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ORDER IN THE ENVIRONMENT

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BY

O. ADEGBOLA



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ORDER IN THE ENVIRONMENT

An Inaugural Lecture delivered at the University
of Lagos on Wednesday, June 12, 1991

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Geography: A Prologue

I WILL like to preface this address with a short comment on the subject of Geography. The image many people have of Geography was gained in their primary and secondary schools where they knew it as the subject which describes the earth's surface - the form and distribution of its physical features, climate, vegetation, soils, products and people (Stamp, 1966). That description of the subject belongs to the pre-Second World War period. The subject has since undergone a revolution which has expanded its subject matter and methodology and changed its objective. Geographical endeavour now embraces spatial structure, process and interaction, as well as formulation and empirical verification of theories explaining complex spatial behaviour and organisation (Harvey, 1969).

To handle these new concerns, the subject has had to accommodate, in addition to cartographic skills, analytic and quantitative techniques, modelling, remote sensing and geographic information system. The objective is to seek theoretical explanation of an increasingly higher order of efficiency for the intricate and complex pattern of spatial phenomena (Haggett, 1965).

All these changes have made Geography relevant not only to environmental issues but also to issues of social and economic policy. In Geography, all these issues are interwoven. Since man depends on the resources of the environment for survival, his social and economic activities have impacts on the environment just as the environment influences the type of activities he undertakes. According to Hawley (1973), environment is a generic concept for whatever is external to and potentially influential upon the unit under study. The environment of a population is different from that of an individual and from that of a set of populations. Thus, the act of defining refers one back to the thing environed. That thing varies from subject to subject.

From the point of view of Geography, that thing is a population which is organised or is in the process of organisation in space. The physical side of the subject is concerned with how the physical features of the earth and the natural conditions such as air, water and land affect, and are in turn, affected by the population. Human geography is concerned with demonstrating that classes of events are instances of widely applicable laws and theories and that the thickening web of exchange relations that has spread across the world, has created a social environment between each local population and the physical environment. This branch of the subject applies explanatory techniques to classes of experience which are related to locations of people and their activities within given environments. In that setting, Human Geography deals with issues of direct social relevance to the society. In no other branch of the subject is this feature of human geography more clearly brought out than population issues, which have been of major research interest to me for nearly two decades.

It is against this background that, as the first Dean of the Faculty of Environmental Sciences, I have chosen for this lecture a topic which not only links man to the resource environment but also has direct social relevance for our country today. The topic is Order in the Environment

ORDER IN THE ENVIRONMENT

Introduction

IT WAS Alexander Pope, the great eighteenth century English writer, who said: "Order is heaven's first law." It should also be the first law in any society whose members want to live a useful and purposeful life. By "order" is meant the conditions in which rules are obeyed by most of the people, and the government or the persons in charge can keep control. The rules are set to regulate the behaviour of human communities in their endeavour to perform their persistent task of life, come to terms with nature for sustenance and survival and organise their group life. Adherence to the rules ensures that things and people are in their proper places at the appropriate time, and that people perform their duties effectively and efficiently with minimum effort and obtain maximum output. Disobedience to the rules causes confusion which leads to dissipation of energy.

Thus defined, it seems that while we in Nigeria have striven hard to maintain the law, order, the very first law, has either eluded us or has broken down almost irretrievably. This break-down of order is writ large in every facet of Nigerian life. There is chaos in the medical and educational systems, disorder at bus-stops and markets, overcrowding in houses and congestion in cities.

Things were not this bad before. Members of my own generation and those of the generations older than mine may recall how easy it was to live and function effectively in the years past. We were able to maintain that order partly because our needs and demands were adequately met by the resource environment. My thesis in this lecture, therefore, is that the disorderliness we now encounter everywhere is brought about by excessively high rate of population growth vis-a-vis declining resource environment.

But are Nigerians really too numerous for the Nigerian environment? In other words, have Nigerians reached the limits imposed by their environment on the growth of their numbers? If the limit has not been reached, why do we have disorder almost everywhere? If it has been reached (and even surpassed), is this "excess" population the cause of the present "disorder"? What can be done to return the balance between population and the resource environment if order is to be returned to our environment?

These are difficult questions to answer in a country like Nigeria where data on both the number of people who inhabit the country and the resources of the environment are either non-existent or inadequate. What I therefore propose to do in this lecture is to present, as it were, a broad-brush picture of the state of the knowledge on the resource environment - population relationship and attempt an examination of how the balance or imbalance of this relationship has contributed to a breakdown of order. Particular attention will be paid to agricultural land resources, not only because food is the most critical need of Nigerians, but also, because the rural areas where a large proportion of Nigerians live are targets of attention by the government and, in consequence, have acquired some importance in the activities of the present administration.

Some Theoretical Underpinnings

In developing the theme of this lecture, it is necessary from the outset to define some conceptual framework for our discussion. At least three concepts bear relevance to population-resource relationship. The first is that of "carrying capacity." The concept is used by professional ecologists who draw on animal population analogies (autoregulation, ecological niche) and use notions such as "collective unconscious rationality" or "invisible hand" mechanism to account for functional adaptation of population to its environment (Allee *et al*, 1955; Margalef, 1968.)

These ecologists insist that the population of any species in a given environment is always in a state of

entropy. Although the species may attain a maximum feasible size under given environmental conditions, the equilibrium is easily disturbed by temporary shortage of food supply, a condition which may be brought about by the vagaries of weather or an influx of more members of the species into the territory to compete for food and space. As pointed out by Demeny (1989), the "predator-prey interactions may lead to long-term stabilisation of an animal population's size at a level of maximum sustainable capacity, or carrying capacity proper".

In extending the concept to human population, the early ecologists err in treating man as a species, as an aggregate of homogeneous individuals rather than as a highly differentiated and organized population. Thus, Garrett Hardin (1968) thinks of human population in a simple-minded analogy with grazing animals in a fenced pasture. He measures current population trends against "foreseeable technology" by which he means unchanging technology.

The viewpoint shows lack of understanding of the effects of social and economic structures on the man-environment relationship. Paul Ehrlich (1986) tried in vain to correct the error. He defines carrying capacity as "the maximum number of individuals that can be supported by a given habitat; it is usually related to the availability of a limiting resource, one that is in short supply in relation to the population".

This definition is Malthusian in cast, directing, as it were, attention to the critical role of limitational factors. The carrying capacity concept thus shares the weaknesses of the Malthusian conceptualisation of man-environment relationship. In the first place, the Malthusian theory has been informed by neither historical perspective nor a competent assessment of the existing informational and institutional resources for change. History tells us that per capita food consumption improved in Europe towards the end of the 19th century, in spite of a population increase both because yield per acre had gradually increased and because food, mainly cereal, was imported in large quantity

from land-rich Eastern Europe and Europe Overseas as well as from parts of Asia (Clark, 1967). Secondly, discovery and technological change, together with substitution at producer and consumer levels, greatly augmented both the visible and the immediate potential stock of sources of natural resources (Spengler, 1945). The implication of technological change is that population is no longer the only factor which can be manipulated to demonstrate concern with limits imposed by a finite environment. With new technology, the environment, to some extent, is not as absolutely finite as the Malthusian model puts it. Man can and does convert parameters of state such as climate and topography within the environment into variables (Thomas, 1962). There is no doubt that some negative by-products such as denudation, accompany the modification of the environment by man; but the important point to emphasise is that both the increase in number of people and the dynamic nature of the environment should be taken into consideration when relating population to the environment.

The second concept is that of the critical density of population (CDP) defined by William Allan (1965) as "the human carrying capacity in an area in relation to a given land-use system, expressed in terms of population per square mile; it is the maximum population density which a system is capable of supporting permanently in that environment without damage to the land". The CDP is culture-bound; being, as it were, a function of both the population (its distribution, quality and rate of change), and its culture (methods and systems of land use, the tools employed, the crops grown and the physical-soil, climate, terrain - as well as the socio-economic conditions of an area). Thus, the concept is dependent on a combination of the factors governing man's use of the resources of the land, rather than on any one of them individually. It is possible that at any particular time, one of the factors may predominate.

The third theory that links population and resource is the concept of optimum population, explicitly stated by J.S. Mill in 1848. He wrote, "After a degree of density has been attained, sufficient to allow the principal benefits of combination of labour, all further increase

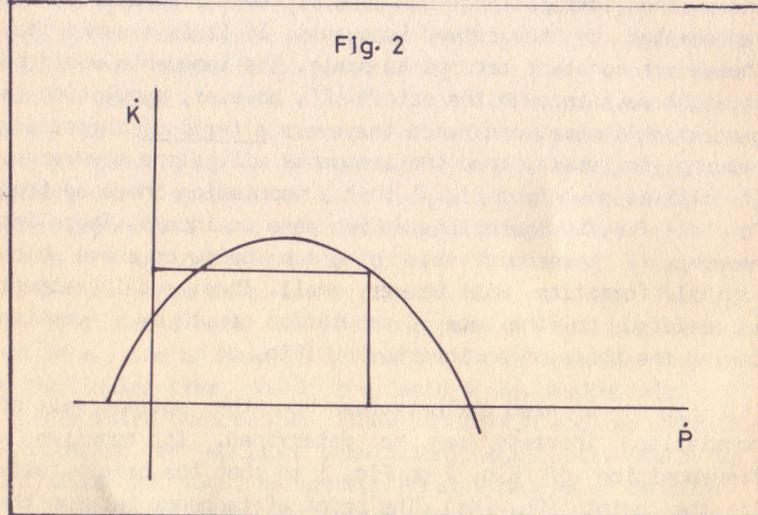
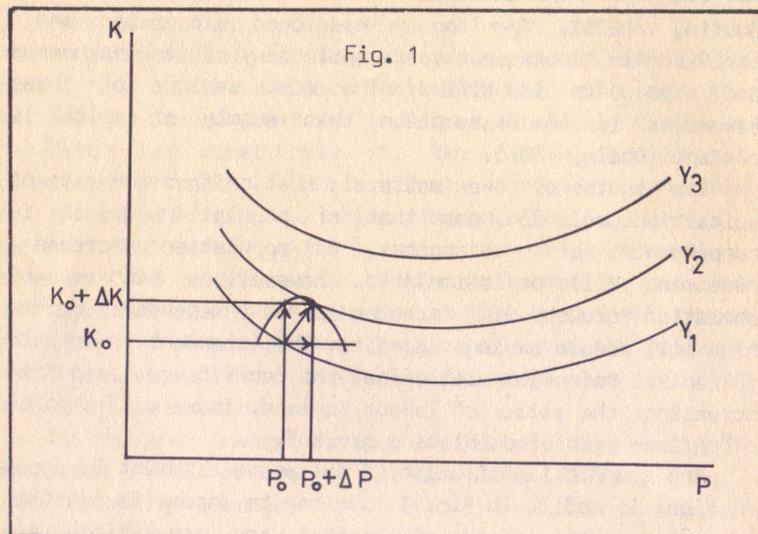
tends in itself to mischief, as regards the average condition of the people". Similar sentiments were expressed 78 years later by A. B. Wolfe who declared that the population that permitted the largest permanently practicable per capita product would be optimum size (Dublin, 1926). The theory has been elaborated and clarified in subsequent years while many of its weaknesses have also been identified. The most serious of these weaknesses is the assumption that supply of capital is constant (Ohlin, 1967).

