-51.9
34	Canal		30.76	30.76	
35	Mining Areas		61.15	61.15	

To demonstrate this, seven landcover classes (of the mapped 35 classes) that can serve as index for measuring disturbance and abandonment of former lands to new productive areas were selected. These landcover classes include disturbed forest, extensive small holder rainfed agriculture (including grazing), floodplain agriculture, forest plantation, rainfed arable crop plantation, sand dunes/Aeolian deposits and undisturbed forest.
The statistics of static landuse and cover data of Nigeria for both 1976 and 1995 (table 4) were generated and compared.

The results of static land cover changes for the 19 year period indicated that disturbed forest increased by 32.8%, extensive small holder rainfed agriculture by 12.9%, and floodplain agriculture by 123%. Forest plantation increased by 58% and rainfed arable crop plantation by 3000%. The strong increase in acreage mapped as disturbed forest, extensive small holder agric and rainfed arable crop plantation suggests intensification in down-south movement of grazing zone. The strong increase in floodplain agriculture strongly suggests intensification of cultivation within the Fadamas when other surrounding lands are already close to the climatic margin (limit) of cultivation. Forest plantation increased by 58% which is due to some limited arid protection afforestation and shelter breaks projects embarked upon especially in the Sudan and Sahel zones by some State Governments in collaboration with UNEP and some other international organizations. The very strong increase (425%) in the extent of area mapped as sand dunes /Aeolian deposits and the over 50% decrease in areas of undisturbed forest gave strong pointers to the land resources loss due to global climate change. The increasing down-south march of the Sahara desert through the Sahelian zone of Nigeria is leading to the opening up of more natural forests for cultivation and grazing in the guinea savannah and rain forest zones. This of course is leading to pressure on land, land use conflicts and ethnic and communal clashes in the areas that are being opened up.

4.3 Human Security and Communal Clashes

There appears to be a very strong connection between climate change and the pattern of communal clashes in the country. This is clearly discernible. Rainfall controls the rhythm of activities especially in the GSSZ of Nigeria. As explained earlier, the Sudan and Sahel savannah represents the region of extensive grazing with vegetable and cereal cultivation localized around the Fadamas. The Guinea savannah zone is the food basket of the nation. It is the region where both intensive and extensive root and tuber crops, cereals and other arable crops are cultivated. This region represents the net exporter of food items such as Yam, Cassava, Potatoes, Guinea Corn, and millet to other regions of Nigeria. The rainforest belt

represents the only region where growing of commercial tree crops especially cocoa and oil palm is done. In addition, it also supports the growth of some root and tuber crops at subsistence level. However, decrease in rainfall with increase in surface temperature over the years is now resulting to pressure on land in the Guinea Savannah zone and the rainforest belt. Most of these pressure resulted from the long range trans-humance of the Fulani cattle rearers from Sahel and Sudan savannah to the Guinea savannah and now the rainforest belt. It is noted that many cattle Fulanis with their herds are now found permanently settled or roaming within the Guinea savannah and the rainforest belt. This is a contrast to what obtains in the 1960s and 1970s where they only move down-south when grasses are no longer "green" in the Sudan and Sahel, and make the return migration with the onset of rainy season in the north.

Of course, the natural result of this pressure on land is conflict, especially between the cattle Fulanis and the crop growing natives of the guinea savannah over the right to the land which in most cases result in destruction of their farmlands by the cattle.

Other clashes over land include inter-community struggle for dominance and control of land resources which is common in the densely peopled south east of Nigeria, and of course the case of the Niger Delta area which combines the struggle for control of land, environment and oil activities. To capture some of this, past newspaper clippings were reviewed to generate a list of some critical communal clashes that were reported between 1991 and 2005. In all, 37 crisis/clashes were reviewed as shown on the summary on table 5, figure 6 and the main table on appendix 1. 13 of the cases (35%) were purely crisis on agricultural land, 4 (10.8%) on oil and environment and 2 (5.4%) on urban land.

