

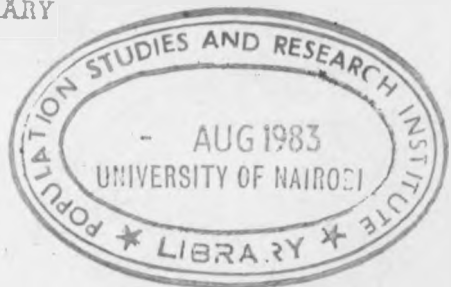
"REGIONAL FERTILITY LEVELS AND  
RURAL-URBAN FERTILITY DIFFERENTIALS  
IN THE SUDAN

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"A THESIS SUBMITTED IN PART FULFILMENT OF THE REQUIRE-  
MENTS FOR THE DEGREE OF MASTER OF ARTS 'POPULATION  
STUDIES' IN THE (P.S.R.I.), UNIVERSITY OF NAIROBI"

AUGUST 1981

DECLARATION

"This thesis is my original work and has not been presented for a degree in any other university"

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ABSTRACT

The objective of the present study is twofold: The first aim is to estimate, on the basis of data available and its nature, the most plausible fertility levels for the Sudan as a whole, its regions and rural-urban populations. The second purpose is to summarize present informations on rural-urban fertility differentials in the Sudan.

Chapter one, which is titled "Population, Economy and Society", examines the factors underlying the persistence of high fertility and fertility differentials within and between the different regions of the Sudan. This is done within a historical context covering three periods: the pre-Colonial, the Colonial and the post-Colonial period up to 1973, the census time. In brief, the cultural context, within which the Sudanese society exists, is conducive to high fertility while the <sup>pre-</sup>Colonial period was characterized by variations in the natural fertility prevailing then; the Colonial period had in fact witnessed the start of fertility, -- mortality and migration, -- differences, other than the already existing variations in fertility, as caused by the uneven distributions of economic plantations -- agricultural schemes -- and the subsequent differences in health and educational differences, in the various parts of the country. During the post-Colonial period, high fertility and fertility differentials have to exist due to: the absence of any significant structural changes in the economic structure modelled since the Colonial time, as an agricultural export economy; and the continuation of regional inequalities in socio-economic development.

Chapter two deals with the analysis of demographic data reported in the 1973 population census for the Sudan as a whole; its regions and rural-urban populations. Data on age are erroneous, characterized by age heaping and age misreporting. The systematic bias of the interviewers to "age" the respondents, especially the female population, has produced a systematic pattern of age misreporting characterized by large-scale distortions, which is common to most of the underdeveloped countries in Asia and Africa. However, the identification of such pattern of age distortion is useful for the accuracy of the estimates of fertility levels. Data on fertility, on the other hand, though affected by women not stating their parity, agree with the assumptions underlying the use of the Brass P/F ratio method, that it could give good results.

Marital conditions is an important area in fertility analysis. High fertility, according to the analysis of marital conditions undertaken in Chapter three, is achieved through: early age at marriage, low permanent celibacy and quicker rates of re-marriage of the divorced and widowed women, especially in the rural areas. The latter tend to imply higher rural than urban fertility.

Chapter four deals with regional fertility estimates. In the light of the characteristics and the nature of data on age and fertility, the best estimates of the fertility levels can only be obtained by combining the different techniques available for estimating fertility levels from a defective data. The estimates of fertility for the Sudan as a whole, its regions and rural-urban populations, by combining both the Brass P/F ratio method and the quasi-stable population method

are the most plausible that can be obtained. The estimates have located Sudan among the African countries, whose fertility is high or perhaps very high. They have also revealed fertility differences within (rural-urban) and between the different regions of the Sudan.

Chapters five and six summarize present information on rural-urban fertility differentials. For the Sudan as a whole, rural fertility is slightly higher than urban fertility. This is also observed in all regions except the Western region. In the latter region, urban fertility is very slightly higher than rural fertility. Chief among the factors that generate the observed difference in rural-urban fertility levels are: (i) early age at marriage, affecting urban areas more than the rural areas; (ii) traditional practices, e.g. prolonged lactation and/or abstinence, affecting rural areas more than urban areas, and (iii) factors affecting the biological capacity of women to reproduce, which are more apparent in the Western and Southern regions. However, the effect of these factors in rural and in the urban areas, tends to offset each other, with the net effect that rural fertility, for the Sudan as a whole, is slightly higher than urban fertility. On the other hand, rural-urban migration has no effect on rural fertility. In fact, rural fertility is highest in the Northern region, which is more affected by the migration of its adult males.

A summary and conclusion is given in Chapter seven, supplemented by a section dealing with the implications of socio-economic development for fertility levels and trends in the near future.

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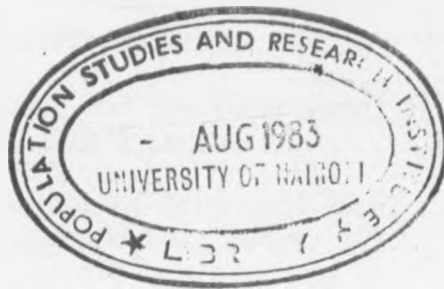
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## CHAPTER I

### POPULATION, ECONOMY AND SOCIETY

#### "THE PERSISTENCE OF HIGH FERTILITY IN THE SUDAN"



#### 1.0 Introduction

Man has been concerned with population and population growth since antiquity. Ancient Chinese, Romans and Greeks have shown a considerable concern about their population size and growth in relation to their political issues, army's requirements, city's growth and general socio-economic problems. (U.N., 1973, 33-34). Among the Muslims views of population, mention should be made to Ibn Khaldon - an Arab - who related population growth and welfare to the political and economic conditions of a society. (Ibid, 1973, 35). However, more formal population theory is generally considered to have its beginnings in the late eighteenth century writings of T. Malthus. His work stimulated social issues associated with it, and pushed the subject into prominence for the first time. The basic propositions that Malthus attempts to prove are: 1) Population is necessarily limited by the means of subsistence. 2) Population invariably increases where the means of subsistence increase, unless prevented by some very powerful and obvious checks. 3) These checks, and the checks which repress the superior power of population, and keeps its effects on a level with the means of subsistence, are all resolvable into moral restraint, vice, and misery. (Ibid, 1973, 39). After stating that strong impediments to population growth are constantly in operation, Malthus inquires what would be the natural increase of population, if left unchecked, and what would be the rate at which the means of subsistence can be increased. On this basis, he stated that population tends to double



itself every 25 years, thus increasing in a geometrical ratio, while under the most favourable conditions agricultural produce increases each 25 years by an equal quantity, thus increasing only in an arithmetical ratio. Hence the main thesis is that man's capacity to increase his means of subsistence was much less than his capacity to multiply and that the evils of over-population existed and had always existed.

In general, Malthus appears to assume diminishing returns from land. Diminishing returns were thought to be typical to agriculture only. That is, given a fixed quantity of land, then an increase in the number of labourers tend, after a certain point, to generate decreasing returns. On the other hand, Malthus's propositions that population was limited by the means of subsistence and that, in the absence of checks, population would increase when these means increased, was incorporated in the theory of wages of the classical school economists. According to them, wages tended towards a level which was just necessary to enable the labourers to subsist and to perpetuate their race without either an increase or decrease. This wage theory held that at the so-called subsistence wage level, the supply of labour would be completely elastic. If wages were above the subsistence level, population and labour supply would tend to reproduce at a more rapid rate in accordance with Malthus's theory and the increased supply of labour would tend to bring wages down again to subsistence level. Likewise, if wages were below the subsistence or natural price, population would decline; but in response to the resulting labour shortage, wages and population would rise again, tending towards the equilibrium level.

Hence, the vulnerability of Malthus's ideas comes mainly from his shorter views of the role of technology in increasing both the

productivity of the worker and the land; and in his biasness against the poor class, asserting "the absolute impossibility from the fixed laws of our nature, that the pressure of want can ever be removed from the lower classes of society". (Ibid, 1973, 38).

The course of events of the behaviour of the birth and death rates since Malthus's time had led to the gradual evolution of what was latter termed the "theory" of demographic transition. While the theory derives all its wisdom from the European experience, it claims universal applicability.