The truth of the matter is that neither the rate of capital accumulation nor that of population growth is independent of one another. As population increases, investment will be stimulated. However, a high rate of population growth will produce a heavy dependency burden which will reduce savings capacity: The attendant lower rate of capital formation will offset the benefits realised from increasing the ratio of labour to land. There will then be an "optimal rate of population growth".

The graphic illustration of the above argument is shown in Figs 1 and 2. In Fig. 1, per capita income is constant and the combinations of capital and populations are represented by the curved isoquants. If it is assumed that there are constant returns to scale, the isoquants would be straight rays through the origin. If, however, population is generating income, and hence there are a fortiori increasing returns to scale, then the isoquants will slope downwards. It will be seen from Fig. 1 that a population increase from P_0 to $P_0 + \Delta P$ generates an increase in income. There is, however, a threshold rate of growth below or above which capital formation will be very small. Thus, net investment is related to the rate of population growth by a function taking the shape of an inverted U (Fig. 2)

Fig 2 also illustrates how the optimal rate of population increase can be determined. It requires a transposition of Fig. 2 on Fig. 1 so that the origin falls in the point (P_0, K_0) . The point of tangency between the transposed curve and a new isoquant is the highest possible increase in per capita income in a short period of time. A progressive shortening of the time period will make the

slope of the new isoquant, at the point of tangency approximate the slope of the original isoquant at the point of departure. The optimal rate is, thus, that rate of increase at which the slope of the curve in Fig. 2 is equal to the slope of the isoquant at (P_0, K_0) .



The three theories have the same objective, which is to demonstrate that, given the level of technology of a country, the welfare of the citizens of that country is a function of both the size of the population and the size of its resources. If the population grows faster than the available resources, the welfare of the people will decline. They are therefore complementary to one another and various aspects of their formulations will be made use of in my discussion. The different routes they choose to achieve their common objective make them lay different emphasis on different aspects of the variables used. While the CDP and carrying capacity concepts rely on total population, the notion of optimum population has been extended to include population growth. Emphasis today is placed on the broader question: Is additional population growth advantageous? Will it elevate or reduce the rate of growth of per capita income with which other indicators of welfare are highly correlated? Will it contract or extend the range of choice? In other words, the real problem is not so much the size, but the excessive rate of growth of the population which throws out of gear, the population-resources balance and impedes the process of modernisation and development. It is to the growth of population in Nigeria that attention is now turned.

The Growth of Population in Nigeria

An understanding of the process by which some 16 million mainly rural dwellers 80 years ago became 113 million residents of cities, towns and villages today is essential for an evaluation of both the present circumstances of the population that in part cause the chaos in our daily life, and the future prospects of the population. But any numerical description of the development of the Nigerian population cannot be totally free from errors, simply because there has never been an accurate census in the country. The nature of these errors gives rise to different figures computed by experts using various assumptions (Adegbola, 1981, 1984). These figures are usually different from figures given by the various government statisticians.

Since the first of these official figures to cover the whole country was given in 1911, the tracing of the history of population growth in Nigeria is meaningful from that year. The pattern of growth divides itself naturally into two periods, the point of division being 1931 (Table 1). In the two decades 1911-1931, the total growth was less than 25 per cent, or an average of about 1.1 per cent per annum.

Table 1

Rate of Population Growth

	Population (in thousand)	Absolute Increase (percentage)	Average Annual Growth Rate
1911	16054		
1921	18720	16.6	1.5
1931	20056	7.1	0.7
1952	30402	51.6	2.0
1963	55670	83.1	5.5

Source: Adegbola, O. (1980)

The slow growth rate in the period 1911-1921 is attributable to such disastrous circumstances as the 1914 - 18 War, the great influenza epidemic which broke out soon after the war and the post-war slump in trade. The retardation of population growth in the next decade was brought about by both the bubonic plague pandemic of 1925 - 26, which was especially severe in Nigeria, and the general world economic depression which resulted in the fall in prices of Nigerian exports.

After the Second World War, the growth of the population accelerated somewhat. The 20 million of 1931 was, by 1952, about 30.4 million. This increase represents an annual growth rate of 2.0 per cent or an absolute increase of 51.6 per cent over the 21-year period. From 1952 to 1963 the population increased by about 25.2 million to some 55.7 million, yielding a growth rate of 5.5 per cent per annum. It was at this time that the extraordinary modern acceleration of population growth began.

The National Population Commission (NPC) assumes that population has been growing at an annual rate of 2.5 per cent since 1963 and will continue at that rate till the year 2000. This assumed rate is just about half the figure obtained by the 1952 and 1963 Census results. It is also at variance with the United Nations estimate of 3.5 per cent per annum for the period 1980 - 2000 (UN, 1984). In a 1981 article, strong evidences were advanced to show that the basis of NPC estimation was faulty (Adegbola, 1981). A rate of 3.2 per cent computed in that article for the period 1980 - 2000 is closer to the UN estimate made recently. This difference in the assumed rate of growth dictates caution in assessing the population-resource relationship. What shall be done in the remaining part of the lecture is to treat the United Nations figure as the higher estimate and the NPC figure as the lower estimate, called high and low variants respectively. On this basis, the population of Nigeria would double in about 19.8 to 27.7 years.

Any of these doubling times is shorter than what has gone before, except the period 1952 - 1963. The cumulative effect of a small number of doublings is a surprise to common sense. One well-known illustration of this phenomenon is the legend of the king who offered his daughter in marriage to anyone who could supply a grain of corn for the first square of a draught board, two grains for the second square and so on. To comply with this request for all 100 squares would require a mountain of grain many times larger than today's worldwide production of corn.

In accordance with the same law of geometric progression, the Nigerian population has reached its present size of between 113 million and 119 million (NPC and UN

estimates) through comparatively few doublings. If we accept the 1911 census figure as a rough estimate, then the population of the country has doubled only three times, or an average of about once every 27 years. At the current rate of growth (3.5%) the present population of 119 million will double in the year 2,011, that is 20 years hence.

Determinant of Population Growth

What has unleashed this extraordinary demographic acceleration in the country has been a rather sudden and continued drop in mortality especially after World War II. Crude death rates are influenced by the age structure, and mortality is therefore measured by the average age at death or the average duration of life which is expressed as the expectation of life at birth. As shown in Table 2, life expectancy has risen from 31 years to 50 years between 1931 and 1982.

Table 2
Basic Demographic Indicators

	Life Expectancy (years)	Total Fertility Rate	Infant Mortality Rate (per thousand)
1931	31	6.56	
1952	35	6.56	
1963	40	6.56	
1965	40	6.36	128.7
1971	41	6.35	
1983	50	6.34	113.0

Source: Adegbola, O. and Ayeni, O. (1985)

Although this increase is modest when compared with such developing countries as Mexico, Columbia and Sri Lanka, it is substantial compared with the increase in life expectancy in Europe between the 18th and 19th centuries. Indeed, the country has telescoped into half a century, a development that took a century and a half to achieve in the West.

The improvement in life expectancy was accounted for partly by basic economic improvement and partly by public health programmes. There is some evidence to show that improvement in living standard and in nutrition, brought about by more efficient and regular distribution of food, might have accounted for some decline in infant mortality. The decline in mortality has been more uniform than the gain in prosperity. In the decade 1961 to 1970, the per capita GDP growth rate was only one per cent per annum. During the same period, life expectancy rose from 39 years to 41 years, a gain of only 2 years or 2.4 months per year. In the next decade (1971 - 79), per capita GDP grew at the rate of 2.6 per annum while life expectancy rose by seven years or 8.4 months per annum. By contrast, the negative per capita growth rate (-6.5) between 1980 and 1984 resulted in only a gain of one year in life expectancy during the period or about 2.4 months in one year.

Information on Lagos shows that the major public health programmes were connected with vaccination, antimalaria measures, water supply and sewage disposal. Vaccination against small-pox was made obligatory in Lagos in the period following the Second World War. Nearly all school children were vaccinated, and vaccination centres were set up in various wards for the people to be immunized. The anti-mosquito operations which commenced in Lagos at the beginning of the century were intensified after the war with the reclamation of swamps in Apapa, Victoria Island and various parts of the mainland. The Iju Water-works, completed in 1915, provided adequate water supply for the city until the mid-1960's. The piped water considerably reduced the incidence of dysentery and guinea worm diseases (Adegbola & Chojnacka, 1984). The maintenance of a clean environment was ensured by the Health or Sanitary Inspectors

who enforced proper sewage disposal as well as other health laws.