Table 5: Summary of some Crisis in Nigeria: 1991-February 2005

S/n	Crisis/Clashes Group	No	Percent
1	Land - Agric	13	35.1
2	Land -Oil/environment	4	10.8
3	land-urban	2	5.4
4	Religious	5	13.5
5	Political	5	13.5
6	Ethnic	7	18.9
7	Others	1	2.7
		37	100.0

This indicates that 19 of the 37 cases representing about 51% were basically crisis/clashes triggered by land resources. The result also shows that many of the crises on agricultural

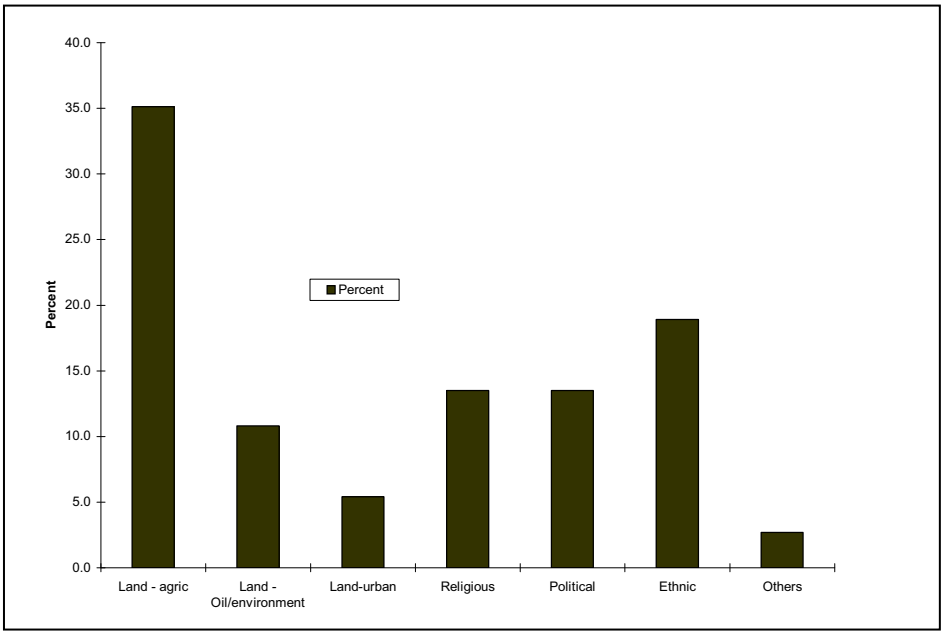


Fig 7: Percentage of some crisis in Nigeria (1991- February 2005)

lands were between the nomadic Fulanis and the natives. Clashes on oil and environment were basically localized in the Niger Delta area because of some reasons which have been mentioned in some other parts of this paper.

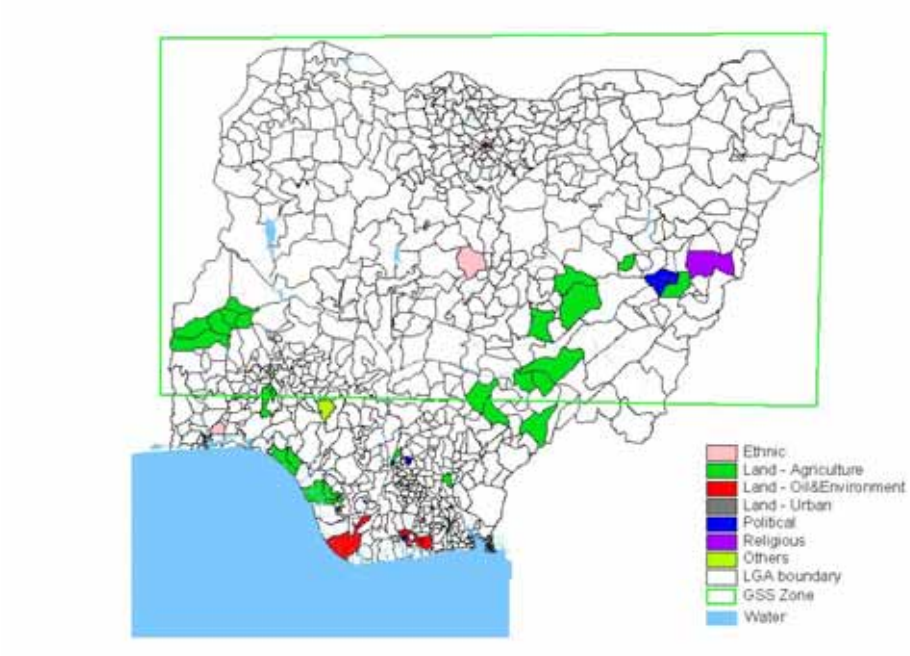


Fig 8: Some communal conflicts/clashes in Nigeria (1991-February 2005)

Ethnic and religious clashes too which respectively account for about 19% and 13.5% of the cases were in some cases offshoots of the question “who owns the land” which is a

reverberation of diminishing returns on land resources. However some of those complex factors that go into the equation for this are beyond the scope of this paper.
The spatial perspectives of these clashes by local government areas (LGA) where they occur shows more cases around the guinea savannah zone, the rain forest belt and the mangrove ecology of the Niger Delta as shown of figure 8.

