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Desertification and Population Dynamics in Nigeria

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Abstract: *This paper examined the effect of desertification on population dynamics and local response to the menace in Nigeria. Data on population changes, type of energy use, house hold size, farm practices and tree plantings were collected through questionnaires from eighteen development areas as well as government agencies in Yobe State of Nigeria. The objective was to examine how desertification has resulted in diverse population changes and responses. Factor analysis was used to analyze the trends in selected environmental and population change variables. A combination of climatic factors, general increase in population and livestock pressure on land and vegetation has been identified as the chief causes of desertification. Change in population as a result of in and out migration have been dramatic coupled with diverse adjustment responses demonstrated in the development of indigenous adaptation strategies such as woven stick construction around homes, mulching and indigenous tree plantings. Environmental changes have been momentous particularly in the case of reduced water body, disappearance of vegetation cover, shifting sand dunes, increasing bare grounds and loss of biodiversity. The paper recommends the incorporation of indigenous desert environmental knowledge into government environmental conservation Programs and the need for massive tree plantings in desert prone areas and Nigeria in general. Moreover, the Federal and State departments of forestry have to be empowered with adequate revenue for massive reforestation all over the nation. Discourage dependence on wood for local energy and alternatives such as kerosene be economically provided. List of suggested anti desertification tree species has been provided since sustainable environment is concomitant with stable population.*

Keywords*: Desertification, Population Dynamics, Population Response*.

I. Introduction

Concern about desertification is not entirely new. People have always been worried about the dwindling natural resource base as a result of continuous increase in population and natural resources exploitation. Today, the concern is still there and growing due to the devastating effects. (Adinna, 2001). We are now not only worried about dwindling resource base, but also agitated about different forms of environmental modification through different acts of human activities. These have produced such deleterious effects such as species extinction, accelerated erosion, pollutions, global warming, acid rains and genetic mutations. These new concerns are lucidly captured in great works of UNEP (1992); and Calestous and Ojwuang (1996). Neo-Malthusians have cautioned that we have already exploited planet earth beyond its carrying capacity and may well be heading towards the dooms day (Environmental Protection Agency, (EPA 1990). In Nigeria, and Africa in general, desertification has caused devastating long period of drought. Food situations in Africa have deteriorated seriously over last fifteen years. (Uyanga and Ekop, 2005). It is important to note that the utilization of forest resources by the rural people provides a great potential to the solution of rural poverty but at the same time constitute abuse and misuse leading to environmental degradation in the absence of regeneration programs. (Adebayo and Akindele, 2003) (Amadi,*et al* 2011). It is this kind of concern that gave rise to the establishment of anti-desertification projects such as the Centre for Arid Zone Studies in the University of Maiduguri in 1982 and the establishment of the Northeast Arid Zone Development Programme (NEAZDP) in Gashua in 1990. These projects were aimed at providing and developing necessary base line information to back up research in addressing the local ecological problems of desertification. The projects would encourage and stimulate appropriate and practical inputs in rural projects thereby encouraging self-sustaining rural development which will be in harmony with the farming and other land use practices. Thus, conservation and forest regeneration measures are inevitable for sustainable management of the environment since desertification is not only preventable, but reversible (UNEP1991, 1992). This is inevitable if man is to continue to live in safe, healthy and sustained environment.

II. Methods

The data collected for this study includes among others respondents' settlement area, their ages, marital status, educational background, household size, source and types of energy use, rate of tree planting/removal and population changes. The study area is made up of eighteen units administratively defined as "development areas". The main source of data was through questionnaire, field observations, interviews and focus group discussions directed to community and household heads, and some officials of North East Arid Zone Development Programme (NEAZDP). The questionnaires were developed in English language, translated by the research assistants into Hausa language and administered to respondents. (Table 1.) A total of 1,779 respondents, representing 5 percent of the total population were sampled. Observations were employed side by side with interviews and discussions and they covered issues such as indigenous adaptations, agricultural practices, water use, soil erosion sites, settlement pattern, rural to urban movement, and sand dune locations. Data on the climatic conditions were collected from the meteorological station at Nguru (Tables 2, and 3). Descriptive statistics were used to summarize the conditions obtained in various areas for several variables. Factor analysis was used to establish population dynamics and dimensions of response.