The measures in Lagos were operated in varying degrees in other parts of the country, especially after the civil war when a strong Federal Government began to emerge. Thus, the National Malaria Control Programme launched in 1975 by the Federal Government had as its activities, the spraying of insecticide for vector control and the prophylactic use of chloroquine among school children and pregnant women throughout the country. Also, the EPI, ORT and primary health care programmes were national and directed by the Federal Government. The sinking of new wells and repairing of old ones to provide adequate water supply were undertaken nationwide by the Directorate of Food, Roads and Rural Infrastructure (DFRRI). A monthly environmental sanitation day is observed throughout the Federation. The success being recorded in all these programmes shows that there remains a considerable margin for further improvement in life expectancy (Adegbola, 1987).

The decline in mortality has been accompanied by constant fertility. Total Fertility Rate (TFR) remained at an uncomfortably high level of 6.56 between 1931 and 1963 (Adegbola, 1985). The rate declined slightly to 6.36 in 1966 and thereafter has been oscillating between 6.34 and 6.35. The Nigeria Fertility Survey conducted in 1981/82 reveals that the TFR for all surveyed women was 6.34 and the ever-married women 7.48. If the rate computed by the Population Reference Bureau of Washington is anything to go by, fertility has been increasing since the mid-80's, for the TFR given for 1990 by the Bureau is 6.50.

For the immediate future, fertility is likely to remain constant. A study currently being conducted by Adegbola shows that many women express preference for late marriage and few children (about 4) because of the economic situation in the country. That attitude to child-bearing encourages the assumption that the country is poised for a crisis-led demographic transition. But this prospect of the economic crisis being an effective contraceptive is offset by fear of rising infant and childhood mortality. A very large proportion of the same group of women believe that the economic

crisis has adverse effect on mortality and express the desire to have many babies to be sure that at least four survive. Indeed, as will be shown later in the lecture, several indicators point in the direction of constant, if not rising, fertility.

The picture that emerges from falling mortality rates plus constant or increasing fertility rates given above is a continuation of population growth in the immediate future. The question that readily comes to mind is whether or not the country has the resources to shoulder the burden to be imposed on it by this growth.

The Debate on the Extent of Nigerian Natural Resources

Although there is as yet no comprehensive inventory of the resources of the country, opinions differ as to the state of our resources. There are the "pessimists", who readily identify a population-resources problem in the country. They argue that the claim of some Nigerians that the country has abundant natural resources is at best an exaggeration and at worst a myth. They intimate us with impending resource scarcities relative to population size and insist that population growth must be reduced to avert the impending catastrophe. The position of the "pessimists" is best illustrated by the growth of water hyacinth.

Suppose there is a lake in which a water hyacinth is growing in a geometric progression every day. If the hyacinth were allowed to grow unchecked, it would completely cover the lake in 30 days, choking off the other forms of life in the water. For a long time, the hyacinth seemed small, and so no attempt was made to cut it back until it covered half of the lake. That date would be the 29th day, when there was only one day left to save the lake. The Nigerian nation, like the lake, may already be at least half full. The burgeoning population has crept into the country in a stealthy, surreptitious and imperceptible manner like a thief in the night without the faintest indication that most people in the country are yet aware that the Nigerian lake could fill up entirely within the next generation. This lack of awareness will make it difficult for us to adjust our

lifestyles and reproductive habits before the doomsday.

By contrast, there are the "optimists" who find no population-resources problem in the country. To them, Nigeria is blessed with abundant resources crying for exploitation by its human resources. These resources include energy, non-fuel minerals and agricultural products - the three types of resources often considered as playing a limiting role to population growth. Compared with the resources, so their argument goes, the population is relatively scarce. There is enough vast hospitable land to accommodate several billion additional Nigerians and a lot of land left over for agriculture, industry, recreation and other purposes.

But how abundant are the resources? A partial answer to this question is provided in Table 3 in which the mineral reserves, both proved and indicated are recorded. The largest reserves of 7.1 billion metric tons were recorded for petroleum while the smallest reserves were for cassiterite and columbite which had only 143,525 and 45,475 tonnes respectively.

Table 3
Mineral Reserves, Proved and Indicated
(in million tonnes, except otherwise stated)

	Reserve	Date of Estimate
Crude petroleum	7,100	1975
Iron ore	476.5	1981
Coal	244.8	1981
Cassiterite	0.144	1973
Columbite	0.045	1973
Natural gas	10 trillion ft ³	

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Sources: 1. Federal Ministry of Mines and Power (1983)
2. Gulf Oil Co. (Nig) Ltd. (1975)

However, Table 3 does not tell the whole story; for, it does not indicate what proportion of the reserve can be extracted for future use. It is difficult to foresee readily the discovery of new techniques of extraction that will make the currently inaccessible reserve become economical to extract. As the current technique of exploitation makes the reserves inaccessible, attention has to turn to new sources or to substitution of either alternative raw materials or other industrial processes which change the demand away from the raw material we are considering. Thus, in addition to the stock of resources, the production of the resources, a process which reflects the level of technology at any given time, should also be taken into account when assessing the extent to which resources constitute a limiting factor to population growth.

Limits to Growth

Let us now examine whether or not the rate of population growth is leading us to run out of the three types of resources indicated above, namely, fuel, non-fuel metals and agricultural production (food). The stock of the existing energy resources seems to indicate that the overall supply of the resources may not pose a problem for many generations to come. The primary energy consumed in 1989 totalled 22.4 million tons of coal equivalent (tce) and represented a per capita consumption of 0.210 tce. The per capita consumption for previous years ranges from .198 tce in 1985 through .203 tce in 1987 to .246 tce in 1989. It is therefore possible that the per capita consumption in subsequent years may not change much. But, let us make the following assumptions:

- (i) rapid industrialisation will bring about a five-fold increase in per capita energy consumption by the year 2,000 (to 1.05 tce per year per capita);
- ii) the population of the country will grow at the low variant rate of 2.5% per annum to bring the total population to 142 million by 2,000;

- (iii) The country operates a closed economy
- (iv) renewable energy sources such as hydro-electric or geothermal and solar-electric energy are not used in the country.

Given these conditions, fossil fuel reserves in the country will last another 129 years.

This period of time, though long, is not at all comforting. In the first place, it is far less than the 280 years which **Revelle** (1982) claimed would take the energy resources of the world to be exhausted. Yet, **Revelle's** assumptions are more liberal than the assumptions made above. For example, he assumes per capita energy consumption in the developing world by 2025 to be twice per year a levelling off of consumption in the developed countries and a total world population of 8.2 billion, also by 2025.

In the second place, some of the assumptions are unrealistic and a relaxation of them will have serious effects on the results of the computation. For example, the Nigerian economy is not a closed one. A large percentage of the fossil fuel is exported. In 1989, for example, 84 per cent of the 626.456 million barrels of crude oil produced in the country was exported. The percentage of crude oil deliveries for domestic consumption has been declining over the years. It was 18.7 per cent in 1984 and 15.7 in 1985. It is expected that as oil becomes more and more expensive, Nigerians will be forced to utilise it much more sparingly. Therefore, a more realistic calculation should be based on production and not on consumption. If it is assumed that production of crude oil will level off at 700 million barrels a year and that the productive capacity of the wells will remain the same, then, the current proven reserves may not last more than 57 years! In other words, relaxation of the various assumptions above will shorten the lifespan of the energy resources in the country.

A relaxation of the last assumption is likely to have the opposite counter-balancing effect. But even if vastly large quantities of energy resources are available for several generations hence, the following example shows that

it will be to the advantage of the country to slow down the rate of population growth. Total primary energy consumption in the country grew from 13,761,293 tce in 1979 to 22,436,357 tce in 1989. Total population during the same period (using the low variant rate) grew from 82.926 million to 104.339 million. Thus, the 63 per cent total increase in energy use can be decomposed as the combined result of a 26 per cent increase in population and a 37 per cent increase in energy use per capita. If per capita energy use had increased as it did, but population size had remained constant, total energy use would have grown not by 8,675,064 tce but by 5,086,377 tce only. In other words, 41 per cent of the net increase of energy use was generated by population growth. The proportion would have been higher, had the high variant rate of population growth been used.

The range of non-fuel minerals available in Nigeria at present is limited, contrary to the claims of the 'optimists' that Nigeria is endowed with unlimited natural resources. A number of minerals they claim Nigeria possesses, do not occur in sufficient quantity to place the country high on a list of producers. Only five non-fuel minerals are available in commercial quantities and classified in official publications as principal minerals. They are iron ore, cassiterite, columbite, limestone and marble. While reserves estimates are available for three of them and are given in Table 3, estimates are not available for limestone and marble. The estimates for the first three are on the high side because "speculative" or "indicated" resource estimates are included. The largest reserves of 476.5 million tonnes were recorded for iron ore, the iron content of which varies between 40 and 50 per cent.

There are both internal and external demands for these minerals. The iron and steel mills in the country form the market for the iron ore, cassiterite and limestone; the building and cement industries demand limestone and marble. Cassiterite and columbite are exported and are affected by instability in international tin market. For example, the glut in international tin market in 1985 reduced demand for cassiterite.

products, not only to make up for the shortfall in domestic production, but also to combat inflation which the shortfall had unleashed. In the period 1970 - 80, the value of food imports increased by a factor of 20, with food imports amounting to 25 per cent of the total import bill by 1983 (Andrae and Beckman, 1985). Between 1974 and 1982 food import rose from 389,000 tonnes to 2.28 million tonnes, an increase of nearly 500 per cent. Indeed, by 1980 the paradox had been reached whereby Nigeria was simultaneously Africa's largest food producer and largest food importer.

Yet, the food crisis cannot be attributed solely to neglect or indifference on the part of the government. As the various National Development Plans show, infinitely much larger investment was poured into the rural areas of the country in the post-colonial period than during the colonial era. In the Second Plan (1970 - 74), 12.9 per cent of the total ₦2.05 billion public sector capital investment was allocated to agriculture including livestock, forestry and fishing. Although the proportion of the total ₦32.85 billion public sector capital investment allocated to the sector in the 1975 - 80 plan was only 6.6 per cent, the absolute value of the allocation far exceeded that made to the sector in the 1970 - 74 plan. In the 1981 - 85 plan, 12.6 per cent of the ₦70.28 billion investment was allocated to the development of rural areas.

