INTERNATIONAL JOUNAL OF: SCIENCE RESEARCH AND TECHNOLOGY

TIMBOU-AFRICA ACADEMIC PUBLICATIONS
INTERNATIONAL JOURNAL, FEBRUARY, 2022 EDITIONS
VOL. 8 NO. 9 ISSN: 2623-7861

POPULATION GROWTH MODEL TO PROJECT HUMAN POPULATION IN NIGERIA

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ABSTRACT

Nigeria population size is a question of considerable important and interest. The main objective of this study was to carry out a population projection for Nigeria. Population growth model are used to calculate population growth rate between 2022 population and

INTRODUCTION

The size of the population of a country is a question of considerable interest and importance. Population projection is the estimation of future populations based on the present age-sex structure, together with assumed rates of fertility, mortality, and migration in the future, that is, extrapolation of past and present population trends into the future as claimed by Shryock (1976). Projections must be evaluated in light of when they were made, prescribed assumptions and conditions at that time. Therefore, projections are based on current knowledge about population size, age structure, rates of birth, death, migration, and

2045 population. Calculated growth rates were then used to predict figures based on the states of the federation. The projected provincial population shows that, Central Province population is set to increase from 4.5 million in 2010, to 5.1 million in 2015, to 5.7 million in 2020, to 6.3 million in 2025 and 7 million by 2030

Keywords: *- Population, Absolute Population Growth Projection, Growth rate, Relative Growth and Arithmetic Population Growth*

assumptions about how quickly these rates will change. Population projections are essentially concerned with future growth. They may be prepared for the total population of nations, their principal geographical subdivisions or specific localities within them. Although a given projection can be judged by the merits of its assumptions in relation to the use to which it may be put, it can never be proven right or wrong by future events. A forecast may be defined as the projection that is selected as the one most likely to provide an accurate prediction of the population Shryock (1976). It represents a specific viewpoint regarding the validity of the underlying data and assumptions. A forecast reflects a judgment, and it can be proven right or wrong by future events. Based on such projections, we can raise our understanding of the determinants of population change such as what impact would a 20% decline in birth rates have on a country's population size and age structure in 50 years?

They can also be used to provide information on possible future scenarios since we cannot see into the future Wilson (2011). Population projections are essential for planning at the national, regional and district levels in both the private and public sectors. In order for planners and policy makers to efficiently allocate the scarce resources,

they need to know the future size and structure of the country's population as well as their characteristics. Planning for any sector of the economy therefore requires information about the future size and structure of the population in the area Population census provides full and reliable picture of the country's population and its characteristics. In census, data is collected at a specific time from the entire population, in contract to other surveys in which information is collected from only a small part of the residents and from the conclusions is reached regarding the general population. The census is one of the most important sources of information that provides a basis for the official statistics of the country.

Population is a very important element in development planning. Olateru (2008) noted that population censuses are the primary sources of the basic data required for planning, for administration and also for many aspects of economic and social research. These include planning for education, housing, agriculture, rural-urban migration which often lead to squatter settlements in the urban centres, manpower and labour , health and other infrastructural facilities Oyekanmi (1992) .The main population question in Nigeria has revolved around the issue of numbers. Since the first census was conducted, each census figure was disputed by one segment or the other in the country Oyekanmi (1992). There were and still are accusations of either undercount of some ethnic groups or over count of some other ethnic groups. Rather than seeing census taking as a scientific/technical exercise it has been regarded largely as a political issue in this country. It is notable that the last two census exercises in the nation; i.e. those done in 1991 and 2006 have been accepted albeit with some reservations from certain stakeholders .The counts gave total population figures of 88; 992; 220 in 1991 and 140; 431; 790 in 2006 for the nation (NPC.1998; 2009). If one uses the medium variant