III. Results.

The sampled population constitute of 895 males and 884 females representing 50.1 and 49.9 percents of the total sample respectively (Table 4). The ratio of male and female population in the study area shows that both sexes are adaptable to the environment and are willing to continue to live in the area if the desertification condition could be ameliorated. 37 percent of the respondents are between the ages of 20 – 30 years, 35 percent are between 30 – 50 years of age. On the other hand, 19 percent of the are between the ages of 50 – 70 years while only 9 percent are 70 years and above. This shows that majority of the population are composed of the active age who are potential users of most natural resources. Hence it may be concluded that the active population age demand on natural resources had contributed to desertification. In Muguram , Kaska and Wachakal some respondents had lived there between 20 to 30 years. This shows that they have contributed much to the exploitation of the environmental resource for a long period. Their continued stay also indicates their love for their home environment. It is therefore certain that any environmental conservation effort will be locally welcomed and reduce migration drastically.

Environmental Change and Migration.

It was observed that some areas have sand dunes covering above 50,000 ha. (Fig 2) Sand dunes positively influence heat and dryness, producing infertile soil and therefore induce people to move. Out - migrations are highest in Machina, Bulanguwa, Wachakal and Balle (Table 5 and Fig.1). Population density varies from one locality to another. In 1991, Giedan Development Area had a population density of 26.9 persons per square kilometer. This figure increased to 36.9 in 2002 due to migration. Population Density of Nguru/Karasuwa Development Areas increased from 221.2 persons per kilometer in 1991 to 331.1 persons per kilometer over the same period. Yusufari had a population of 44,274 in 1991 increased to 55,617 in 1999 (an increase of 125.6%) The change in population density in these areas may be explained increase in birth rate and out migrations from Machina, Bulanguwa, Wachakal and Balle.Hence. Irag (1986) observed that in most developing countries, pregnancy and birth rates are high. In the same vein, Smith (2004) submitted that sub-Saharan Africa remains the region with the highest levels of fertility.

Factors of Response.

Factor analysis (varimax rotation) was adopted in the data analysis and it yielded a seven dimensional solution (Table 6) each with eigenvalue greater or above one. Commensalities associated with the variables were generally high. This indicated that the variables used in the study were appropriate and relevant. The seven dimensions which accounted for 83% of total variance in the original data could be seen as composite indicators defining the basic patterns of population response.

Factor 1 – Urbanization Dimension

This factor is clearly the most important, accounting for 36.7 percent of total variance in the data set. Of the 10 variables used, 5 had high positive loadings (Table 7). These include household size, population density, annual population growth, number of new settlements and change in population. Five out of the six variables had high positive values which indicates strength and importance, while percentage house hold had high but negative value on the factor. This indicates favorable but weak association. Therefore factor 1 suggests that "Urbanization Dimension" is responsible to desertification and environmental change.

Factor 2- Pressure Dimension

This factor with an eigenvalue of 3.70919 accounts for 14.3 percent of total variance in the data set (Table 8). It has high positive loadings on out migration and percentage household, and high negative loadings

on annual population growth, number of new settlements and change in population. Two variables – out migration and percentage house hold had high positive loadings, showing their importance, while the other three variables namely annual population growth, new settlements and change in population had high but negative loading. This shows that their presence were favorable but with weak association. Hence, there is obviously a "Pressure Dimension" capturing the push factors as population response to desertification.

Factor 3 – Policy Intervention Dimension

Four variables had high positive loading on this factor and accounted for 11.4 percent of total variance in the data set. (Table 9) These were average household size, desire for additional children, additional wives and percentage household. Again the high positive loadings of these variables indicates strength and importance Therefore factor 3 is accordingly the "Household Decision Dimension." The remaining five factors accounted for less than one quarter of the variance and were therefore not considered in the analysis. The spread of the loadings however suggest that they represent the "Policy Intervention Dimension."

IV. Conclusion

This paper discussed population dynamics and response to desertification. It was observed that sand dunes encourage the existence of heat and dryness of bare ground which propel population move out of the environmental hash areas to more favorable locations. These phenomena provide constraints to agricultural and pastoral activities. The infertile bare soil dotted with tufted grass are exposed to incessant winds making the development areas to be sparsely populated by vegetation to the detriment of few homely areas as they experience in-migration. The study has highlighted the imperatives of indigenous environmental management knowledge in arid land management, and also provided a framework for developing a better understanding of the nexus between the environmental changes, population response and environmental policy and management.