The investments went into the following projects aimed at inducing changes in the rural areas and at sustaining increased agricultural production:

1. setting up of farm settlements;
2. establishment of plantations and export-crop processing plants;
3. sponsoring of agricultural research, training and extension services;
4. granting of subsidised credits to farmers;

5. maintenance of such agencies as the River Basin Development Authorities and the Directorate of Food, Roads and Rural Infrastructure (DFRRI) (By September 1990, the Directorate had disbursed ₦16.97 million to the states in support of its food and agricultural programme);
6. execution of such programmes as National Accelerated Food Production Programme, Operation Feed the Nation and the Green Revolution;
7. provision of fertilisers at heavily subsidised prices;
8. sponsoring large-scale irrigation schemes;
9. funding of World Bank-assisted Integrated Agricultural Development Projects (IADP's); and
10. undertaking numerous other rural development projects.

The Nigerian State did not just stop at investing in agricultural and rural development. It went further to ban the importation of cereals, particularly wheat and rice, in the belief that Nigerian commercial food production would accelerate, especially as the rises in food prices during the early 1980's had provided a powerful incentive to the commercial expansion of agriculture. The ban on wheat took effect from January 1987. The government has not rescinded the ban despite strong internal and external pressures. Internally, Nigerian millers, bakers, politically powerful cereal importers who profited from the trade, and vocal and overprotected urban industrial labour force who found imported cereals cheaper than the locally produced ones, all had vested interest in maintaining the ever-increasing volume of food imports and therefore continue, up till today, to lobby government to lift the ban.

The strongest external pressure is that put up by the largest wheat exporter to Nigeria, the US, which sees the

measure as going against liberalisation of trade. As far back as 1964, the US Department of Agriculture (USDA) had claimed that there was no possibility of wheat being produced in Nigeria under competitive conditions (USDA, 1964). According to Andrae and Beckman (1985), this US view had not changed even in 1981 when an agricultural attache in the US Embassy in Lagos was quoted as asserting that barring an extraordinary technological breakthrough, Nigeria would never be a significant wheat producer because neither climate nor soil was suitable for its cultivation. US farming lobbies requested the US Administration and Congress to take punitive action against Nigeria. To back up this demand, the lobbyists cite the USDA claim that up to 300,000 tonnes of wheat flour are smuggled into Nigeria yearly from neighbouring countries, and that wheat production is subsidised to the tune of ₦3,000 per tonne.

Both claims are correct. But if the end justifies the means, then the ban is in order because it has achieved at least two of the three objectives the government had for imposing the ban. The first objective is to increase the income of farmers. The producer price of domestic wheat increased from ₦500 per tonne in 1986 to ₦3,000 per tonne in 1988 - a staggering 500 per cent increase. A year later, it increased again by 40 per cent. The price of domestic rice also increased by an even more staggering 960 per cent between 1983 and 1988.

The second objective is to increase domestic production of the two grains. Wheat production increased from 139,000 tonnes in 1987 to 257,000 tonnes in 1989 (about 85 per cent increase) while the tonnage of rice produced increased by 8 per cent from the 1987 level to 555,000 tonnes in 1989. However, the achievement of the third objective, that of attaining self-sufficiency in food production, seems to have eluded the nation. For other farm products recorded very small increases. According to CBN (1983), "total agricultural production declined substantially by about 9.4 per cent in 1983 compared to a rise of 2.7 per cent in 1982, 3.4 per cent in 1981 and 2.5 per cent in 1980". The general trend since 1983 has been a slight rise in the index of

agricultural production, although a 1.8 per cent decline was recorded in 1987.

The inability of the measures so far taken by the government to provide a lasting solution to the food crisis is reflected in soaring food prices. Composite consumer price index for food rose by 52.2 per cent between 1987 and 1988. For the rural areas, the increase was even higher, being 53.7 per cent. Agricultural experts have given several reasons for this predicament of the nation. One reason they usually gloss over but which I consider very critical is population growth.

No country with a high rate of population growth has been able to solve its food problem without finding a solution to its population problem. India is able to feed itself and now has the ninth industrial output in the world, largely because it implemented the Green Revolution pari passu with a massive programme to reduce population growth. The one-child policy is the cornerstone of China's development programme, while the industrial miracles of such Asian nations as Japan and South Korea are hinged on strict control of their population growth. Agricultural programmes are used by these countries to buy time to balance their rate of population growth with growth in the agricultural sector.

In the case of Nigeria, the balance was attained only in the decade of the 1960's when agricultural production grew at about 2.3 per cent per annum, roughly equivalent to population growth. Since then, agricultural, particularly food, production has been losing the race with population growth. During the 1970's (i.e. from 1971 to 1979) the per capita food production recorded a negative growth rate of -0.7 per cent while population grew at a rate of 2.5 per cent, using the low growth variant. In the first four years of the 1980's, population growth accelerated, but the growth rate of per capita food production was negative, being -1.6 per cent (McNamara, 1985). The pace at which population growth is outstripping growth in food production requires an assessment of the carrying capacity of the Nigerian land in so far as it relates to food production.

Limits Discovered: The Food Crisis and the Carrying Capacity of Land

The credit for providing modern quantitative formulation of food-supporting capacity problem goes to Ravenstein (1891). His formulation has been used by other scholars, albeit with widely differing assumptions and results. Assumptions concerning the optimal nutritional standard, the cropped area and the average yield per unit of land expected to be obtained, are the critical elements in the calculations of food carrying capacity. It is to the examination of each of these elements that attention will now be turned.

There is no agreement on what constitutes the optimal nutritional standard or minimum physiological requirement of food. According to Colin Clark (1967), calorie requirements per head per day in Africa vary between 1,792, if men work four hours a day, and 2,012, if they work 8 hours a day. Since cereals yield about 3.2 calories/gram, the requirements of calories/day can be met by the consumption of 204-230 kilograms/person/year of cereal. But Clark asserts that the minimum agricultural requirements of a population can be put at somewhat below 250 kilograms/person/year of grain. By way of comparison, an American consumes 2,750 kilograms/person/year.

Recently, Gilland (1983) asserts that 9,000 kilocalorie (kcal)/capita/day is a reasonable dietary allowance that provides a varied diet. This figure is a standard, roughly at midpoint between the current minimum and maximum consumption levels. The minimum is 3000 kcal recorded in South Asia while the maximum of 15,000 kcal is recorded in North America, Australia, New Zealand, France and Argentina. World average consumption is approximately 6,000 kcal per day, although the FAO found that the average level in the 117 countries studied recently was 4,000 kcal (Higgins et al 1983). This world average consumption level corresponds to 0.67 tonne grain equivalent (tge) per capita per year, while Gilland's dietary requirement corresponds to one tonne grain equivalent (tge) per capita per year.

Going by Clark's subsistence dietary requirements, and using the low growth rate variant, Nigeria needed 26.76 million tge in 1989 and would need 35.4682 million tge by the year 2000. If Nigerian consumptions were based on US dietary levels, the country needed 294.36 million tge in 1989 and would require 390.1502 million tge in 2000. The requirements will be more than the requirements based on subsistence diet but less than that based on US diet if Nigerians' consumption is predicated on Gilland's assumed allowance of 9,000 kcal. A total of 107.04 million tge would have been needed in 1989, while 141.873 million tge would be needed in the year 2000. If the high growth rate variant is employed and if Gilland's dietary level is used, the country would have needed 119 million tge in 1989 and 169 million tge in 2000.

Whether or not the country will be able to produce the amount of grain needed to feed its population on the minimum diet recommended by Gilland depends on the amount of land available for cropping. Unfortunately, the data needed for the assessment of cropped area are poor in quality and quantity. No area, whether that of the country or of its cropped land, is known with precision. The total land area of the country given in official publications varies from 913,072.64km² (Federal Ministry of Information, 1977) to 923,768.64km² (Federal Office of Statistics, 1988; Daily Times, 1981). Since the source of the figures is the Federal Surveys, it appears that the official area of the country is not static. None of these official figures agrees with those given by various international organisations and in books published by reputable foreign publishers. According to the United Nations Environmental Programme (UNEP) (1989), the total land area of Nigeria is 911,000km² while the World Almanac (1975) gives the area as 922,814km².

Neither is there any agreement on the distribution of the major land use and land cover in the country. According to the UNEP (1989), only 32 per cent of the land area of the country was devoted to cropland between 1964 and 1966. The proportion so classified increased to 34 per cent between 1984 and 1986. About 21 per cent and 23 per cent of the country was classified as being under permanent meadows in

the period 1964 - 66 and 1984 - 86 respectively. Forest and woodland accounted for 16 per cent in 1984 - 86, down by seven per cent from the 1964 - 66 figure of 23 per cent. Other land, which includes cities, unmanaged rangeland, wetlands and other land not classified elsewhere, took 26 per cent of the total land area in 1984 - 86. It should be noted that by 1984 - 86, cropland, meadows and other land had each gained 2 percentage points at the expense of forest.

A completely different land use distribution emerged from an estimate made from the Nigeria Radar Project maps. About 41 per cent of the land surface were given over to cropland while 16 per cent and 32 per cent were under grassland and shrub/woodland/thicket respectively. Forest accounted for 10 per cent of land use and only one per cent was earmarked for other uses. This inconsistency in data makes it extremely difficult, if not impossible, to know the hectareage of land under permanent crops and non-food crops, and how much hectare of land has the potential of being converted to cropland from forests and grassland.

Nonetheless, some useful information can be gleaned from the data. Using both the land area given in the Annual Abstract of Statistics and the more plausible land use distribution given by UNEP, and assuming that all cultivable area is devoted to agricultural production, the total arable area would be 31,408,134 hectares. If it is assumed that 10 per cent of the arable land is devoted to non-food crops (cocoa, coffee, cotton, rubber, tobacco, benniseed etc), the food-producing area is 28,267,321 hectares. The carrying capacity of this area depends on the minimum annual crop production per capita considered to be satisfactory and the annual crop yield considered attainable.