The theory claims that the historical decline of fertility in the now developed low-fertility countries is generally attributed to a complex of factors related to economic development and industrialization, or to what is vaguely described as the process of modernization. It is agreed, however, that national fertility decreases in response to an alternation of values relative to children and child-bearing among a sufficiently large number of couples. Scholars, however, differ in answering in what circumstances will individuals consciously control fertility. Coale (1967, 168); Freedman (1961/62, 35-121); P.G. Podyachikh (1968, 245-247); and many others share the view that aspects of modernization influencing fertility control include: declining mortality; a rising status of women; an increase in the influence of secular rationality and a decline in the motivating influence of customs and traditions; and the spread of education and literacy. While all these scholars agree that these factors have their influence on fertility decline, each one stresses the importance of different factors or combinations of factors. It is interesting to note here, as the early decline in mortality in the Western countries came before the invention of modern medicine technology; the early decline

in fertility preceded the inventions of modern contraceptive technology.

At a micro-level, fertility decline is believed to be a result of declining mortality; rising social status (J. Brent, 1952, 244-260), and cost-utility of children. K. Davis (1963, 350-351) asserted that birth control was only one of the means whereby the people of Japan and North-Western Europe reduced fertility. He asserted that "each industrializing nation tended to postpone marriage, to increase celibacy, to resort to abortion, to practice contraception in some form and to emigrate overseas".

The question posed is whether the experience of Western developed countries and of Japan are likely to be repeated within a reasonable time without "interference" in countries where fertility is still high; is debatable. (Henin, 1970, 19-20) asserted that the African experience differs from that of Western Europe in two aspects: the level of fertility reached by the African woman; and the existence of fertility differentials within and between the individual African countries. Furthermore, and most important, is the different levels of socio-economic development between the two regions, and the possibility of duplicating the European development achieved in the underdeveloped countries. However, while the factors underlying the decline of the birth rates in Europe and the Western countries are not fully understood, and since the time element is crucial, massive programmes of family-planning are undertaken in most of the underdeveloped countries that expressed a population problem of high fertility and population growth rate. While it is claimed that family-planning programmes have succeeded in encouraging a slow decline in fertility in some countries, scholars still debate the issue.

Freedman has speculated that "Family-planning is unlikely to be widely adopted in any country until there has been a significant mortality decline and until there has been enough social and economic development to lessen dependence on local and familial institutions and to make smaller families more rewarding than larger families". (Freedman, 1965, 45).

It is said in some current writings on population problems that the "Inhabitants of the developing countries generally are procreating with little restraint, at rates near the limits of their physiological capacity". (U.N., 1965, 7). If it were true generally in the under-developed countries at present that free rein is given to the powers of procreation, then, the differences in fertility levels among these countries would have to be explained mostly by differences in factors, affecting physiological capacity to produce living-offspring. Such factors include the general state of health and nutrition and the prevalence of diseases closely linked with pathological sterility, sub-fecundity, and foetal mortality : notably <sup>venereal</sup> diseases, malaria, and other debilitating illnesses. In some areas, especially in parts of Africa and Mongolia, it has been suggested that the explanation of relatively low fertility might be found in factors of this sort. (Ibid, 1965, 8).

Caldwell (1977, 25-120) criticized the demographic transition in many ways. He attributed its failure to answer many questions regarding fertility and mortality levels and trends in the third world, to the insufficiency of research, as well as the use of Western assumptions and models in analyzing these societies. He distinguished between two types of fertility regimes: one where there is no economic gain from restricting fertility, and the second where economic rationality alone

would dictate zero-reproduction. Further, he suggested that movements from a society characterized by economically unrestricted fertility to a society characterized by economically restricted fertility is essentially a product of a social, rather than economic change although with economic implications. Caldwell adopted a micro-approach investigating families and the relationship between the different individuals within the family. In a wide research in West Africa, Caldwell recognized the mode of production as a familial one, and the production relations as those existing between different individuals within the family. He asserted that persons who control economic and demographic decisions are the ones who benefit most wealth from high fertility. Only by changing that situation to a situation where they generate no economic or other gains, is fertility going to decline.

In the underdeveloped regions of the world, populations are noted to be growing rapidly. Africa, is one of the least developed regions of the world. Its growth, generated by its higher (or increasing fertility) and the rapidly declining mortality, is as high as 4.0 percent annually in some of its countries.<sup>1/</sup>

In the Sudan, fertility is high. The 1955/56 Population Census reported a birth rate of 51.7; a death rate of 18.5, leaving a growth rate of natural increase of 3.32 percent annually. Ecological, economic, social and cultural factors are working interrelatedly to keep fertility high. Only by explaining these factors can a comprehensive view of Sudanese fertility be achieved.

In this chapter we intend to examine the factors that are

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<sup>1/</sup> Kenyan population in 1979 is reported as growing at 4.0 percent per annum. (Mosley, H.W., 1981, 1).

responsible for the persistence of high fertility in the Sudan. This will be done within a historical context covering three periods: the pre-Colonial, the Colonial and the Post-Colonial period up to 1973, the census time. In each period the factors responsible or related to fertility and the general reproductive behaviour of the population will be examined.

### 1.1 General Characteristics of the Country

Sudan is the largest country in Africa, covering an area of approximately one million square miles (2.5 million square kilometers). With a population of just less than 15 million in 1973, the country is sparsely populated. The average density of less than 15 persons per square mile is less than the African average of people per square mile.

Generally, the country forms an immense basin, sloping gently downward - the north, with high land, on the other three sides: the Red Sea Hills and the Ethiopian highlands on the east side, the Marra mountain range on the western side and the Imatong range in the far south.

The main feature of the climate of the Sudan is a variability of rainfall and humidity, except for the Red Sea coastal strip, where maritime conditions prevail. The rainfall of the country ranges from 1400 mm. annually in the extreme south to nil in the extreme north and, accordingly, the climatic conditions vary from humid tropics to arid desert conditions. The Sudan can be conveniently divided into four climatic regions: (a) The Red Sea coastal strip, (b) Northern Sudan (constitutes the northern region) north of latitude  $19^{\circ}\text{N}$ , (c) Central Sudan (constitutes the Central region, part of Khartoum and the Eastern region, between latitude  $19^{\circ}\text{N}$  and  $13^{\circ}\text{N}$ ), and (d) Southern Sudan (south of latitude  $13^{\circ}\text{N}$ ).

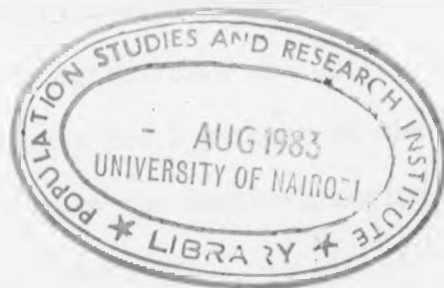
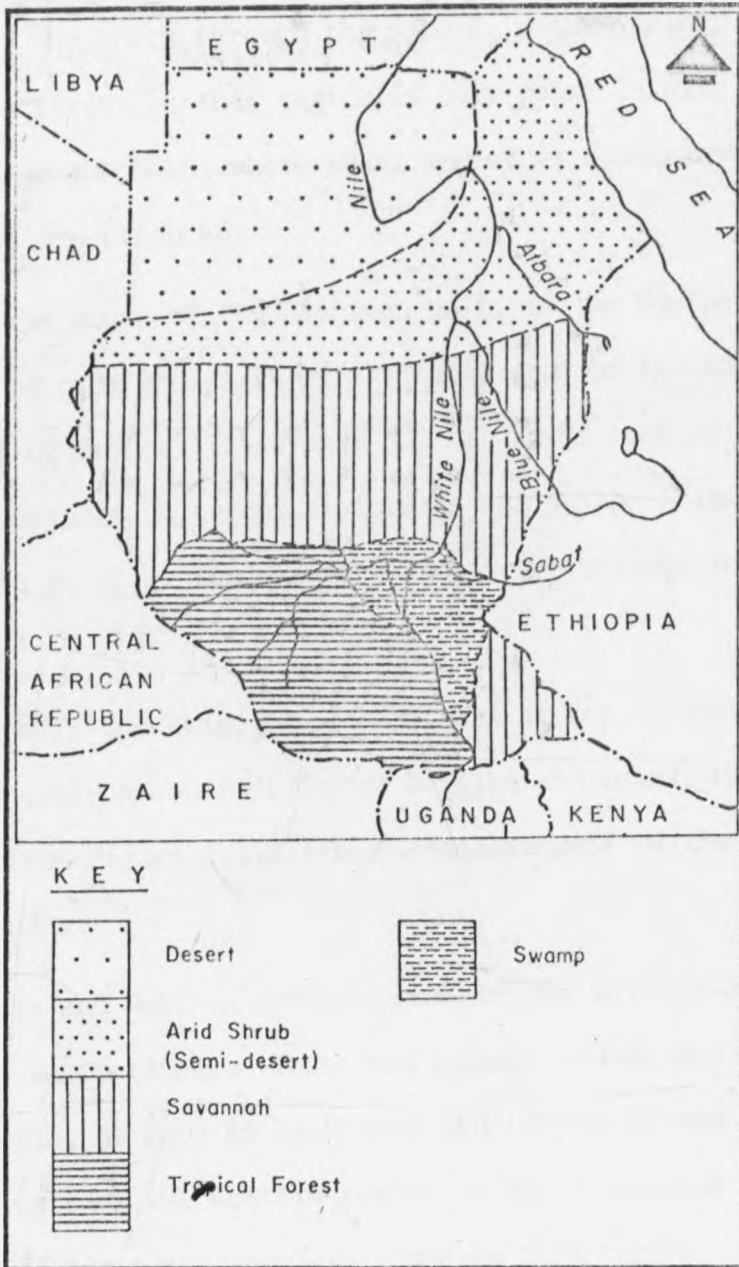
The various types of vegetation follow the rainfall, and accordingly, tend to be in broad bands running roughly east and west. These types are -- from north to the south -- desert, arid shrub, Savannah belt (with swamps) and tropical forests. These are given in Figure 1.1.A.