More cases of agriculture related land conflicts recorded in the rainforest, guinea and lower Sudan zones suggests strongly the influence of climate change induced pressure on this zone. The oil and environment related conflict are localized around the Niger Delta as a result of environmental degradation, loss of farmlands and pollution of surface waters brought about by oil exploitation and exploration activities. The only type of crisis recorded in the Sahel and upper Sudan zones are city-localized religious crisis.

5. DISCUSSIONS

Struggle for diminishing land resources in the guinea savannah and rainforest belt of Nigeria is increasing due to uncertainties and climatic variability that already had terrible telling effects on farmers (including cattle rearers) of the Sahel and upper Sudan zones. The pattern (rate and direction) of land use and cover changes have also gave strongly evidence to loss of productive arable lands and opening up of new virgin forested lands especially in the guinea savannahs and other forested areas. These are strong signals of the effects of climate change at local level. Of course the guinea savannah farmer who is already farming close to the margin of cultivation will attempt to resist the “northern invasion”. The result is: attempt to protect narrow interest on the land both by the natives and the immigrants which leads to communal clashes. This presents a classical case for the effect of climate change at communal levels in Nigeria. Communal and ethnic clashes and struggle for control of exploitation of mineral resources has also increased in the mangrove ecology of the Niger delta area. These regions are therefore very critical flash points of climate change induced human insecurity in Nigeria.

There has been serious decline in cash crop production in Nigeria from the 1980s to the present. The groundnut pyramid of the northern sudano-sahelian zone has disappeared. Cocoa production in the rainforest belt has been on steady decline since 1980s as most original cocoa plantations are now fallow lands. The remote triggers of agricultural decline are traceable to global change, and the results are manifested in massive migration of rural folks to the urban areas and the struggle and clashes over available land resources as

discussed earlier. Massive rural-urban migration drives the carrying capacity of these cities towards the limit of acceptable change. This results in widespread breakdown of urban infrastructure, crime and the emergence of urban slums, ghettos and squatter settlements, which portrays the social dimensions of global change.

6. SUMMARY AND CONCLUSION

This paper has presented a picture of rainfall changes (which is a critical element of climate and climatic changes in tropical Africa) in the GSS zone of Nigeria. Virtually all the stations in the Sahel region recorded deficit (less than the total average) rainfall over a 6 decade (1940-2000) period. The decade 1950s recorded the highest rainfall while the decade 1980s had the least rainfall from the total decadal mean. The pattern of land cover changes between 1976 and 1995 strongly indicated loss of prime arable lands resulting from climate change, which is in turn leading to opening up of new virgin lands towards the south. This is correlated with the pattern of communal clashes and conflicts over land resources which are more common in the guinea savannah zone, rainforest belt and the mangrove ecology. The situation as it is now is a zero sum game where each participant's gain is the others (and collective) loss (Keene, 2004). This is a situation where all will be losers at the end. That is how far this competition can work. Any efforts at redeeming the present situation should aim towards cooperation rather than competition among all actors and stakeholders.

It is recommended that any policy aim at reducing ethnic conflicts and communal clashes in Nigeria must necessarily be imbued with programmes that have objectives of making more arable lands available through restoration of already degraded and impoverished lands. Stemming the downward march of the Sahara through intensification of afforestation projects is important towards reducing the rate of evapo-transpiration in the Sudan and Sahel zone. It is also about time for international organizations to assist Nigerian government in providing alternative solution to the long and short range trans-humance agriculture of the cattle Fulanis in Nigeria. This can be achieved through the development of intensive small area grazing where these areas are equipped with facilities that can ensure quick re-growth and regeneration of grasses to ensure continuous feed for animals. There is also the need to intensify research on fodder systems in Nigeria to sustain animals on hay and silage rather than the current long range search for greener pastures.

Urban ethnic crisis are results of deep seated resentment resulting from lack of job and social alienation by people who were forced by environmental changes (leading to poor

yields and less productivity) to migrate from rural lands to urban areas. There is a strong teleconnection between rural land degradation and urban crisis. Therefore, urban ethnic crisis in Nigeria can be greatly reduced by improving and restoring degraded rural lands and by making available basic infrastructure including electricity, good roads, pipe-borne water and small cottage industries for processing agricultural products. These are presently lacking in virtually all rural countryside of Nigeria. Oil and environment related crisis is endemic to the mangrove ecology of the Niger Delta. The spate of crisis can be reduced through sound proactive land use and resource planning with the view to locate local coastal resources that will provide alternative viable income and livelihood sources to the inhabitants in areas where less oil related ecological risks are involved.