estimate of natural increase rate of 2.5% per annum by the United Nations the population of the country by mid-2010 is put at 158; 259; 000. By the year 2020 it is projected by the medium variant that the population would be 175; 928; 000 (UN; 2009). The age distribution shows a very young age structure where about 41 percent of the total populace are less than 15 years of age. On the other hand about 5 percent of the nation's population are aged 60 years and above. Hence the people who are in the economically active age groups in the country form half of the population. The implication of this is that there is a high dependency ratio whereby each economically active person would cater for about three people on average. As noted earlier it is estimated that 23 percent of the male and 61 percent of the female populace aged 15 years and older are unemployed (PRB; 2011). Hence each worker, in fact has to cater for 5 or more people. Information on ethnicity and religion were not collected as part of the characteristics of the people in these last two censuses in order to avoid exacerbating an already contentious situation and making the efforts of nation building more difficult. Nnorom and Kunnuji (2006) argue that ethnic pluralism in the country and the struggle for numerical supremacy impact negatively on the census process and population statistics, which are believed to be manipulated for political purposes making the figures needed for planning unreliable. This reservation about the negative effect of unreliable population figures on development in Nigeria has also been expressed by several scholars Nnorom and Oyefara (2008), especially as it pertains to the achievement of the Millennium Development Goals in the country. If we do not know how many Nigerians there are then how can we plan accurately for the present and future population.

Malthus (1798) offered what may be history's most chilling forecast. He postulated that an ever increasing population would continually

strain society's ability to provide for itself. As result, mankind was doomed to forever live in poverty. Malthus (1798) arrived at these assertions based on the following premises. He noted that"Food is necessary to the existence of man" and that the passion between the sexes is necessary and will remain nearly in its present state". His conclusion is that the power of population is infinitely greater than the power in the earth to produce subsistence for man". To him, the only check on population growth was "misery and vice; Accordingly, efforts by charities or governments to alleviate poverty were counterproductive, since they merely allowed the poor to have more children, placing even heavier burdens on society's productive capacities. This is the famous Malthusian population trap; The predictions of Malthus have been faulted, challenged and are largely criticized on several grounds. First, the impact of technological progress on productivity was neglected. Second; the theory was anchored on a wrong assumption of macro relationship between population growth and level of per capita income. And finally, it focused on the wrong variable, per capita income as the major determinant of population growth rates. It has also been observed that Malthus forecast for mankind was far of the mark as the world population grew six fold over the past two centuries, and living standards around the world are on average much higher. Economists note that"famine occur from time to time, but they are more often the result of an unequal income distribution or political instability than inadequate production of food" But the pertinent question is where did Malthus go wrong? He failed to appreciate that growth in mankind's ingenuity would exceed growth in population. New ideas about how to produce and even the types of goods to produce have resulted to greater prosperity than Malthus - or anyone else of his time -ever imagined. The application of pesticides, fertilizer, mechanized

farm equipment and new crop varieties have led to agricultural revolution that have enabled each farmer to feed ever greater numbers of people. The wealth enhancing effects of technological progress have exceeded whatever wealth diminishing effects might be attributed to population growth. Indeed, some economists now go so far as to suggest that population may even have helped mankind achieve higher standards of living. If there are more people, then, there are more scientists, inventors, and engineers to contribute to technological progress, which benefits everyone. Perhaps, world population growth, rather than being a source of economic deprivation as Malthus predicted, has actually been an engine of technological progress and economic prosperity. This development in economic thought has given rise to the great population debate in which economists are divided in their opinions as to what constitute the implications of population growth. This study, thus, hopes to contribute to this debate as we examine the case of Nigeria's population growth overtime. Another important literature that attempts to explain the trend of population growth overtime as it pertains to the advanced industrial societies and the emerging developing world is that of the demographic transition theory. This theory tries to categorize the dynamics of population growth into - three different phases. According to the theory, stage 1 or phase one has a stable population growth at high birth and death rates. Stage 2 is characterized with rapid population growth due to high birth and low death rates. And Stage 3 has a stable low population growth caused by simultaneous falling of birth and death rates due to the incidence of modernization and development. (Augustine 1997). This theory appears to be \relevant to the Third World Countries; after an initial stable or very slow growing population (Stage 1), overall population growth rates have remained relatively high" since the

1950s. Thus, these countries are in stage 2 of the demographic transition .