The dominant physical feature of the country is the Nile system, running through it for two and a half thousand miles. This Nile system divides the country into a vast table land to the west of the White Nile. A very fertile region is enclosed in the area between the White Nile and the Blue Nile (the Central region) as well as between the Atbara River and the Blue Nile (the southern part of the Eastern region). The main gravity irrigation schemes are located in these two regions. Khartoum is situated at the confluence of the White and the Blue Niles. Being the capital city, it is the most industrialized, urbanized and economically advanced centre in the country, with a considerable influx of rural emigrants in search of employment. The settled populations in both the Central and Eastern regions are involved in cash crop cultivation (cotton and groundnuts) and other food crops (wheat) and are therefore far better in economic conditions than in other regions. These regions are also subject to a considerable influx of emigrants, especially seasonally (for cotton picking especially in the Gazera area).

To the west of the Blue Nile and along the Savannah belt, the populations of the Western region are involved in cattle and animal herding, and seasonal rain cultivation, where agriculture is used mainly for subsistence. This area is also characterized by heavy male out-migration to the agricultural schemes in the Central and Eastern regions.

Down-stream of Khartoum the river is simply called the Nile

Fig.I.IA: GEOGRAPHY AND FLORA.





sloping to the north through the Sahara in the Northern region. Agricultural activity in this region is only possible with irrigation along the banks of the Nile, where wheat and other cash crops in small quantities are produced.

To the south of the Savannah belt, is the Southern region. It consists of over one-sixth of the total area of the country with rainfall varying from a little over 800 mm. to as much as 1500 mm. This area is dominated by tropical forests and swamps (Figure 1.1.A.). Figure 1.1.B. gives the distribution of the various regions of the Sudan.

Broadly speaking, the inhabitants of the Northern regions are pre-dominantly Arab of different origins and mainly Muslims. As can be seen from Figure 1.1.C., they dominate most of the Northern regions of the Sudan.

Beja and "Nubiya" dominate most of the Eastern and Northern regions, respectively. These are mainly Muslims and claimed to be of Arab origin, or come to be contacted by Arabs a long ago. In the western part of the Western region, human stocks who emigrated from Western Africa a long ago are found in this region. The inhabitants of the Southern region are Negroid of African origin. The inhabitants of this region are involved in agriculture and cattle-keeping. Christianity, believed to account for 5 percent of the population, is found mainly in the urban areas of the Southern region. The rest of the inhabitants in this region are pagan.



Fig.1.1.B: SUDAN REGIONS.

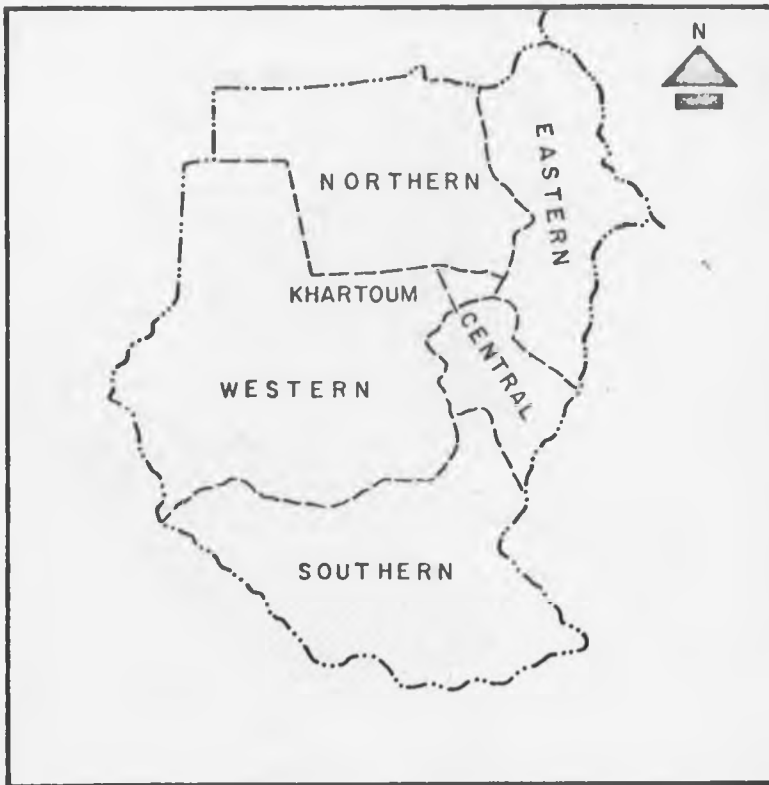
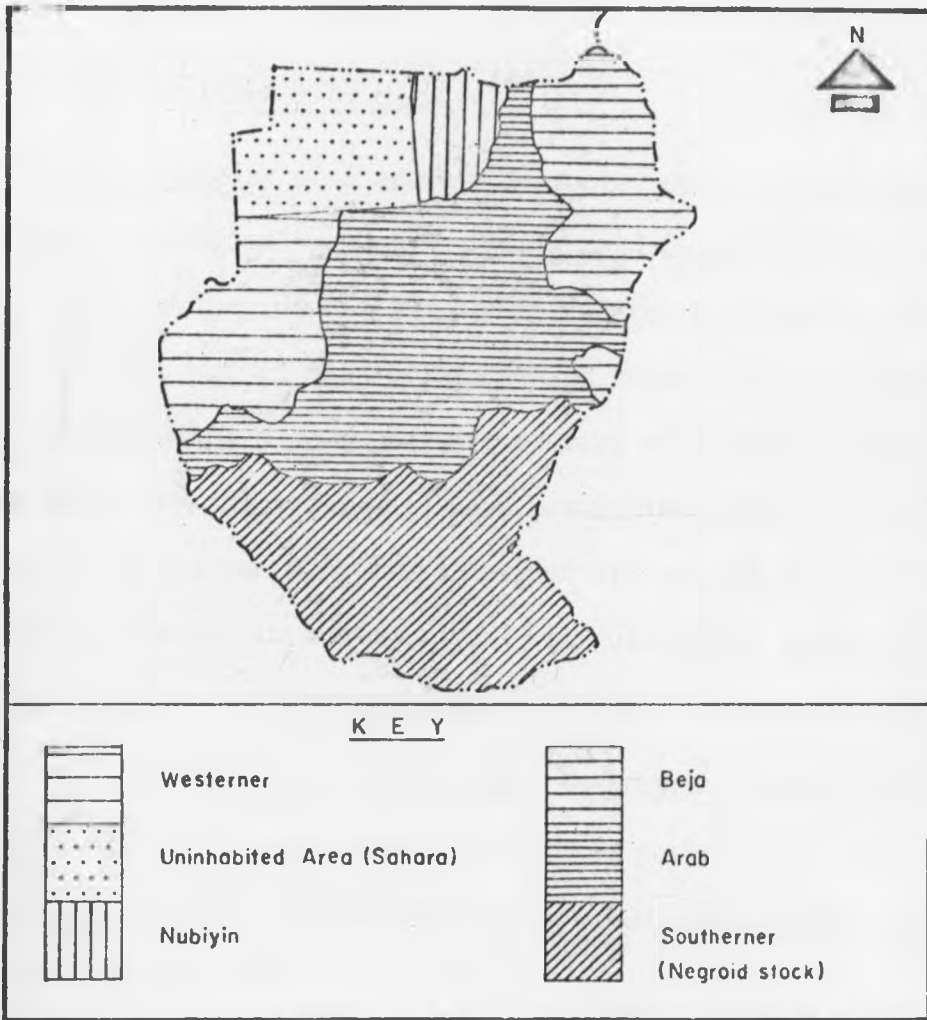


Fig.I.I.C: S U D A N P E O P L E S .