V. Recommendations

There should be a long term sustainable participatory environmental improvement and resources management program. The key area that needs to be given priority in desertification prone areas is the incorporation of indigenous desert environmental knowledge into government environmental conservation program. The Federal and State Departments of Forestry need to be empowered with adequate revenue for massive reforestation program. There is need to discourage dependence on wood for local energy while alternatives fuel such as kerosene be economically and readily provided.

VI. Tables and Figures

Table 1. Population in the sampled villages

Development Area	Population in clustered villages	Male	Female	Total household	Sampled household	Percentage
Balle	11,635	63	58	2327	116	4.98
Bulanguwa	11,034	54	56	2297	110	4.78
Dagona	10,277	56	51	2055	102	4.96
Dapchi	70,034	45	30	1406	80	5.68
Degeltura	7,882	44	39	1576	78	4.94
Dumburi	10,022	55	50	2004	100	4.99
Futchimiran	4,209	21	26	841	52	6.18
Gumsa	5,147	25	30	1029	61	5.92
Gwio kura	16,377	86	82	3275	163	4.97
Gorgoram	9,046	45	50	1809	100	5.52
Kanama	6,889	34	37	1377	69	5.01
Karasuwa	5,049	25	30	1009	60	5.94
Kaska	13,747	68	70	2749	137	4.98
Machina	13,081	65	70	2616	130	4.96
Muguram	10,905	58	54	2181	119	5.46
Yunusari	8,822	44	49	1764	95	5.39
Yusufari	11,089	56	61	2218	111	5.00
Wachakal	8,140	46	41	1628	96	5.90
Total	170,385	895	884	34077	1779	5.22

Source: National Population Commission (2001)

Table 2 Annual Rainfalls for Some Selected Towns in Sahel Region of Yobe State. (Mm)

	Year	J	F	M	A	M	J	J	A	S	O	N	D	Total	Mean
Nguru	1997				4	10.3	22.2	170.0	129.5	85.8	12.0			434.7	395.4
	1998				1	12.1	29.6	105.8	113.5	125.4	8.0			395.4	
	1999					12.1	45.5	97.6	137.9	63.6	8.0			364.7	
	2000					12.5	56.4	86.1	104.6	80.2	26.5			366.3	
	2001					28.6	44.7	108.4	181.4	49.2	3.6			415.9	
Kanama	1997					8.5	37.0	83.3	104.7	140.5	12.6			386.6	381.6
	1998					7.5	39.0	82.4	111.1	130.5	14.7			385.2	
	1999					5.9	41.1	87.5	120.4	131.7	12.4			380.9	
	2000					4.6	38.5	84.7	106	135.5	11.6			377.9	
	2001					1.2	40.6	80.0	115.4	127.7	12.5			377.4	
Geidam	1997					30.1	67.1	70.5	179.1	22.5	24.3			393.6	425.9
	1998				1.1	25.5	44.0	64.7	208.1	55.3	8.8			407.5	
	1999					16.8	25.1	321.2	211.5	69.0	15.8			659.4	
	2000					21.6	27.6	69.1	126.7	68.0	22.4			335.4	
	2001					18.6	24.5	72.4	130.1	78.2	10.1			333.9	
Machina	1997					11.5	36.5	99.9	168.5	136.0	17.0			469.4	467.7
	1998					18.0	36.1	159.9	168.0	131.0	16.0			528.2	
	1999					17.5	36.0	160.0	110.0	129.7	16.0			469.2	
	2000					17.1	48.5	168.0	115.0	73.7	16.5			438.8	
	2001					16.5	39.5	163.4	151.3	45.7	16.7			433.1	
Kaska	1997				8.2	17.8	20.0	104	150.4	38.1	6.0			250.9	346.2
	1998					17.0	35.5	174.1	107.2	38.2	8.7			380.7	
	1999					15.5	34.4	175.3	103.1	37.9	4.3			370.6	
	2000					15.7	35.4	174.0	101.5	35.1	8.0			369.7	
	2001					16.0	34.1	170.0	100.6	34.5	4.0			359.2	

Source NEAZDP Gashua.