Crop yields depend on many factors, including climate, soil type and depth, species of plant cultivated and availability of plant nutrient. Gilland (1983) reports a world average crop yield of two tonnes per hectare while Revelle (1976) suggests a yield of 5 tge per hectare. The average on-farm yields of wheat in Nigeria have been shown to be in the region of 1-2.5 tonnes per hectare even with

heavy application of fertilizer (Etuk & Abalu, 1982; Kolawole 1987; Palmer-Jones, 1980; Sano, 1983). The mean annual yield of cereal reported by UNEP is 1.121 tonnes per hectare for the period 1984 - 86. If the maximum yield of 2.5 tonnes is accepted, the maximum crop production in the country will be 70.7 million tonne grain, if allowance is made for utilisation of some land for non-food production or 78.5 million tonne grain, assuming that all the cultivable land is given to food production.

This theoretical production level can be compared with the actual output of crops reported in Table 5. While there has been a steady increase in crop and livestock production over the years, the production of fisheries has declined. Although the output of staples increased by 93 per cent between 1983 and 1989, the increase in root crop production during the period is higher (being 144 per cent) than that in cereal production (61 per cent). "Other crops" category, consisting mainly of cash crops, increased by 257 per cent. Smaller increases were recorded in the production of livestock and forest products over the seven-year period, the former having increased by 7.8 per cent and the latter by 13 per cent. By contrast, production of fish declined by 41.6 per cent during the period.

Table 5

Estimated Output of Major Agricultural Commodities
('000 tonnes, except otherwise stated)

	1983	1984	1985	1986	1987	1988	1989
1. Crops							
(a) Staples	14768	16544	19568	21149	24908	26203	28533
Cereals	9047	10735	13177	13957	11840	13179	14552
Roots	5721	5809	6391	7192	13068	13024	13981
(b) Other Crops	2611	3035	7465	8193	8485	9043	9325
2. Livestock	988	1075	1121	1162	1117	1088	1065
3. Fisheries	539	375	303	348	254	279	315
4. Forestry ('000cm ³)	89434	90865	93574	93620	95961	97980	101184

Source: CBN (1989)

Much of the improvement in the agricultural sector occurred in recent years. At 120.1 (1975 = 100), the aggregate index of agricultural production increased by 6.1 per cent in 1989 compared with only 2.5 per cent in 1985 when the index was 94.3. Crop production rose by 7.4 per cent in 1989 compared with 5.6 per cent in the preceding year while fish production increased by 12.9 as against a decline of 5.1 per cent recorded in 1988. By contrast, livestock production dropped by 2.1 compared with the decline of 2.6 per cent in 1988.

The improvement in agricultural production is reflected in per capita food production, the index of which rose to 105 between 1985 and 1987 (1979 - 81 = 100). But is the amount of crops produced enough to meet the requirement calculated above? To compare the production and the required consumption, it is necessary to convert the agricultural output to a common unit. It is convenient to convert agricultural production into "grain equivalent", valuing other agricultural products in accordance with their exchange value against grain (wheat) in the local market. The total crop production in 1989 equalled 17.52 million tonne grain equivalent (Mtge) in primary terms. To this must be added livestock and fish products calculated in Mtge. The value of these products in terms of cropland products is the quantity of feedstuffs that would be needed to produce the same amount of animal protein by feeding farm animals with cropland product. If, as suggested by Gilland, one tonne of livestock products and one tonne of marine products each corresponds to about 42 tge in primary terms, livestock and fish production must have contributed 44.73 Mtge and 13.23 Mtge respectively. The gross primary production in 1989 was, therefore, 75.48 Mtge.

This estimate falls between the minimum (70.7 Mtge) and the maximum (78.5 Mtge) obtained when production was calculated on the basis of assumed crop yield and amount of land under crops. In either case, the total production falls short of the requirement of the population by between 28.54 Mtge and 36.34 Mtge in 1989.

It is clear from what has been said thus far that at the current level of technology, the resources available in

the country (except energy resources) seem inadequate for the needs of the population whichever theoretical framework is used. In other words, using food supply as an index of carrying capacity, the limits of growth have been reached and manifest themselves in the continuing fall in the standard of living of many Nigerians. There is no denying the fact that the average Nigerians is poorer today than he was in 1970. If the problems of population growth and declining resources are not addressed more effectively, he will be poorer in the year 2000 than he was at the time the country became independent. Yet, 2000 is the magic year to which everybody is looking forward to have access to health, housing and all the good things of life. What is more ominous, the pyramidal pattern of socio-economic structure of the population will be badly distorted. An increasing proportion of people may be condemned to eternal poverty; the rank of the middle class may be drastically reduced or eliminated, while only a very tiny fraction of the population will be in the high-income group category. In such a situation where poverty becomes very acute, population growth will have to slow down because of increased mortality rather than reduced fertility.

I am sure the optimists will not only condemn the view in the preceding paragraph as alarmist but also claim that it is wrong to ascribe the disorderliness that now characterises our environment or, indeed, the serious problems of the country, to population trends. What is needed, they are likely to argue, is a more equitable distribution of incomes, purposeful leadership, display of organisational and managerial skill by our leaders and elimination of corruption. They will be quick to point to the network of roads, new industrial, commercial and administrative complexes and expansion in educational and health institutions. They will also point to some groups in the society who have gained new opportunities. They may even claim, quite rightly, that countries with large populations or high population densities such as Japan, Taiwan, South Korea, Hong Kong and Singapore have little physical resources but maintain a very high per capita GDP by means of external trade.

I concede all these positive points to them. I am aware of the progress that has been made in the last few years in the socio-economic development of the country. I also know that the population-resource balance of each country is modified to a greater or lesser extent by external trade. Indeed, striving to increase external trade to meet the needs of the population may be preferred to the slow and painful process of reducing population growth. But the brute fact is that the country is not on the cutting edge of technological innovation and thus does not have the ability yet to establish a strong enough industrial export sector to be able to compete in the international market. Part of the reason for this state of the economy is the fact that the resources to be invested in other development programmes are spent on provision of services to a large population. Even if the country were to have the abundant resources needed to develop rapidly with sustained fertility, it will do still better if fertility were reduced. In other words, all other development measures should be complementary to, and not be a substitute for, population control. My stand remains that our country would have achieved better progress if it had reduced its fertility than if it had not done so. In the next section, I shall endeavour to substantiate this claim.

Benefits of Slow Population Growth

Let us assume that the actual population of the country in 1991 is 112.7 million, the figure given by the NPC. Incidentally, this figure is close to the figure I arrived at when I projected the population of the country in 1979 (Adegbola, 1981). By that projection, the country should have a population of 112 million in 1990 using the medium growth series in which fertility was assumed unchanged at GRR of 2.2. If fertility had fallen, beginning in 1965, according to the low series, the striking difference between the hypothetical population and the actual population would be the change in the age structure of the population. The influence of the age structure on the ratio of labour force (L = 15-59) to the total population (P) is reflected in Table 6 for the hypothetical and the "actual" populations. L is 55.0 million in the actual population compared with 53.6 million in the hypothetical population. Assuming a

participation rate of about 80 per cent, since the labour force participation of women tends to be hampered by frequent births and a large number of children, the economically active population in 1991 would be 44 million,

Table 6

Age Structure of the Hypothetical and "Actual" Population of Nigeria, 1991

Age Group	Hypothetical		"Actual"	
	Number	%	Number	%
0-14	40658	40.8	53,201	47.4
15-19	10,080	10.1	11,934	10.6
20-24	8,724	8.8	9,857	8.8
25-29	7,508	7.5	8,105	7.2
30-34	6,570	6.5	6,646	5.9
35-59	20,678	20.7	18,456	16.4
15-59	53,560	53.6	54,998	49.0
60 & above	5,483	5.5	4,064	3.6
Total	99,701	100.0	112,263	100.0

over 1.2 million more, had fertility been lower in the preceding years. The rate of unemployment would have been lower, particularly among the volatile younger age groups (15-34) who cannot generate employment of their own and who make up 66.4 per cent of L.

The problem of unemployment is compounded for the country by modern technology which offers the potential of much greater productivity for the labour force. The application of technology to agriculture and industries means that output can be increased rapidly with little additional inputs of manpower. It is not a surprise,

therefore, that the estimate of unemployment rate is as high as 7.5 per cent in 1989 (CBN, 1989). This rate does not reflect the underemployment which is manifested in involuntary short hours of work, work at excessively low pay, street hawking and work for which the employee is overqualified.

Let us now consider the age category 0 - 14 years. The number of persons in this category would have been about 31 per cent fewer had fertility fallen according to my lower projection. The smaller numbers would have yielded many economic advantages for the whole population. In the first place, the income per equivalent adult consumer would have been increased by some 15 per cent. Second, the size of the completed family would have been three or four instead of between six and seven. With the small number of children, there would have been less crowded living conditions, better feeding and better parental care. Wide spacing, which fewer births engender, has been shown to be advantageous to the learning of children (Zajoric, 1976). The exposure of children to much older siblings who have had some schooling rather than siblings who are only a little older helps their intellectual development.