SOURCE : Compiled from , D. Paul "The Demography of the Sudan" "An analysis of the 1955/56 Census , In Brass W. et al, Demography of Tropical Africa" Princeton ,1968 , pp. 447.



1.2 Population, Economy and Society:  
"The Persistence of High Fertility"

The fertility of a society is rooted deep in the history of that society. Ecological, economic, social and cultural factors work inter-relatedly and interdependently to influence the reproductive behaviour of a society. It is only by explaining these factors, within a historical context, that a comprehensive picture of fertility can be obtained. This means two things: first, at a particular time the fertility of a society and its reproductive behaviour are a by-product of these factors; secondly, changes in these factors will ultimately lead to a change or a modification in the reproductive behaviour of the population.

In this section, we will trace the reproductive behaviour of the Sudan society by tracing factors in three periods: the pre-Colonial period, the Colonial period and the post-Colonial period, up to 1973, the date of the last census.

(i) The Pre-Colonial Period:

Before systematic British colonization, the vast majority of Sudan land consisted of independent producers -- peasant cultivators, nomads, and even hunters and gatherers in the most remote areas of the Southern and Western regions -- still involved in pre-capitalist modes of production, generally clustered in various socio-cultural groupings that are normally referred to as "tribes". A general characterization of these units is a bit difficult because of their heterogeneity and the inadequacy of available information about them, yet a few but basic features that are pertinent to our analysis can be isolated.

Land is known to be communal. Membership in the group is a

pre-condition of land appropriation, allotted on conditions of proper use and gainful exploitation. The dominant productive unit is the village commune, family or the clan. The family in turn was organized in most along partriachal structure lines. It was also grounded amongst almost all communities on: (a) a sufficient male offspring for ancestor worship, and (b) a form of family solidarity based on a descent from the same parent, often father's descent. The locus of family power was in elders often of a partrilineally extended kin group, that is, in the eldest ascendant generation.

The independence of these groups was regulated by their mutual relationship as members of a community and by the need to safeguard common land for common need. Land was distributed by chiefs, kinship, etc. Labour was acquired through marriage, kinship, and friendship reciprocity. For example, work parties "nafirs" were organized to do common tasks in land clearing, cultivation and harvesting. Hence the two factors of production, land and labour, were never traded. Labour is a sort of social obligation and not for the creation of value; labour being the most important factor of production, since land is in plenty supply. The larger the reproductive unit, the more productive it is likely to be. To maximise output is to put into the process of production as much labour as possible, especially in seasonal activities. Hence, the seasonality of agriculture is very important with regard to the need for labour and hence the size of the family. With production organized on a family basis, marriage and reproduction are the essential pre-requisites for security, well being, eventual independence and comfortable old age (Gruenbaum, E., 1979, 39).

Wealth distribution is socially guaranteed through a strong system of mutual reciprocation of gifts, goods and services. Marriages,

births and male circumcisions were the most important events or occasions for help and solidarity. The contribution by the community members to these events, are material contributions and in services. Hence marriage, whose prime objective is the production of children, does not require as a pre-condition the possession of wealth or high occupation. Marriage is usually organized by elders who also decide the age at marriage, which usually starts at or before puberty. Veneration to age is generally recognized, and this perhaps is what stabilizes the system.

Ancient and modern history of the Sudan reveals a lot of invasions and foreign penetrations, which by itself, stresses the need for fighters and larger groupings, and consequently for high fertility to meet these ends. The prevalence of the slave trade and war, on the other hand, tend to drain the society of its most productive forces and consequently to decrease its productivity. This results in the regression of agriculture and productivity and ultimately in famines and diseases, and further reduction in the population. Bayoumi (1979, 46-55) reported that in the nineteenth century, Sudan faced more than seven epidemics of cholera and an aggregate of a dozen episodes or so of smallpox. Hence, it was generally believed that during the nineteenth century, Sudan was depopulated due to famines, warfare, epidemics, and slave trade. However, Galal-el-Din reported that "it seems that there was some underestimation of the population at that time (nineteenth century) in order to exaggerate the losses in population during the Mahadiya mainly for political reasons". (Galal-el-Din, El, M, 1976, 24). However, it must be noted that wars, famine and slave trade, in a society where productivity depends mainly on the available manpower, tend to drain the society of its main productive forces. Hence, a woman in such a society would need to have as many children as possible, some

to be taken by mortality -- which is extremely high in such societies -- and some to be slave traded and the others remain fighting for survival. In such a society, children contribute early in life to the household economy and provide the only source of security for parents at old age (Coale, J.A., 1958, 9-17). In his study "the economic value of children in rural Sudan", Galal-el-Din has shown that not only is the cost of bringing up children in rural Sudan negligible, but also their great contribution as children and adults to their families' welfare and well-being and they are the best form of security for parents at the time. (Galal-el-Din, 1977, 617-632).

Traditional modes of life other than peasant cultivation include nomadism, hunting and gathering. It must be noted that nomads and hunters are themselves seasonal cultivators. In all these modes of life there is a need for the size of the family for physical, political and security reasons "while the peasant economic structure of the peasant family holds, fertility everywhere in the region remains high and contraception is rarely used". (Caldwell, 1977, 18).

All the factors discussed above must have placed a high value on procreation. Moreover, all religions welcome the birth of a child. Due to this high value of procreation and the religious prescriptions, we notice: (a) early age at marriage, (b) low permanent celibacy, (c) non-use of contraception, and (d) a host of other factors that would place a plus sign on fertility. Hence, the cultural context in which the Sudanese pre-Colonial society exists -- reinforced by its poor and traditional socio-economic structure -- was conducive to high fertility.

Yet, ecological, environmental and cultural variations within these societies resulted in fertility variations relative to these factors. Variations in "natural" fertility prevailing in these communities can be

attributed mainly to variations in traditional practice, norms governing sexual intercourse and social beliefs. One of the practices commonly used to space children is lactation, which is usually long and often continues until the next pregnancy occurs. Among the Dinka -- "the largest tribe in the Sudan" -- for example, fertility is controlled by traditional practices that tend to space children even though procreation is an over-riding value. For example, while the mother is breastfeeding her child she must abstain from sexual relations. Also in the case of polygamy -- which is very common and only limited by wealth, -- senior wives do not compete with junior wives or co-wives in fertility. (Deng, F., 1971, 27-28). On the other hand, the fertility of the nomads, -- who constitute a good proportion of the population then -- was reported to be low as a result of poor nutritional standards, poor health conditions, the prevalence of malaria and other diseases, and as a result of the hard work performed by nomadic women. (Henin, R.A., 1969, 171-198). Furthermore, among the Azande of the southern Sudan, the prevalence of malaria and venereal diseases are thought to be the cause for high incidence of sterility, foetal wastages and miscarriage.

(ii) The Colonial Period:

The Colonial policy in its direction and magnitude, have resulted in many factors that would affect the economy, and consequently the population dynamics. Chief among these are: (a) a dependent economy well linked to metropolises to assure its dependence, (b) underdeveloped economic structure as revealed by regional inequalities and incomes disparities between the various regions of the Sudan, and (c) consumption growth that has further stimulated consumption values over the productive values.