For projections of the total population, we believe the empirical evidence is clear: complex methods do not consistently produce more accurate forecasts than do simple extrapolation methods for projections of demographic characteristics; however, few empirical tests have been performed. The reliability and usefulness of projections depend on the assumptions and their closeness to reality. In the end, the policy parameters are to be incorporated in the projections. The likely effects of policy changes are to be judged and projections are to be made accordingly. Thus, when an element of judgment is added to the projections, it becomes a forecast. Population forecasts predict the future size and composition of populations, based on predictions of fertility, mortality, and migration. They should be reviewed frequently in order to determine the degree to which they agree with recent demographic changes. If the discrepancies between the projections and the ultimate events are significant, it should be found out whether it is due to the quality of input data or due to the methodology adopted Population Mehta (1994), projections are used for a wide variety of planning and budgeting purposes. In many instances, projections of demographic characteristics are at least as important as projections of the total population. Age is a particularly important characteristic and is commonly used when projecting births Lapkoff(1993), school enrolment Fishlow(1994), residential care for children Dunton(1994). hospital services social Rives(1994). security revenues, expenditures and many other policy-relevant variables. By their very nature, population projections are uncertain. We cannot know precisely what the population will be one year from now, much less in 10, 20 or 30 years. The accuracy in a projection is improved by developing

stochastic forecasting models that attach explicit statements of probability to population projections Alho(1990).

Materials and Methods

The rate of growth of a population is one of the most important single demographic facts about the population. The rate at which population is changing affects not only its size and numerical increase but also its composition.

Absolute Population Growth

The growth of a population at any given time t is largely determined by its own size at any moment. Suppose P is the population of a defined territory at time t then absolute population growth (change) at time t. denoted as

$$\delta P_t = P_t - P_o \qquad (1)$$

Where P_o and P_t are initial and present population respectively. This measure enables us to know the absolute amount of population change that has taken place. Limitation of the Absolute Population Growth is that the estimates of the absolute population growth do not take into account the size of the population. We cannot therefore, compare the growth of population for different countries.

Arithmetic Population Growth

The crudest measure of growth rate of a population at the period t is the arithmetic growth rate (AGR) which is more appropriately referred to as rate of increase. AGR may be determined as relative growth or percentage change

Relative Growth

The relative growth of population (RA) is given by

$$R_A = \frac{P_t}{P_0} \quad (2)$$

Arithmetic Percentage Growth

This arithmetic percent growth rate (APGR) is the change in the size of population during period t as a percentage of population at the beginning of the period. It is defined as

$$\text{APGR} = \frac{p_t - P_0}{P_0} \times K \quad (3a)$$

Where radix K is taken as 100. The arithmetic growth rate between two census dates is called intercensal arithmetic growth rate and when the censuses are ten years apart, it is called decadal arithmetic growth rate.

$$\left(\frac{P_t}{P_o} - 1\right) \times 100 \quad (3b)$$

A population growing arithmetically would increase by a constant number of people in each period. Hence, arithmetic change produces a linear trend in population growth. The arithmetic growth rate is expressed by the following equation

$$r = \left(\frac{p_t - P_o}{t}\right) \div P_o \times 100$$

Average Annual Arithmetic Rate of Population Growth:

Sometimes like to compare the growth of different population or different periods. This can be done when the time interval between censuses is the same. When these intervals are not the same, the ratios must be put on a comparable basis. This is done by converting them into annual rates of growth (or the annualization of growth rates).