The population of the children in the age category 0 - 14 has increased very rapidly because, in a high fertility regime, mortality decline is usually largest in infancy and childhood, so that the effect of falling mortality has been not only to accelerate the growth of the population, but also to accelerate it faster at the younger ages. Consequently, the increase in the population of children of primary school age is greater than the increase in the total population. Although the total population increased by a factor of 2.1, the school age population increased by a factor of 2.7. The actual number of children attending primary school had increased from 2.9 million in 1965 to 12.2 million in 1988. This increase implies that the number of school children in 1965 had been multiplied by a factor of 4.2 and increased at an extraordinary rate of 6.2 per cent annually. The average number of pupils per school rose from 195 in 1965 to 364 in 1986. The increase in the size of school-age children has forced the governments of

the Federation to allocate large resources to education. For example, in 1989, 5.13 per cent of the budget of the Federal Government was allocated to primary and secondary education. The allocation of state budgets to education in the same year varies from 3.0 per cent to 15 per cent. Imo state, which allocated the largest proportion of its 1989 budget to education, spent ₦123.4 million out of a total budget of ₦912.81 million (or 13.5 per cent) on primary education alone. Despite the allocation of such large amounts of resources to education, the number of children not enrolled in school increased from 21 million in 1965 to 31.8 million in 1989. In other words, very rapid increases in enrolment could not reduce the incidence of non-attendance.

If fertility course had taken the path of the low series, the number of children of primary school age in 1991 would have been 27 per cent less. If the same amount of resources had been devoted to expanding education, any or all of the following would have happened: The current attendance ratio would have been higher and the number of children not in school would have been drastically reduced. Alternatively, the student/teacher ratio, and the number of students per classroom as well as per unit of resources allocated to education would have been less and the quality of education would have been higher.

Population growth has also contributed to the sharp tapering off of enrolment in post-primary institutions. In 1965, primary education accounted for 82 per cent of all enrolment in educational institutions. By 1986, the percentage had increased to 93. In other words, an increasingly larger proportion of primary school leavers are being thrown into the labour market at the rather tender ages of 11-15, while the relative importance of their certificate is declining. Similarly, at the tertiary level, vacancies are grossly inadequate in spite of the establishment of more universities. Although 14.0 per cent of all applicants were offered admissions into Nigerian universities in 1980/81, the percentage increased only slightly to 14.6 in 1986/87 session even though the number of universities in the country had more than doubled within the same period. Had

there been a linear decline in fertility beginning in 1965, of the sort I predicted in the lower fertility projection, the number of people in the age-group (15-19) that should normally seek admission to tertiary institutions would have been 18 per cent less.

The same scenario sketched above for education is also true of other welfare services such as health facilities and housing: a lower fertility would have produced a low ratio of dependents to producers and the resulting population would have consumed less of a given output, devoted more to investment and produced more. With fewer consumers to larger total product, there would be higher economic welfare. Higher levels of consumption would, in turn, strengthen the forces leading to higher output through better incentives and improved physiological capacity.

Two points need to be clarified in respect of the above analysis. The first is that the "actual" population to which the analysis refers is the official population which is far less than the real population which many experts believe Nigeria now has. If the analysis had been based on this real population, the difference between the hypothetical population and the current total number of Nigerians would have been brought into sharper relief. The second point is the impetus to growth that has already been built into the current population as a result of the past continuation of high fertility. The impetus is what demographers call the momentum of population growth, a principle that stresses the inevitability of growth in a fertility regime. The fact that fertility has remained high means that the recent cohorts of those born each year are twice as large as those born 20 years earlier. The passage of these enlarged cohorts through the successive years of life makes substantial future population growth inevitable, even if from now on, parents were to bear a greatly reduced number of children. If fertility were to begin a linear decline from its current value of 3.5 per cent to reach 3.0 per cent in 2000 and then remain constant thereafter, the population will reach 286 million by the year 2025. If, however, the fertility behaviour remains unchanged, the population would jump to

about 380 million by the year 2020. The next jump will put Nigeria in the population class of India and China with the country having neither the resources nor the social organisation to cope with such a magnitude of people.

Indeed, the inability of the country to cope with the very large size of its population has generated the disorder in the environment. In order to restore order into the environment a new framework needs to be defined for population growth. An understanding of such definition is enhanced if the link between population growth and social structure is examined.

Population Growth and the Prevailing Social Structure

The prevailing social structure is based on the peasant mode of production. According to Hyden (1980), a mode of production is an abstraction identifying the basic logic and structures of given social formations. The real implication of the continued dominance of the peasant mode of production is that it gives rise to a type of economy in which the affective ties of common descent, common residence and other communal ties prevail. In this type of social structure, individuals, who are seen as perpetuating a lineage, must contribute their maximum to ensure the growth of the lineage and the well-being of its members. Also, the resources of the lineage are shared in such a way as to promote the continued existence of the lineage. Thus, a peasant mode of production links production and reproduction and thus encourages a large family size. Of the several hypotheses that have attempted to explain this link, two are relevant for our purpose.

The first is the nutrition hypothesis of Whiting (1964) and Murdock (1967). The theory claims that in tropical forest belts, low protein tubers and fruits are produced while the production of cattle, which should supply protein, is inhibited by the presence of tsetse fly. Mothers therefore have to breastfeed their children intensively for a prolonged period to make up for a low protein diet for their children. Since the survival of the baby is dependent

on child-spacing and the maintenance of high prolactin levels in mothers, a post-partum taboo on sexual abstinence during lactation is practised. There are at least two implications of this hypothesis for the peasant mode of production. The first is that the prolonged period of lactation encourages the husband to take another wife as he himself often finds it difficult to abstain from sexual intercourse for a long period of time. Secondly, the large social and psychological distance that the taboo creates between the spouses not only hampers intimacy between them and makes discussion on regulating family size among spouses difficult, if not impossible, but also discourages emotional nuclearisation of the family. Consequently, in spite of long birth intervals, family size per woman is large. It is interesting to note that in Western Nigeria, where this taboo was observed in its purest form in 1952, TFR was 7.9, compared with 6.5 and 7.4 for Northern and Eastern Nigeria respectively (Adegbola, 1977). Indeed, the highest TFR of 9.7 was recorded in Ibadan Province.

The second hypothesis, associated with Boserup (1970) and Saucier (1972), is the "social organisation" theory. Like the first hypothesis, it also links social structure with a given ecosystem. Boserup (1970) claims that there is a strong association between form of agriculture and input of female labour. In traditional agriculture, female labour input is much higher than that of male. In such a situation, the social organisation makes the possession of many wives to mean "many powers" (Clignet, 1972). Saucier (1972) is of the view that in a unilineal kinship organisation, the resources are controlled by male gerontocracy. The association between kinship organisation and gerontocratic control breeds a long postpartum taboo which is fuelled by such variables as polygyny, bridewealth, primogeniture, hereditary leadership of settlements, isolation of wife etc. Of the 20 variables identified by Saucier, the four best indicators of the taboo are bridewealth ($\phi = 0.38$), Swidden agriculture ($\phi = 0.36$), polygyny ($\phi = 0.35$) and physical or psychological separation of the spouses ($\phi = 0.31$).

This hypothesis has been claimed by Lesthaeghe (1984) to account for both the high incidence of polygyny and the quick remarriage following both widowhood and divorce. In his words, "gerontocrats control both production factors, i.e. land and female labour, and fend off competition from younger males who have to sit out their time. This feature also accounts for the fact that age at marriage for women is fairly early, while that of men is later". The net result of this type of social structure is that the women very nearly make use of all their reproductive age span, losing little time as a result of celibacy, widowhood or divorce. The only period lost to reproduction is the non-susceptible period following a child birth (i.e. period of lactational amenorrhoea and postpartum abstinence).

The evidence that this social structure engendered by the peasant mode of production is a strong prop of fertility, and hence of population growth, is provided by the Nigeria Fertility Survey. The relevant indicators computed from the survey data are depicted in Table 7. As the Table shows, fertility regime is characterised by high levels of polygyny. Among currently married women, more than 30 per cent live in a polygynous union in 13 states of the Federation. The proportion is highest in Kaduna and lowest in Lagos which records 51.1 and 6.4 per cent respectively. In states where the level of polygyny is high, the proportions of those single among females 15 - 19 are, in general, low, whereas they are high where the incidence of polygyny is low. Figure 3 shows that the percentage of women 15 - 19 who are single is less than 40 in the northern parts of the country where incidence of polygyny is high. Polygyny is also influenced by the incidence of marriage in most of the states. Between 70 and 98 per cent of all union disruptions have already remarried by age 50 in 12 states, while in no state does the percentage fall below 30. Consequently, the overall exposure period is long. In no state is the percentage of time spent in married state less than 92; it is 100 per cent in Niger. Thus, in spite of the child-spacing effect, TFR-levels in the states range from 5 to 9 (Fig. 4).

Table 7

Indicators of Marriage by States

State	% Whose First Marriage Was Dissolved	% Who Remarried	% of Time Spent in Married State	% in Polygamous Household
Anambra	23.8	39.5	92.3	38.7
Bauchi	14.4	98.1	97.9	31.6
Bendel	16.1	77.8	97.1	30.5
Benue	9.4	77.4	98.1	45.5
Borno	23.9	90.9	95.8	24.8
Cross River	18.3	60.7	95.8	43.0
Gongola	9.0	73.7	97.9	43.7
Imo	16.1	30.7	95.2	18.1
Kaduna	20.4	90.8	95.9	51.1
Kano	16.1	77.8	97.1	30.5
Kwara	8.9	66.7	97.2	33.9
Lagos	7.7	52.2	98.1	6.4
Niger	5.3	86.7	99.7	49.5
Ogun	23.9	90.7	96.4	33.3
Ondo				
Oyo	7.8	70.1	98.1	42.6
Plateau	10.5	95.7	99.0	43.9
Rivers	22.3	66.1	95.2	23.9
Sokoto	15.6	98.4	97.9	50.8