While all these factors tend to affect the economy, and consequently the population characteristics and dynamics in various ways, but



most relevant to our discussion on fertility levels and trends, is the manifestation of regional inequalities as caused by the uneven economic development.

The main motive of Colonial policy was the exploitation of the country's resources. This was manifested in its increasing efforts to establish "economic islands" for the cultivation of cash crops -- mainly cotton -- for export. The Gazera irrigated agricultural scheme was erected in the most fertile area of the Central region after the completion of Senar dam in 1925. The second development was the establishment of the pump schemes along the White Nile in the Central region. Most of the transportation facilities (Sudan railways) were kept between these areas and the sea outlet. Social and health services in terms of education and hospitals would eventually concentrate in these areas.

The introduction of cash crops divided the country into two major areas. On the one hand, we find a fairly prosperous and relatively densely populated peasantry, located in areas with plentiful rainfall and/or irrigation system, engaged mainly in the cultivation of cotton, and favourably located with respect to transport facilities. On the other hand, we find a less prosperous peasantry, located in areas with moderate and unreliable rainfall or located along the Nile banks and its tributaries, -- excluding the Southern region -- where sparsely settled populations -- including nomads -- are still engaged in largely subsistence cultivation of food and a few exchange items, and are unfavourably linked with systems of transportation and urban market centres.

The major agents of these regional differentiation are economic and the subsequent social services (e.g. health and educational

services). The economic differentiation was brought through the introduction of large-scale cash crops and the creation of labour market. As this tends to favour the Central and Eastern regions, they have been subject to considerable influx of emigrants from other regions, especially at the harvest time of cotton in the Gazera area. Education, on the other hand, was not only unevenly distributed, but was also highly influenced by a Colonial policy geared to production of junior clerks and administrators to serve in the government offices, especially in the Northern regions, and by the missionary activities in the Southern part of the Sudan. (Bahir, O.M., 1979, 18).

So, the land tenure system in the less developed areas remained communal; the population remained illiterate, in bad health conditions and with increasing migratory streams from these areas, especially the Western and Northern regions, towards the relatively developed areas in Central, Khartoum and the Eastern regions.

In terms of health services the Colonial period had actually witnessed the start of modern health services. However, the same period had also witnessed the appearance of new diseases for the first time, for example, cerebrospinal meningitis and relapsing fever. Further, the impact of the newly introduced irrigation systems and canalization in the Gazera has also resulted in the intensification of such diseases as malaria and schistosomiasis. (Bayomi, A., 1979, 326).

Overall then, apart from the environmental and cultural variation in fertility in the different regions of the Sudan, the Colonial policy in its directions and magnitude had in fact resulted in differences of fertility, mortality and migration, mainly as a result of regional inequalities created or expanded during that period. While the fertility of the settled population in the Gazera increased as a result

of settlement, that of the nomads remained low, almost half that of the settled population who were previously nomads. (op. cit. 1969, 171-198). Infant mortality, on the other hand, in the less developed regions remained high. The 1955/56 census undertaken on the eve of independence reported an infant mortality rate in the Southern region as high as twice that of the Gazera area.

(iii) The Post-Colonial Period (1956-1973)

Sudan became politically independent in January 1956. Since independence, Sudan has changed little. The one-sidedness of the Sudanese economy continues, and it continues in its heavy reliance on agriculture. In 1973/74, only 38.2 percent of Sudan's gross domestic product (GDP) at factor cost was provided by agriculture, livestock, forestry, and fishing activities, which indicates the low productivity of the methods and techniques used. (Elhasan, M.A. 1976, 5). Table 1.2.1 presents the composition of the GDP by economic sector for the years 1955/56 and 1973/74.

TABLE 1.2.1 COMPOSITION OF GDP BY ECONOMIC SECTORS, SUDAN, 1955/56 AND 1973/74 (Percentage)

Sector	1955-67	1973-74	Difference 1973-74 - 1955-56
GDP, Factor cost (Ls. million)	284.2	698.6	-
Agriculture, livestock, forestry and fishing	61.0	38.2	-22.8
Mining, manufacturing and handicrafts	4.5	8.3	+ 3.8
Electricity and water	4.5	2.7	- 1.8
Construction	5.7	4.1	- 1.6
Commerce and hotels	6.0	16.6	+10.6
Transport and communications	7.5	8.1	+ 0.6
Finance, insurance, real estate, etc.	3.7	6.4	+ 2.7
Government services	6.7	14.5	+ 7.8
Others	0.4	1.1	+ 0.7
TOTAL	100.0	100.0	-

The table shows that as the reliance on agriculture during the intercensal period has decreased from 61.0 percent to 38.2 percent of the GDP, it still dominates nearly two-fifths of the GDP. The table also shows the slow growth of both industry and transportation, and an increase in commerce and hotels businesses. The contribution of the manufacturing sector does not exceed 8.3 percent, which indicates that since independence, Sudan has not experienced any significant structural changes. The contribution of public administration and defence is the highest in the Sudan. (Ibid, 1976, 7).

In regional terms, no comparable figures of the GDP are available. However, the overall picture reveals the low incomes for individuals and households. While incomplete and suffering from statistical differences, the only data available on household income by region from the Household Budget Survey for Sudan 1967-68, provides some interesting and useful comparisons. The data in Table 1.2.2 indicate sizeable differences in average income by region.

TABLE 1.2.2 AVERAGE INCOME OF HOUSEHOLD BY REGION, SUDAN, 1967-68

Region	Av. Annual Income (L.S.)
Khartoum	236
Eastern	183
Central	180
Western <sup>1</sup>	125
Northern	124
Southern	n.a.
Av. of the above regions combined	189

N.B.<sup>1</sup> Average of two provinces (Kordofan and Darfur).

Source: Household Budget Survey for Sudan, 1967-68,  
Department of Statistics, Khartoum, 1968.

The data above indicate sizeable differences in average income by region. Not surprisingly, the Western and Northern regions have the

lowest household income. While the latter region is less wealthy than Central, Eastern and Khartoum, the Western region is less urbanized and poorer than other Eastern regions. Both regions are characterized by heavy male out-migration. Data for the Southern region are not available, because at the time of the survey, the Southern region was disturbed by war. But the region is much poorer than others, being continuously subsidized by the central government. The table also shows that the most urbanized region, Khartoum, enjoys the highest level of income per household. The Eastern and Central regions come in the second position to Khartoum.

#### Food and Crop Production and Livestock

The dominance of the agricultural sector in Sudan's economy is revealed by the following characteristics reported by Abdel-Salam (1976): it constitutes two-fifths of the GDP in 1973/74; contributes 92 percent of the export earnings; supplies more than 90 percent of local industries' raw materials; supplies about 80 percent of the population job opportunities. (Abdel Salam, M.M., 1976, 42-43).

Perhaps the most outstanding contribution of the agricultural sector is the provision of food for the population. Sorghum (Dura), though shortages in sorghum are witnessed in some years in some regions, especially in the Western and Southern regions, Sudan is generally self-sufficient in this staple food crop. However, despite the fact that food items are produced in appreciable quantities, food import bills rank high among the total imports of the country. Import of consumption goods amounted to 68.9 percent of total imports in 1950 and 49 percent in 1971. (Ibid, 1976, 40). Table 1.2.3 shows the major crop production in the Sudan. No figures are available for the different regions of the Sudan.

TABLE 1.2.3. FOOD AND CASH CROP PRODUCTION IN THE SUDAN -  
1955/56/69/70 AND 1973/74 (000 Metric Tons)

	(1) 1955/56-69/70 (5 yrs average)	(2) 1973-74	% Change 2 - 1
Food crops:			
(a) Sorghum	1250	1625	+ 30
(b) Millet	350	268	- 23
(c) Wheat	95	235	+147
(d) Rice, Raddy	2	5	+150
Sub-total	<u>1625</u>	<u>2133</u>	<u>+ 29</u>
Export crops:			
(a) Cotton	569	670	+ 18
(b) Groundnuts	293	543	+ 85
(c) Sesame	162	240	+ 48
(d) Castor seed	17	-1	- 35
Sub-total	<u>1041</u>	<u>1464</u>	<u>+ 40</u>
Grant Total	2693	3597	+ 34

The overall increase in crop production in the intercensal period is 34 percent, the majority of which comes from the expansion of export crops. The rise in the production of both food and cash crops is attributed to an increase in an area under crop production rather than an increase in the productivity of the acreage. Among the food crops, millet has decreased in the intercensal period, while sorghum -- the staple food for the majority -- has increased by 30 percent. It must be noted that the overwhelming majority of these crops come from the Central and Eastern regions.