Somehow distributing the observed growth through the intercensal period. Suppose t is measured in years, then the average annual arithmetic growth rate r_A is

$$r_A = \frac{1}{t}\left(\frac{p_t - P_0}{P_0}\right) 100 \quad (4)$$

TIJSRAT
ISSN: 2623-7861

Where t is the interval between two periods: P_o and P_t are the beginning and the end of period t if P_o and P_t are the beginning and the end of the same year, respectively, the formula for the annual rate of population growth is the same as that for the arithmetic rate of growth.

Geometric Population Growth

In a population, every addition has the potential to change the size of the population. Increased population contributes to further increase during their lifetimes. This implies that the growth of population mimics the principle of compound interest rate, from which we can write the geometric growth equation as:

$$p_{t+n} = P_o\ (1 - r_G\ )^t \qquad (5)$$

Where r_G is the average annual geometric growth rate we may obtain r_G from the equation as:

$$r_G = \left[exp\left(\frac{1}{t}\ln P_t - lnP_o\right) - 1\right]k \qquad (6)$$

$$r_G = \left(\sqrt[t]{\frac{P_t}{P_o}} - 1\right)k \qquad (7)$$

Exponential Population Growth

The geometric growth rate assumes that t is taken as a discrete variable, that is, the rate of growth operates annually, year to year. This is quite adequate and meaningful as data are usually available on an annual basis. However we also known that population growth is a continuous process, and so we need to modify the geometric growth e.g nation to take care of instantaneous growth instead of annual growth. This gives the exponential growth equation define as

$$P_t = P_t e^{r_G t} \qquad (8)$$

Taking the natural logarithm of equation (8), gives

$$lnP_t = lnP_o + lne^{r_G t}$$

TIJSRAT
ISSN: 2623-7861

$$lnP_t = lnP_o + r_G t$$
$$r_G t = lnP_t - lnP_o$$
$$r_G = \left(\frac{1}{t}\ln P_t - lnP_o\right) \quad (9)$$

Double Time of Population

This is the time it will take for a given population to double itself for a given population growth rate r. This is given by

$$2P_o = P_o e^{rt} \quad (10)$$

Knowing the value of P_o and r

$$2 = e^{rt}$$
$$t = \frac{\ln 2}{r}$$

Table 1: Population and Yearly Percentage Change

YEAR	POPULATION	YEARLY % CHANGE
2019	201,164,764	2.60
2018	196,070,754	2.62
2017	191,064,308	2.64
2016	186,146,387	2.66
2015	181,318,767	2.71
2010	158,661,859	2.68
2005	139,004,020	2.58
2000	122,406,256	2.53
1995	108,056,391	2.54
1990	95,307,758	2.64
1985	83,646,431	2.62
1980	73,497,130	2.99
1975	63,437,736	2.51
1970	56,038,182	2.23

1965	50,178,099	2.12
1960	45,183,642	1.90

Table 2: Projected Population

YEAR	POPULATION	YEARLY % CHANGE
2022	206,345,935	2.58
2025	233,576,689	2.51
2030	263,240,578	2.42
2035	295,281,332	2.32
2040	329,396,011	2.21
2045	365,076,884	2.08

Results and Discussion

A population projection gives a picture of what the future population may look like, based on knowledge of the past and taking, for the future, hypotheses based on fertility, mortality and migrations. The demographic projections are made on the basis of the results of the population data available. After careful analysis, one cannot but arrive at the inevitable conclusion that the growth rate recorded from 1960 to 2020 population increases based on the yearly percentage change exception for the year 1995 to 2000. The annual growing rate ranges from 18.0725 to 1.5551. The northern part of the country have declined in growth rate due to decrease in population 2000 and 2045 and this can be due to COVID -19, unemployment and emigration..

Conclusion

Based on the analysis and findings, The estimated population of Nigeria will be 167.27 millions by 2019, it is not reasonable to accuse the National Population Commission of any biasedness against either Kano or Lagos and other states given the balanced nature of the

annual growth rate recorded in the census. With the present result of the provisional figures, which contained statistics for the states, no one can reasonably fault the 2006 census result and also for the population projection 2019.

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