Fig.3: Percentage Women 15-19 single

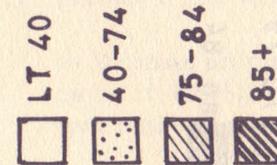
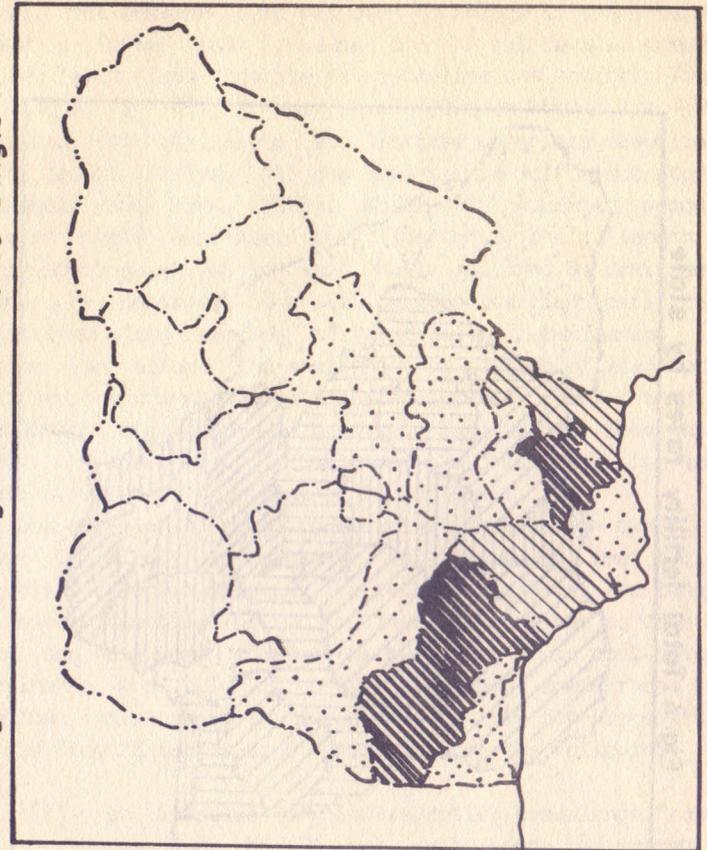
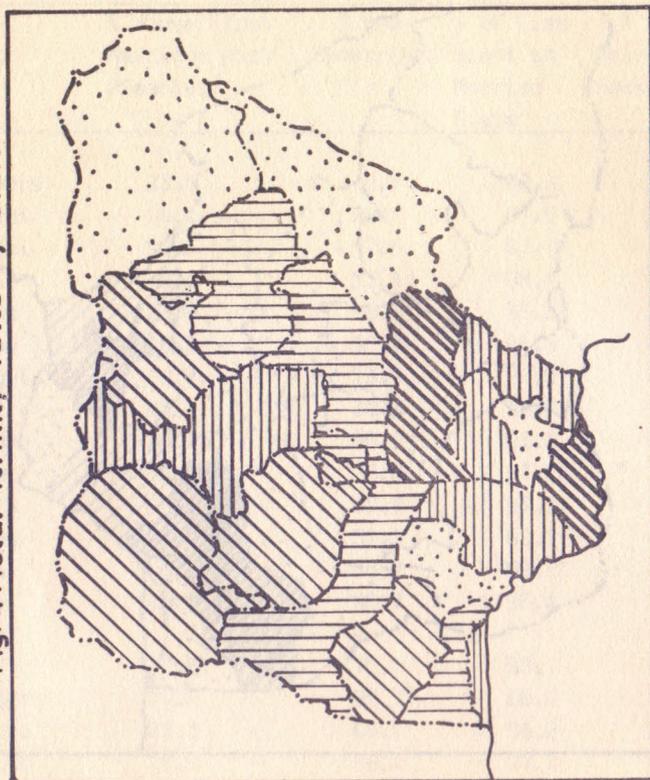


Fig. 4: Total fertility rates by state



Ironically, modernisation has hardly affected the TFR level, not because there has been no change in the intermediate variables that produce the TFR but because compensating mechanisms operate to neutralise one another. Thus, in Lagos, in 1976, it was found that even though the TFR's obtained for illiterate and literate women are identical, both groups arrived at the level via different routes (Adegbola and Page, 1979). While the educated women delayed their marriage, they shortened their length of child-spacing, an action not fully matched by contraception. By contrast, the illiterates married early but maintained long periods of post-partum abstinence. The former can afford the shortening of periods of abstinence because the communal ties characteristic of peasant mode of production enable them to have relations to help them nurse their children. The latter, on the other hand, can send their children to relations to be fostered.

One example is enough to show that the pattern described above is likely to continue in future if the social organisation which produces the pattern persists. The length of non-susceptible period is likely to continue to drop as more and more women shorten the period of their post-partum abstinence and rely on only lactational amenorrhoea for spacing their children. A reduction in the non-susceptible period from 16 months to 8 months implies the following:

- (1) an increase of contraceptive prevalence from 5 per cent to 30 per cent among the currently married women by the year 2000 in order to prevent a net marital fertility (TMFR) increase;
- (2) an increase in contraceptive use to 37 and 45 per cent if fertility is to decline by 10 and 20 per cent respectively.

Nothing short of a change in social structure can bring about the contraceptive revolution that the above calculation implies.

Towards a New Social Structure

A new social order is predicated on the belief that family planning measures will be enhanced by a redefinition of social relations. This idea is absent in the policy adopted by the Federal Government in response to high growth rate. The policy, titled "National Policy on Population for Development, Unity, Progress and Self-Reliance" and launched in 1988, gives pride of place to family planning. In order to make it acceptable to the populace, family planning programme is presented in the context of maternal and child health; it thus emphasises motherhood and the family. It is also made voluntary so that individual couples do not see it as infringing on their personal freedom. On both scores, it ties into accepted values and thus achieves political viability.

The measures in the document have been criticized by some people as being too little, too late. Some argue that a couple should be allowed two and not four children; others suggest 25 years and not 18 years as the minimum marriage age for girls in line with the age of marriage in Europe; yet others want all the recommendations to be legally binding and prescribe heavy penalties for offenders. My reactions to these comments have been given elsewhere (Adegbola, 1988). What I want to examine here is the effectiveness of a voluntary family planning programme in an economy dominated largely by peasant mode of production.

Some experts doubt the efficacy of a population policy which is voluntary in nature. Garret Hardin (1968) claims that progress cannot be made toward optimum population size until the spirit of Adam Smith (1776) is exorcised in the field of population. In other words, Smith's idea that an individual who embarks solely on his own gain is, as it were led by an invisible hand to promote public interest, is not applicable to population issues. The rebuttal to the invisible hand in population control is popularised by Hardin in his "Tragedy of the Commons". Demographic processes are the result of a very large number of uncoordinated individual decisions, each individual striving for

maximum advantage (Demeny, 1986). Several evidences have been cited by Berelson (1969) and Davis (1967) to show the futility of a population policy based on voluntary measures. In Africa, Kenya and Ghana are the first two countries to adopt a population policy. Yet, their fertility rate has not improved much. Indeed, Kenya, which established its family planning programme in 1967, still had a TFR of 6.7 in 1989.

It follows from the foregoing that there is a need for another approach to fertility reduction. That solution should not be involuntary fertility control, which is impracticable in a democratic society and difficult to enforce even in a totalitarian society. It caused the electoral defeat of Indira Gandhi in democratic India and is flouted with impunity in despotic China (Greenhalgh, 1989). Our own solution should be the adoption of a social adjustment programme that will give rise to a new social order. I am afraid, in the new social relations, men may have to relinquish many of the privileges they now enjoy.

The first stricture of the programme is the abolition of both polygyny and payment of bride wealth which fuels it. The ban should apply to the traditional form of polygyny based on co-residence of wives or its new variant called "outside wives" or "number 2". As long as polygyny is kept as a form of marriage, early marriage and fast pace of remarriage by dissolved union partners, two important props of high fertility, will remain irrespective of the marriage age specified in the National Policy on Population. Indeed, the four-child principle enunciated in the policy document without any pronouncement on the practice of polygyny has created some apprehension among some segments of the population. While the female group wants the principle applied to men as well, majority of men argue that the principle applies to women who are the only group capable of procreation. Other groups contend that the policy is designed to promote the growth of the population of those areas of the country where the practice of polygyny is prevalent at the expense of those areas where the incidence of polygyny is low.

Being in a monogamous union reduces very considerably, but does not eliminate totally, the probability of having a large family size within marriage. Several suggestions, which lay emphasis on allowing economic advantages to accrue to the small as opposed to the large family, have been made to encourage limitation of births within marriage (Davis, 1967). The specific methods suggested de-emphasise the family. A closely related method, and the second structure of the new social order, is the modification of the complementarity of roles of men and women. Men are able to work and enjoy the satisfaction of having several children because the burden of housework and childcare fall mainly on their wives. Women are impelled to seek this role by their idealised view of marriage and motherhood. The Women Commission and the Better Life Programme have created avenues for women to hold full citizenship in more and more diversified national culture through the restructuring of the occupational system and developing interest that transcends the home. Women now have the opportunity, more than ever before, to hold important political and decision making posts, get employed in the labour market on equal terms with men, engage in fulfilling and rewarding self-employment and enjoy social life organised around their local community. But it is not just enough to improve the economic and social conditions of women in their work places and communities; their social conditions at home should also be improved. Men should share housework and child-care with their wives. Therefore, the two agencies should further press for the restructuring of the domestic establishment to the point of permanently modifying the old division of labour by sex. A new definition of family role should therefore form a part of population education being introduced in schools.

The third ingredient of the social adjustment is the nuclearization of the family. The emotional nuclearization being advocated here means that the psychological identification of the individual with the extended family will have to be loosened and later completely broken. The shift implies that each couple will be responsible for all the

costs - visible and invisible, direct and indirect - of reproducing and rearing children in keeping with, at least, minimal standard prescribed by the state. An important impediment to such a change is the reliance of parents on the support from grown-up children. As long as parents look upon their children as a pension policy, they will continue to breed them in large numbers, for they will claim they do not know which of the children will be compassionate on them at old age. In a situation where the means of the children are too small to afford a decent livelihood, the fears of the parents are increased. There is therefore the need to take over, gradually, the support of the aged. Such a shift-over to society of the security of the aged has a strong psychological and political basis in a democratic society to which we aspire. If the aged lived and worked, they have a right to support when they are getting old. Furthermore, the aged have votes which can be exercised for people who advocate social change. They will have ears of many who will identify themselves with the interest of the old, simply because they figure they themselves will soon grow old.