Sudan possesses animal wealth which contributes about 10 percent to the GDP annually. It has been estimated that livestock totals in 1973/74 were 40.7 million of which 14.1 million were cattle, 13.4 million sheep, 10.5 million goats and 2.7 million camels. This indicates a ratio of 2.75 livestock per person in the population, and the ratio of

cattle is approximately 1 (i.e. 0.96 cattle per person in the population)

Table 1.2.4. gives the the distribution of livestock by region.

TABLE 1.2.4. ESTIMATES OF LIVESTOCK POPULATION AND THE RATIO OF LIVESTOCK AND CATTLE TO POPULATION. SUDAN REGIONS, 1973-74

Region	Pop. in millions	Live stock (in millions)				Total	Ratio of livestock to pop.	Ratio of cattle to pop.
		Cattle	Sheep	Goats	Camels			
Southern	3.02	5.5	2.2	3.3	-	11.0	3.6	1.8
Western	4.34	6.7	5.9	3.5	0.4	17.7	4.1	1.5
Central	3.74	1.2	3.6	2.4	0.3	7.5	2.0	0.3
Eastern	1.55	0.4	1.1	0.7	0.6	2.8	1.8	0.3
Northern	0.96	0.2	0.5	0.3	0.1	1.1	1.1	0.2
Khartoum	1.15	0.1	0.1	0.3	0.1	0.6	0.5	0.9
Sudan	14.76	14.1	13.4	10.5	2.7	40.7	2.7	0.9

Source; National Commission "Economic Survey", 1974, Khartoum, July 1975, G.D.P., p. 56.

As can be seen from the table, the regions differ considerably in livestock possession. The Western and Southern regions remain with the highest figures of livestock and particularly cattle. Ratios of 1.8 and 1.5 cattle per person in the population in the Southern and Western regions, respectively, indicate that considerable population in these regions are involved in animal herding. A further distinction between these two regions is that while the population in the Southern region are homestead, the population in the Western region, who are involved in animal herding are constantly moving for grass and water. However, the development of livestock, especially in the Southern region is bounded by strong traditions and beliefs, where cattle is kept mainly for social significance. On the other hand, other regions have shown smaller involvement in animal herding, with Khartoum and the Northern regions remaining with the smallest ratios of cattle in the population.

Industrialization (Manufacturing):

As indicated earlier, Sudan remains primarily an agricultural country. No significant changes have happened since independence. Such changes, especially towards industrialization and female participation in the labour force are very important with respect to changes in fertility as accommodated in the theory of demographic change and in many other studies.

The share of industry (mainly manufacturing) does not reach 9 percent of the GDP in 1973/74. The geographical location of the industrial establishment has also favoured the urban zone, especially Khartoum, resulting in further regional inequalities. Table 1.2.5 gives the regional distribution of manufacturing industry in the Sudan for the years 1970/71, just two years prior to the 1973 Population Census.

Regional distribution of manufacturing industry in the Sudan offers a typical example of an underdeveloped country where industries are heavily concentrated in only one area. In the Khartoum region, more than 73 percent of all manufacturing industries are located, contributing 66 percent of manufacturing production, 61 percent of total value added, employing about 65 percent of the industrial labour force, and possessing almost half of the invested capital in industry. This concentration is related to the availability of raw materials, energy, transport, labour and market accessibility, etc. Consequently, while per capita income for Sudan as a whole is about LS 34, it is estimated to be about LS 100 for Khartoum region (Numeri, S, 1976, 97).

The Central region comes second in importance as an industrial centre and the Eastern region in the third position. In fact, these regions and Khartoum account for 88 percent of the establishment, 95



TABLE 1.2.5. REGIONAL DISTRIBUTION OF INDUSTRY IN THE SUDAN - 1970/71

Region	Establishments		Total Production		Total Value Added		Workers		Total Wage		Total Investment	
	No.	%	LS (000)	%	LS (000)	%	No.	%	LS(000)	%	LS (000)	%
Khartoum	153	73.2	54,144	66.1	16,885	61.5	27,653	64.6	8,693	67.2	48,451	47.2
Central	18	8.6	13,319	16.1	5,232	19.1	8,541	19.9	1,850	14.3	24,935	24.3
Eastern	13	6.2	10,398	12.7	3,772	13.7	4,164	9.7	1,691	13.0	20,688	20.4
Northern	5	2.4	2,146	2.6	859	3.1	1,140	2.7	379	2.9	4,875	4.4
Western	19	9.1	1,523	1.9	576	2.1	1,062	2.5	212	1.7	2,831	2.8
Southern	1	0.5	362	0.4	13	0.5	263	0.6	122	0.9	924	0.9
Sudan	209	100.0	81,892	100.0	27,451	100.0	42,823	100.0	12,947	100.0	102,704	100.0

Source: Nimeiri, M.S., 1976, Table No. 10, p. 99

percent of the production, 94 percent of the labour force, 94 percent of wage earned and 92 percent of the invested capital in manufacturing. The importance of the Central and Eastern regions is the availability of raw materials, especially cotton, power and electricity, which led to industries such as cotton ginneries, sugar and tobacco factories, etc.

While the Western region occupies a second position in the industrial establishment, its contribution to the total production, value added, etc, is insignificant, -- less than that of the Northern region where only five establishments are located, -- mainly because the establishments are very small. On the other hand, the Southern region occupies the last position with only one industrial establishment contributing negligible proportions to production, wage earned and industrial labour force.

This imbalance of industrial activities in the different regions, while might significantly affect fertility, rural-urban migration, depopulation of the rural areas and income disparities, are self-evident.

#### Health and Education

Health conditions and services are vitally needed in the under-developed societies, and their contribution to human reproduction and the life span have been well documented. Table 1.2.6 in the following page presents the distribution of health services in the different regions of the Sudan.

As can be seen from the table, for Sudan as a whole, the growth of health services -- measured here by the growth of hospital beds relative to the population growth -- remain static between 1956 and 1973. If we note that the plan has been based on a figure for the

TABLE 1.2.6. REGIONAL DISTRIBUTION OF HOSPITALS, HOSPITAL BEDS, ETC.,  
SUDAN REGIONS, 1956 AND 1973

Region	1 9 5 6				1 9 7 3					
	Pop.	Hospitals	Hospital Beds	Ratio of beds per 10,000 pop.	Pop.	Hospitals	Hospital Beds	Ratio of beds per 10,000 pop.	Doctors	Ratio of Doctors per 100,000 pop.
Khartoum	504923	9	1524	30.2	1145921	14	2830	25.0	464	40.5
Central	2069046	8	1470	7.1	3740405	31	3170	8.5	128	3.4
Northern	873059	6	789	9.0	957671	18	1387	14.5	67	7.0
Eastern	941039	4	1091	11.6	1547475	10	1788	11.6	93	6.0
Western	3090733	10	2188	7.1	3599259	24	2359	6.6	104	2.9
Southern	2783136	12	2542	9.1	3024914	25	2835	9.4	71	2.3
Sudan	10263536	49	9606	9.4	14758346	122	14359	9.7	927	6.3

population higher than the actual enumerated population in 1973, then health services have been actually deteriorating. It is interesting to note that the ratio of almost one bed for 1000 population remains the same since 1945. (Bayomi, 1979, 97). Khartoum continues to have the highest ratio of beds and doctors to population, while the ratio of beds to population have decreased in the intercensal period -- possibly due to rural-urban migration, -- the ratio of doctors per 100,000 population has increased. Khartoum, Northern and the Eastern regions remain with the highest ratios of beds and doctors to the population in 1973. The growth in these ratios is highest in the Northern region. The low ratio of hospital beds and doctors in the Central region is affected by the presence of seasonal emigrants for cotton-picking, who account for more than 760 thousand persons. If excluded, the ratios of hospital beds and doctors to population in 1973 rise considerably to 10.6 and 4.3, respectively. Both the Western and Southern regions remain with the smallest ratios of hospital beds and doctors to their population in 1973.

The growth of education in the intercensal period (1956-1973) is shown in Table 1.2.7, for Sudan as a whole.