Table 3 Annual Rainfall total for Nguru 1960 – 2001. (mm)

Year	Total	Year	Total
1960	514.09	1981	438.90
1961	608.60	1982	409.30
1962	440.70	1983	239.70
1963	647.40	1984	321.50
1964	536.20	1985	320.70
1965	563.80	1986	309.70
1966	460.8	1987	324.30
1967	517.40	1988	336.10
1968	489.20	1989	338.60
1969	390.70	1990	418.00
1970	533.40	1991	324.60
1971	460.50	1992	415.10
1972	247.60	1993	335.60
1973	258.90	1994	428.80
1974	601.80	1995	370.60
1975	558.30	1996	312.90
1976	430.00	1997	434.70
1977	509.00	1998	395.40
1978	496.00	1999	364.70
1979	587.80	2000	366.30
1980	339,60	2001	415.90

Source NEAZDP Gashua

Table 4. Characteristics of the population

Settlements	Sex		Length of Stay				Age				Religion		
	M	F	1-10	10-20	20+	Since Birth	20-30	30-50	50-70	70+	Islam	Christ	Trad
Muguram	55	54	37	28	22	22	30	47	20	12	100	9	0
Kaska	68	69	55	30	30	42	47	22	31	37	136	1	0
Wachakal	54	46	6	16	24	14	68	21	9	2	100	0	0
Yunusari	44	44	35	35	10	8	34	18	16	20	70	18	0
Yusufari	56	64	30	28	48	30	37	44	29	0	105	5	0
Bulangua	54	56	30	28	22	30	32	44	31	3	100	10	0
Dapchi	40	30	30	17	15	8	21	17	16	16	64	60	0
Dumburi	50	40	30	8	21	41	31	61	5	3	89	11	0
Gwio Kura	81	82	40	51	27	45	63	72	23	5	160	3	0
Kanama	34	35	35	10	14	10	27	24	18	0	54	15	0

Source Field Data

Table 5 Migrations into and out of the study area.

	In Migration	Out Migration
Balle	12	150
Bulanguwa	54	56
Dagona	13	59
Dapchi	30	40
Degeltura	10	6
Dumburi	40	60
Futchimiran	9	38
Gumsa	8	36
Gwio Kura	81	82
Gongoram	6	37
Kanama	25	44
Karasuwa	3	123
Kaska	76	61
Machina	11	140
Muguram	53	56
Yunusari	36	52
Yusufari	43	67
Wachakal	48	5
TOTAL	558	1154

Source Field Work 2002.

Table 6 Rotated Factor Matrix

	FACTOR LOADINGS							
Variable	1	2	3	4	5	6	7	Communality
Y_1	-.29785	0.91389	0.39420	0.2748	-0.11955	.16370	.23683	.087071
Y_2	.32929	0.19892	0.44507	0.09305	0.09345	-.01241	.12199	.72303
Y_3	.68890	0.35723	0.85171	0.26615	0.00033	.00550	.17818	.82851
Y_4	.12996	-.11126	0.58584	0.24048	0.06462	.02720	-.03790	.65607
Y_5	-.42658	0.02150	0.56094	0.07467	-0.12391	.12076	.26484	.80576
Y_6	-.85413	0.68727	0.54467	0.27296	-0.06063	.07694	-.18973	.91712
Y_7	.86827	0.08950	0.16184	0.14049	0.21462	.05712	-.16323	.88380
Y_8	.92934	-.80545	0.17329	0.15246	0.09766	.02278	-.03193	.92801
Y_9	.73948	-.86543	0.32582	0.03807	-0.07843	.0409	.00204	.88276
Y_{10}	.94000	-.60722	-.30881.	0.10069	0.31795	-.07194	-.09507	.93001
Eigenvalue	9.53931	3.70919	2.96268	1.10760	1.31645	1.22648	1.06547	
% Variance	96.7	14.3	11.4	6.6	5.1	4.7	4.1	
Commulative Percent.	36.7	51.0	62.4	68.9	74.0	78.7	82.8	

Source Data Analysis.

Table 7 Significant Variable Loadings on Factor 1

Factor Code	Variable	Rotated Loadings
Y3	House hold Size	0.68890
Y6	Percentage House hold	-0.85413
Y7	Population Density	0.86827
Y8	Annual Population Growth	0.92934
Y9	New Settlemnets	0.73948
Y10	Change in Population	0,94000

Source: Data Analysis

Table 8 Significant Factor Loadings for Factor 11

Code	Variable	Rotated Loadings
Y1	Out migration	0.91389
Y6	Percentage House hold	0.68727
Y8	Annual Population Growth	-0.80545
Y9	New Settlements	-0.6543
Y10	Change in Population	-0.60722

Source: Data Analysis

Table 9 Significant Variable Loadings on Factor 3

Code	Variable	Rotated Loadings
Y3	House hold Size	0.85171
Y4	Desire for Children	0.58584
Y5	Desire for Wives	0.56094
Y6	Percentage Household	0.54467