Finally, although global change effects vary between and within countries, global change causes are no respecter of internal and international borders. Therefore, the time is now for all countries and organization in the world to respect the various treaties and conventions aim at reducing the drivers of global change. Only then can we begin to work towards a sustainable world for future generations.

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Appendix 1

Some Crisis/Clashes in Nigeria - 1991- February 2005

S/n	Crisis/ Location	Date	Causes	Group
1	Ogoni Crisis	1991- ?	Oil/Environment	Oil/Environment
2	Itsekiri/Ijaw/Urhobo (Warri, Delta)	1996 -?	LGA relocation/dominance	Land
3	Ife - Modakeke crisis(Osun)	1998 - 2001	Relocation of local Government	Land
4	Aguleri-Umuleri (Anambra)	1998-1999	Communal Clashes	Land
5	Ijaw crisis (Kaiama declaration)	1998	Oil/Environment	Oil/Environment
6	Arogbo ijaw/Ilaje (Ondo)	1999	Land	Land
7	Kano Riot	1999	Response to Shagamu riot	Ethnic
8	Shagamu Crisis (Ogun State)	1999	OPC/Hausa community misunderstanding	Ethnic
9	Ketu reprisal attack	1999	Sequel to Shagamu crisis	Land-Urban
10	OPC/Ijaw in Ajegunle	1999	Ethnic – response to Ijaw/Ilaje	Ethnic
11	Kaduna – Kafanchan Hausa/Zango Kataf	1999	Ethnic crisis	Ethnic
12	Bayelsa state	1999	Oporoma \ Ijaw Peremabiri youths –communal clashes	Oil/Environment
13	Tiv/ Jukun crisis(Benue)	2000	Ethno-communal clashes	Land
14	Billiri Uprising(Gombe)	2000	Religious(Sharia) riot	Religious
15	Hausa \Yoruba community clashes (Agege, Lagos state)	2000	Ethno-communal clashes	Ethnic
16	Warri crisis	2000 - 2004	Urhobo \ Itsekiri ethnicity crisis	Land/Oil/Environment
17	Idiaraba crisis(Lagos)	2002	Ethno-communal/Religious clashes	Land - Urban
18	Song LGA (Adamawa)	2002	Fulani herdsmen/Farmers in Dumme	Land
19	Owo communal crisis (Ondo state)	2002	Clash between palace guard and Ehinogbe boys	Kingship
20	Kaduna crisis - Kaduna	2002	Religious crisis	Religious
21	Aba riot (Abia state)	2002	Bakassi boys engaged in reprisal killings over earlier killings in Kaduna	Ethnic
22	Saki crisis (Oyo state)	2002	Religious crisis	Religious
23	Ekiti state	2002	Cult\Christian group clashes	Religious
24	Dumme village (Song L.G.A, Adamawa state)	2002	Communal conflict between farmers and herdsmen	Religious
25	Yelwa/Shendam /Wase Crisis(Plateau)	2003	Ethno-communal clashes – Fulani/Tarok natives	Land

S/n	Crisis/ Location	Date	Causes	Group
26	Okeogun Crisis(Oyo state)	2003	Nomadic herdsman/Farmers clashing	Land
27	Ebonyi State	2003	Youths of Ekoli Edda went to Egu Nguzu, a disputed land on the boundary between the two communities and destroyed economic crops of the other community and captured twenty of their youths	Land
28	Kano Reprisal attacks(Kano state)	2004	Aftermath of Jos ethno-religious crisis	Ethnic
29	Kwande (Benue)	2004	Desecration of ancestral tomb	Land
30	Port Harcourt /Okrika	2004	Political	Political
31	Anambra crisis	2004	Political	Political
32	Ullam(Gwer council) and Ugambe community (Konshisha council-Benue state	2005	Two persons killed and 45 houses burnt. The crisis was triggered off by the expansionist tendencies of the Ugambe neighbors.	Land
33	Demsa council (Adamawa State	2005	The crisis was sparked up by the allegations that cattle rearers destroyed harvested farm products.	Land
34	Lamurde council(Adamawa State)	2005	Report says the crisis was a protest by youth on the non-conduct of election in the council and their displeasure with the appointment of a caretaker committee instead.	Political
35	Madagali area(Adamawa state)	2005	16 persons were injured .influx and effect of crisis from other councils in the state causes the scenario	Political
36	Numan (Adamawa state)	2005	Business activities were at its lowest ebb. influx and effect of crisis from other councils in the state causes the scenario	Political
37	Bali Village(Demsa council in Adamawa State	2005	Reprisal attack by the regrouped Fulani cattle rearers for the death of their two colleague killed by farmers	Land