The assumption by the state of the responsibility for the aged should go hand in hand with its responsibility for the welfare of the children. This responsibility is the next feature of the new social order. Indeed, the prevailing development ethics in the modern world requires that a government assumes responsibility for the welfare and well-being of all social classes in its population. In concert with these modern sentiments, Chapter 2 of the 1979 Constitution of the Federal Republic of Nigeria outlines the responsibility of the State to every citizen of the country in terms of fundamental objectives. These objectives are a set of curative and preventive measures of social policy and state that the State shall direct its policy towards ensuring that:

- (a) suitable and adequate shelter, suitable and adequate food, reasonable national minimum wage, old age care and pensions, and employment and sick benefit are provided for all citizens;

- (b) there are adequate medical and health facilities for all persons;
- (c) children, young persons and the aged are protected against any exploitation whatsoever, and against moral and material neglect;
- (d) as and when practicable, there will be provided free, compulsory and universal primary education; free secondary education; free university education; and free adult literacy programmes (Federal Republic of Nigeria, 1979).

The curative measures in the policy are aimed at the directly needy - the poor, the sick, the aged, the unemployed etc. The elimination of poverty, disease and ignorance is essential not only because they usually stimulate a high birth rate, but also because the existence of the poor, ignorant and inexperienced in the stock of the population of a democratic society will put democratic process in jeopardy. The prophylactic measures, on the other hand, are directed at the family and children, the people of the future. The policy embracing such measures is an investment in the human capital of the country.

Whether curative or prophylactic, the social policy to which the Nigerian State aspires has very great financial implications and can be supported only where the power and ability of the State to raise the necessary revenue is untrammelled and effective. For a state whose effectiveness of governance is constrained by the peasant mode of production, living up to these high objectives of policy is bound to be difficult and hazardous. The edge of that difficulty was blunted by the oil boom. Since the collapse of the boom, Nigerians have been feeling the pangs of the sharp points of the falling per capita domestic product growth rates vis-a-vis the aspirations of the Nigerian State.

In a situation where resources measured in terms of the gross domestic product tend downwards, even if the size of the population remains the same, the welfare and well-

being of an individual must suffer a diminution. In our own case, the rapidly increasing population is making the situation even worse. Now, most of our people receive very low incomes, are badly equipped with land and resources essential to the comfortable support of expanding numbers and find themselves entangled at every facet of life in disorder created by having to struggle for very scarce resources. All these problems we have brought on ourselves by the sheer logic of our fertility behaviour in circumstances in which our economic productive capability is hardly being enhanced.

Since social relations are defined in the context of spatial organisations, the new social order being advocated has a spatial component to it and it is here that geography has a role to play in search for order in the society. In what follows, the role of geography in bringing order to the rural environment, which is the main focus of the present administration, is examined.

Geography and Order in the Environment

The restoration of order into the environment will require that the twin bulls of population growth and limited productive capacity be tamed. This, in a sense, is what the government is trying to do. On the one hand, it has adopted, as noted above, a national population policy. On the other hand, it is trying to transform, completely, the economy. Accordingly, a structural adjustment programme has been put in place to check the decline in the gross national product and revamp the economy. Fostering growth in agricultural production as well as the development of rural areas is an integral part of this programme.

I believe that the profession of geography has a crucial role to play in mapping out how spatial reorganisation can bring about serious and lasting structural transformation, both in the pattern of productive activities and reproductive behaviour.

It is over a decade now that Nigerian geographers have been calling for a new approach to rural development. This approach is based on the improvement of the living standard

of the rural population through the transformation of the socio-spatial structures of their productive activities (Mabogunje, 1978, 1980; Adegbola, 1983; Adalemo, 1991).

This call has been ignored by various governments, probably because they lacked either the courage to take the hard political decisions which the implementation of the approach requires, or the imagination to appreciate the advantages of the approach. It is to the credit of the present administration that it has embarked on a new approach to rural development with the creation of DFFRI in 1986. One important task that the Directorate is undertaking is community listing and mapping programme in each local government area. Each community is expected to be the unit to receive government assistance or service. As at September 1990, the directorate had processed and mapped data of communities in 19 states and the Federal Capital Territory, Abuja. The community which organises itself to undertake some projects - be it a bank, a road, a school, an hospital or a borehole - is given a matching grant by the government. This type of community-based strategy is critical for effective mobilisation for rural development. However, DFFRI needs to do more than just compile the list of communities, and government needs to do more than make use of the community as units for provision of services or assistance.

All communities have to be reorganised in new social relations. Each farm in every village in all the communities across the nation has to be systematically surveyed and mapped. The information to be collected will include the size of the scattered lots of each individual farmer, the cropping capacity of these lots, the nature and condition of other land in the village and the demographic profile of each village. The aim is to know the location and size of every settlement, the use to which every inch of land is put, the routes leading to each settlement and the demographic profile of the communities and villages.

With this information, the appropriateness or otherwise of both the existing settlement systems and the mode of land utilisation will be determined. Recommendations will be made on

- (i) grouping of communities into viable units not too small to be effective in undertaking major public works needed for their own use and not too large to make interaction and decision-making remote. Such a unit can involve a single village or a group of hamlets, and
- (ii) consolidation of farms and redistribution of lots to farmers as appropriate.

Each of the new spatial units, which I called a social area in a 1981 article, is an optimum community with a size just large enough to ensure a full appreciation of perceptible interdependence among all its members. In addition to their economic activities, the units will ensure nation-wide participation in decision-making and the execution of development programmes at the grass root levels. Leadership at this level devolves not on traditional rulers but on people chosen on the basis of their ability to provide the farmers challenging opportunities for their (farmers') improvement. With this outfit, the optimum communities are in the best position to undertake development activities which urban-based improvement unions now perform in their homes of origin, since they will now provide the basis for organising the provision of infrastructural amenities, for maintaining existing projects, for providing primary health care services including family planning, for dissemination of information on family life and for initiating, appraising and evaluating development efforts.

There is no doubt in my mind that the adoption of an optimum community-based approach to both population and development policies is a viable path to reducing our population and increasing rural productivity and, hence, restoring order into our environment. As Mabogunje (1980) has observed in connection with co-operatives, "the interaction between households in the economic sphere can more easily be extended to an open discussion of the relationship between the two critical variables of production and population. It should not be difficult to

show that the importance of planning and rationality in the former makes sense only in so far as equal attention is paid to similar demands in the latter".

Furthermore, such a manageable socio-spatial unit makes it possible to cover the overwhelming majority of the population for the delivery of contraceptive services. It is possible in such a setting to ensure full participation of village leaders and their communities and take account of local socio-cultural sensitivities. In such a scheme, pride of place should be given to Better Life Programme and Women Commission. To their portfolio must be added task of bringing about a change in the reproductive behaviour of our women.

The optimum communities should be grouped into local government areas (LGA's), the spatial extent of each of which will be far less than the current LGA. There is hardly any developed country which did not organise its society into this type of small area units in the course of its history. For example, in 1931, Britain, with a population of 40 million, organised its society into 12,850 rural parishes. France, with the same population had as many as 38,000 communes. The story is the same with countries outside the West which had to bring decision-making to the grassroot to ensure increase in productive capacity. China, for example, organised its society into over 100,000 communes. It broke down each of its communes into production brigades and production teams, the latter comprising no more than between 20 and 50 households. By contrast, Nigeria, with a 1991 estimated population of 113 million, 106,796 communities in 1990 and an area more than six times that of England and Wales has only 446 LGA's.

The pusillanimous attitude to units of local government in the country shows either that governance is not yet conceived as the right of the people to participate in the making of decisions that directly affect their lives, or

that government is anxious not to alienate a group of people, usually the indigenes, who may regard the creation of new LGA's as an attempt to carve out a territory for migrants. The issues were examined by Alao and Adegbola in 1981, and a set of guidelines based on a combination of political, socio-cultural and economic objectives given.

The reorganisation described above is a gigantic one that is likely to put strains and stresses on the new web of social relations, since issues relating to land often produce serious social tensions. The exercise is thus going to involve some really hard political decisions which, one can only hope, this and succeeding administrations will have the imagination and political will to see through.

Conclusion

My major task in this lecture has been to prove that the disorderliness we find in our society today is a product of excessive population growth. It has given - and continues to give - rise to too many people chasing steadily declining few resources. It is retarding capital formation, accelerating the rate of depletion of our limited store of non-replaceable resources, impoverishing our land and its resources and decelerating the rate of increase of per capita income.

If order is to be restored to our society, it is not just enough to rationalise our economic behaviour as the SAP has forced us to do. Our reproductive behaviour must also be rationalised. For, no matter what effort we put into restructuring the economy, we cannot substantially improve the material scale of living of majority of Nigerians unless population growth rate is reduced substantially. But this implies a much more rapid decline in fertility than took place in Japan or countries of Europe. So rapid a decline calls for not only social and spatial restructuring but also considerable state intervention on a scale far much more than the current efforts. If the state is to assume the responsibility given to it by the Constitution and provide free education for all, it should also have a say in the

number of children a couple should have. He who pays the piper, so the adage says, dictates the tune. In order to be able to dictate the tune, it must make efficient family planning methods easily accessible to all at affordable prices. Only through the assumption by government of population planning through direct funding of family planning and the establishment of a Population Planning Commission can the problem of population growth be seriously tackled.

Ironically, while the two political parties are committed to shouldering the responsibilities thrust on them by the Constitution, none of them has put forward an articulated policy on population planning. Yet, population planning programmes require as much attention and investment as any other development programme. It was the late President Johnson of USA who was quoted as once saying that one dollar spent on the reduction in fertility in a high-fertility population was better than 20 dollars devoted to general development (Coale, 1978). This statement is an exaggeration. It will be more correct to say that 20 dollars spent on development are much more effective if one of them is devoted to a family planning programme. We cannot afford to ignore the statement if we are to defuse before it explodes, the demographic time bomb on which we now sit.

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