Interesting anti-desertification plants

Acacia species: acacia
Acca sellowiana : feijao, pineapple guava
Agave Americana: century plant
Amaranthus spp.: amaranth
Annona cherimola : cherimoya
Annona muricata : guanabana, soursop, graviola
Asimina triloba : pawpaw
Caragana microphylla : littleleaf peashrub
Caryopteris x clandonensis : Blue beard / Blue mist
Cleome gynandra : African cabbage, cat's whiskers
Crocus sativus : saffron crocus
Cydonia oblonga : quice, membrillo
Cyphomandra betacea : tomato tree
Dacryodes edulis : safou or butterfruit
Garcinia lmivingstonei : imbe
Gleditsia triacanthos : honey locust
Hippophae rhamnoides : sea buckthorn
Hylocereus undatus : dragonfruit
INTA Sequia common bean
Ipomoea batatas : sweet potato
Irvingia gabonensis : Dika tree
Jatropha curcas : Barbados nut, Physic nut
Linum usitatissimum : Flax
Lupinus luteus, L. hispanicus and *L. cosentinii*: lupins
Mesembryanthemum acinaciforme : Fig-Marigold, Giant Pigface, Hottentot Fig
Moringa oleifera: Moringa
Morus spp. : mulberry
Oenothera speciosa: Mexican evening primrose (invasive ground cover)
Opuntia ficus-indica: prickly pear cactus
Oxytenanthera abyssinica: drought-resistant bamboo
Panicum virgatum : switchgrass
Portulacaria afra : spekboom, elephant bush
Prosopis cineraria
Rheum palaestinum: Desert rhubarb
Ricinus communis: castor plant
Sesamum indicum – sesame
Sclerocarya birrea: marula
Sesbania rostrata
Sesbania sesban
Simmondsia chinensis: jojoba
Solanum scabrum: African nightshade
Strychnos spinosa: monkey orange
Tephrosia candida
Tylosema esculentum: marama
Vitex agnus-castus: chaste tree

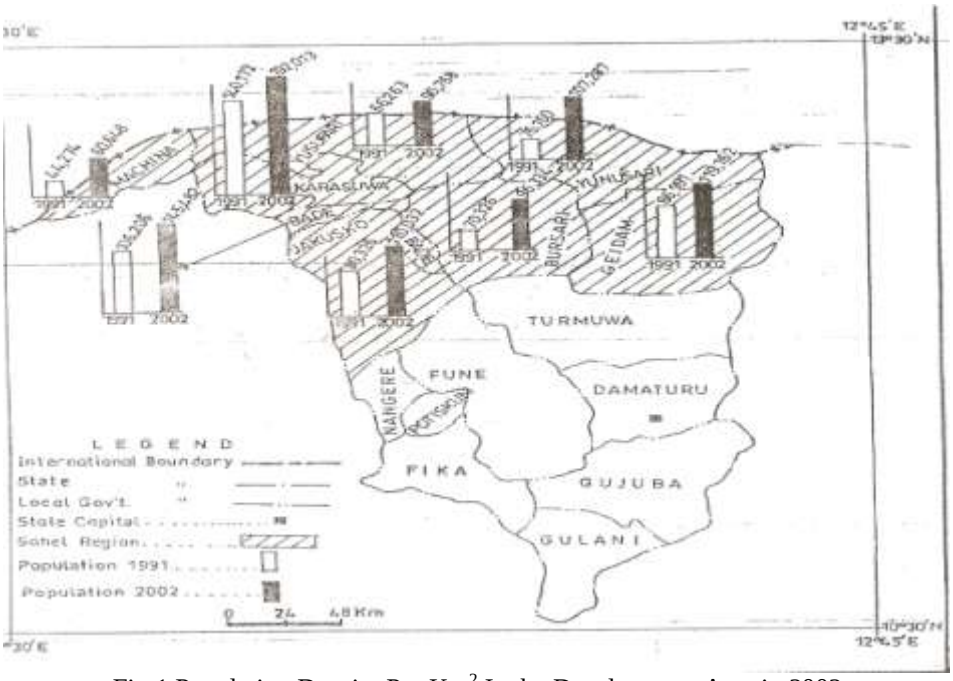

Fig 1 Population Density Per Km^2 In the Development Area in 2002

Fig. 2 Extensive Bare Ground North-East of Tulo-Tulo Village, Yusufari L.G.A., Yobe State

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