As can be seen from the table, the growth of education in the intercensal period (1956-1973) is slow. This cannot be attributed to the population growth, since the plan is based on a population which is 22 percent higher than the figure obtained in 1973.<sup>1/</sup> The ratio of primary school education was raised from 60 to 80 in every 1000

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<sup>1/</sup> The population in 1955/56 was 10.263 million and the reported growth rate was 3.32 percent per annum. Assuming a constant rate of growth for the intercensal period, this results in a population of 18.1 million in 1973, which is 22 percent higher than the 14.8 million enumerated in 1973.

TABLE 1.2.7. ABSOLUTE AND RELATIVE NUMBERS OF STUDENTS BY EDUCATIONAL LEVEL,  
SUDAN, 1956 AND 1973

Educational Level	1956 <sup>1</sup>				1973 <sup>2</sup>						
	Male		Female		Ratio of both sexes for every 1000 pop.	Male		Female		Ratio of both sexes for every 1000 pop.	
	No. (000)	%	No. (000)	%		No. (000)	%	No. (000)	%		
Primary	554	90	60	10	60		850	68	400	32	80
Junior Secondary	39	89	5	11	4		114	76	36	24	10
Higher Secondary	22	88	3	12	2		38	76	12	22	3.3
Literacy	27.6		17.1		-		44.28		17.94		-

<sup>1</sup>Source: Bashir, M.O., 1979, p. 18.  
The population in 1956 is 10,263,536.

<sup>2</sup>Source: Educational Statistics, Ministry of Education, 1973

population, junior education from 4 to 10, and higher secondary school education from 2 to only 3.3 in every 1000 population. The table also shows the dominance of male education over females. The literacy rate of males raised from 27.6 percent in 1956 to 44.28 percent in 1973, while that of females remains almost static in the intercensal period.

In regional terms, the overall picture of education in 1973 is given by literacy rate, educational attainment and school attendance in Table 1.2.8.

TABLE 1.2.8. LITERACY, EDUCATIONAL ATTAINMENT AND SCHOOL ATTENDANCE BY REGION, SUDAN REGIONS, 1973 (Percentages- both sexes)

Region	Literacy	Educational Attainment	School Attendance
Khartoum	58.54	58.62	49.58
Northern <sup>1</sup>	44.69	46.88	53.55
Eastern <sup>1</sup>	41.05	41.71	36.78
Central <sup>1</sup>	39.87	40.46	37.93
Western <sup>1</sup>	26.0	26.0	23.0
Southern <sup>1</sup>	15.72	16.25	16.93
Sudan	31.33	31.93	30.99

N.B. Literacy figures relate to percentages of literate among persons 10 years of age and over.

Educational attainment figures relate to persons with some educational attainment to those 7 Years of age and over

School attendance figures relate to persons attending school to those aged 7-24 years of age.

<sup>1</sup> Provinces combined average.

In the table above, the regions are ranked on the basis of educational attainment. It is clear that the first four regions are significantly above the national average in literacy, educational attainment and school attendance. Both the Western and Southern regions continue to occupy inferior positions.

### 3.2 Summary and Conclusion

From the preceding analysis, we can summarise the following points:

(a) The cultural context -- reinforced by environmental factors and a weak socio-economic structure -- as well as the pro-natal religious prescriptions is conducive to high fertility.

(b) Actions taken in the Colonial era were responsible for the start of fertility and mortality differentials -- other than the already existing variations -- which were a direct result of the regional inequalities and income disparities caused by the uneven distribution of the economic plantations in the country.

(c) Since independence, Sudan has not experienced any significant structural changes. It still depends primarily on agriculture, and regional inequalities in economic and industrial development continue to be reflected in the maldistribution of health and educational services. Khartoum, Eastern and the Central regions continue to occupy priority in economic investment. The Northern region, though less wealthy than the above mentioned regions, still stands as one of the best regions in terms of health and educational services. Both the Western and Southern regions continue to occupy inferior positions in all these characteristics.

The above differences among the different regions of the Sudan are most likely to result in regional differences in fertility levels. While procreation is highly valued among societies in all these regions, regional differences in economic and social factors are likely to be associated with different biological capacities to reproduce, such as different morbidity and nutritional status, which have an impact on fecundity. But there are also major differences among the tribes in

norms regulating fertility behaviour.

The pastoral people in the Western and the Southern regions have lower fertility than settled agriculturalists. This lower fertility may be ascribed to health conditions, prevalence of malaria and venereal diseases, ignorance of proper methods of avoiding pregnancy wastages, as well as the hard work performed by the pastoral women.



CHAPTER II  
DATA ACCURACY

2.0 Introduction:

Data collected in African demographic enquiries and censuses are subject to different types of errors. Data by age may be affected by errors in reporting of ages and by variations of the completeness of enumeration. On the other hand, sex unlike age, is seldom reported wrongly, but data by sex may be faulty because reporting may be more complete for one sex than for the other.

Accurate data by age and sex are essential for many types of planning, particularly planning of community institutions, and services, and in studying mortality, fertility, nuptiality and certain other areas of demographic analysis. For that reason an assessment of age and sex data is needed in order to determine the degree of data accuracy.

In this chapter we examine:

- (a) Accuracy of sex and age data reported in the 1973 Sudan Population Census by region and by rural-urban residence, and
- (b) Accuracy of data on fertility reported in the same census by region and by urban-rural residence.

Data used in this study pertain only to Sudan's urban and rural settled populations, and unless otherwise specified, the whole body of data utilized are compiled from the 1973 census reports.

2.1 Checking Total Population Figures:

Sudan has a limited amount of demographic data. Up till now only two national population censuses have been carried out; the 1955/56 Sample Census and the 1973 Population Census. The two censuses

differ both in the methodology and coverage. While the 1955/56 census was undertaken on a sample and de jure basis, extending over a period of 14 months, the 1973 census is<sup>a</sup> de-facto enumeration following the U.N. recommendations for censuses undertaken in the 1970's.

Table 2.1.1 shows the two populations enumerated at the two different census dates.

TABLE 2.1.1 SUDAN POPULATION IN 1955/56 AND 1973<sup>1</sup>

Year	Population (000s)				Percentages		
	Total	0-14	15-64	65+	0-14	15-64	65+
1955/56 <sup>2</sup>	10263	4639	5347	277	45.2	52.1	2.7
1973	14114	6465	7227	422	45.8	51.8	3.0
Increase (73-56)	3851	1816	1880	145	-	-	-
% of Increase	37.5	39.4	35.2	52.3	-	-	-

N.B. 1. Nomads and cotton pickers included.

2. Source: (Nuer, V.J., 1976, 16).

The table shows that the population of 10.3 millions enumerated in 1955/56 census has increased only by 37.5 percent to reach 14.1 million in 1973 over a period of 17 years, indicating a growth rate of 1.9 annually. The percentage distribution at the given age groups of the two populations shows that greater proportions were enumerated in the older and younger groups in the latter census than in the middle ages. Assuming the accuracy and comparability of the two censuses, this, however, implies a slower growth rate and some gain in the life expectancy, though trivial. Accepting such figures would imply that fertility may have been slightly lower in the intercensal period, which is most likely not the case. While the possibility of underenumeration in the younger age groups in the latter census would explain the observed difference, it does not appear likely that this was wholly the case. On the contrary, given the

longer period of counting in the first census, and the census methodology, it is more likely that the 1955/56 census might have resulted in an over-counting of the population. (Galal-el-Din, El., 1976, 25).

In regional terms Table 2.1.2 shows that, Khartoum, Central and the Eastern regions are growing at higher rates than the other regions.

TABLE 2.1.2 THE REGIONAL POPULATION, AND THE INTERCENSAL GROWTH RATE - 1955/56 AND 1973 CENSUSES

Region	1956		1973		Intercensal rate of growth (1956-73)
	No.	%	No.	%	
Western	3090733	30.1	4174804	29.6	1.8
Southern	2783136	27.1	2804825	19.9	0.5
Central	2069646	20.2	3623238	25.7	3.3
Eastern	941039	9.2	1497381	10.6	2.7
Northern	873059	8.5	917723	6.5	0.3
Khartoum	504924	4.9	1095617	7.8	4.6
Sudan	10263536	100.0	14113590 (14819269)	100.0	1.9 (2.2)

The population of Khartoum has more than doubled during the intercensal period; growing at a rate of 4.6 percent annually. However, Khartoum, Central and the Eastern regions are subject to heavy male in-migration reflecting the economic advantage they enjoy over other regions. On the other hand, Northern and the Western regions are growing at lower rates of 0.3 percent and 1.8 percent respectively, and are characterized by heavy male out-migration. Finally, the Southern region has experienced the lowest regional growth rate of less than 0.1 percent. This might have been caused by the circumstances of unrest and war which took place in this region in the intercensal period. Responding to reflecting these conditions, greater proportions of the population may have fled to neighbouring countries. This pattern would affect not only the numbers enumerated

in the Southern region but also the level of fertility. Furthermore, underenumeration might have affected greatly this region due to hazardous transportation facilities and environment.

The growth rate of 1.9 percent in the intercensal period is believed to be very low and substantially lower than the rate of natural increase of 3.32 percent reported in the 1955/56 population census. An adjusted rate of growth of 2.2 percent is estimated raising the population total in 1973 to 14.8 millions. "Assuming 5% underenumeration"

The young structure of the Sudan population in 1973 would imply a higher rate of population growth. Table 2.1.3 gives the percentage distributions of the population by age and sex.

TABLE 2.1.3 THE PERCENTAGE DISTRIBUTION OF URBAN AND RURAL SETTLED POPULATION BY AGE AND SEX, SUDAN, 1973

Age	TOTAL			URBAN			RURAL		
	T	M	F	T	M	F	T	M	F
Less than 15	46.62	47.86	45.36	42.85	41.05	44.89	47.69	49.95	45.48
15-19	8.09	8.23	8.62	10.08	10.08	10.07	7.96	7.67	8.24
20-24	7.03	6.26	7.80	8.96	9.39	8.88	6.42	5.32	7.52
25-29	8.56	7.53	9.61	9.62	9.92	9.29	8.26	6.80	9.69
30-34	6.19	5.83	6.57	6.57	6.97	6.12	6.09	5.48	6.68
35-39	6.47	6.60	6.33	6.38	6.73	5.99	6.49	6.56	6.43
40-44	4.39	4.54	4.24	4.22	4.47	3.95	4.44	4.56	4.32
45-49	3.44	3.75	3.13	3.24	3.43	3.02	3.50	3.85	3.16
50-54	2.71	2.81	2.60	2.47	2.50	2.44	2.77	2.90	2.64
55-59	1.48	1.63	1.34	1.40	1.47	1.32	1.51	1.67	1.34
60-69	1.69	1.78	1.61	1.46	1.45	1.48	1.76	1.87	1.64
65+	3.03	3.20	2.78	2.55	2.55	2.57	3.12	3.39	2.85
TOTAL	100.00	100.02	99.99	99.99	100.01	100.02	100.01	100.02	99.99

The table shows that the percentage of the population aged 0-14 is 46.6 percent for the country as a whole, and higher for rural (47.69 percent) than for urban population (42.85 percent). This, however, does not necessarily imply higher rural than urban fertility, due to the effect of migration in both centres. This is clear when we look

at Table 2.1.4 which presents the age distribution of the regional populations.

TABLE 2.1.4 THE PERCENTAGE DISTRIBUTION OF THE REGIONAL POPULATION (BOTH SEXES) - SUDAN REGIONS, 1973

Age	Northern	Eastern	Central	Western	Southern	Khartoum	Sudan
Less than 15	48.81	45.38	49.44	47.38	44.48	42.23	46.62
15-19	9.68	8.12	8.37	7.13	8.95	10.64	8.09
20-24	5.93	7.19	6.67	5.71	8.00	10.29	7.03
25-29	6.30	8.82	7.85	8.25	9.70	9.85	8.56
30-34	4.93	6.81	5.71	6.01	6.86	6.38	6.19
35-39	5.66	6.51	5.91	6.71	7.12	5.97	6.47
40-44	4.14	4.73	4.19	4.73	4.30	3.95	4.39
45-49	3.38	3.41	2.97	3.61	3.89	3.01	3.44
50-54	2.97	2.96	2.66	3.04	2.31	2.37	2.71
55-59	1.81	1.53	1.38	1.55	1.43	1.35	1.48
60-64	2.24	1.76	1.70	2.08	1.14	1.42	1.69
65+	6.37	2.78	3.08	3.84	1.83	2.53	3.03
TOTAL	99.98	100.00	100.00	100.01	100.04	100.01	100.00

As can be seen from the table, the regions which are characterized by heavy male out-migration, in particular the Northern and the Western regions, have shown higher proportions at younger ages (0-14) and at older ages (65+). On the other hand, gaining emigrants, Khartoum and the Eastern regions exhibited lower proportions (0-14) of 42.23 percent and 45.38, respectively. The Central region though subject to heavy male in-migration seasonally, exhibited the highest proportions under 15 years of age, possibly due to its higher fertility since the cotton-pickers -- the main emigrants to this region -- have been excluded.<sup>1/</sup>

<sup>1/</sup> Except in the first table 2.1.1 both cotton-pickers and nomads are excluded throughout this study. Both populations appear in different tabulations, and they have not been questioned about their fertility. The cotton-pickers and nomads have been re-enumerated as there was a belief that these two groups have been underenumerated.

## 2.2 Analysis of Sex Ratios

Analysis of sex ratios reveals considerable movement of the populations between the different regions of the Sudan. Table 2.2.1 shows that urban centres in the Sudan are gaining considerable influx of male rural emigrants.

TABLE 2.2.1 REPORTED OVERALL SEX RATIOS FOR SUDAN AND ITS REGIONS BY URBAN-RURAL - SUDAN 1973

Region	Total	Urban	Rural
Sudan	102	113	98
Southern	103	112	102
Central	106	110	105
Western	91	97	90
Northern	88	105	84
Eastern	117	118	116
Khartoum	121	126	108

The overall sex ratio reported for urban Sudan was 113, while the rural sex ratio remains below 100.

At regional levels, Khartoum has shown the highest sex ratio of 121 signifying the dominance of male population in this region, and the sex ratio is higher for urban than rural Khartoum. Other regions gaining male population due to migration are Eastern and Central. The Central region does not exhibit a higher sex ratio as expected due to the exclusion of cotton-pickers. The Western and Northern regions are losing male population due to migration. With low sex ratios of 88 and 91, respectively, the Northern and the Western regions are the main source of migrants in the country. While the Northern region is losing its rural population in favour of its urban and other urban centres in the country, the Western region is losing its male population from both its urban and rural centres.

The dominance of adult males in urban centres in all regions except the Western urban centres, is revealed by the higher sex ratios

in table 2.2.2. The majority of these migrants were dominated by age group 15-19, to age groups 35-39 and 40-44. The sex ratios in the table reveal a lot of irregularities which, however, can be explained in terms of age misreporting and undercounting of one sex than the other. Although these sex ratios are affected by migration, the general pattern is clear, with a high sex ratio in the 10-14 age group, and thereafter a sex ratio rising with age, with some irregularities as we proceed with age.

The sex ratio in the age group 0-4 also deserves some elaboration. For example, the Southern region exhibited a higher sex ratio for the age group 0-4 in its population of 113 compared to only 107 for its urban population. This implies either an underenumeration of female babies or high mortality at infancy and early childhood or both.

On the other hand, the Northern region has shown a slight dominance of females at the age group 0-4 for its total and rural population which can be accounted for by either an underenumeration or age misreporting of male population 0-4 years or both. However, both the Northern and the Southern regions have been affected by underenumerations of their infants aged less than one year of age, especially in the rural areas (see Section: 2.6).

### 2.3 Analysis of Age Data

In this section we examine the accuracy of age data reported in the 1973 census. The comparability of the two censuses in terms of age data is rendered difficult due to the different methods used for age grouping. The 1955/56 census adopted wider age groupings for both sexes. The 1973 census provides single years of age and five years' groupings for both sexes in its population.

TABLE 2.2.2. REPORTED SEX RATIO OF THE URBAN-RURAL POPULATION OF SUDAN'S REGIONS, 1973.

Age Group	SOUTHERN			CENTRAL			WESTERN			EASTERN			NORTHERN			KHARTOUM		
	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
0-4	113	107	113	102	102	102	102	102	102	108	104	109	99	102	99	103	103	104
5-9	117	108	118	105	103	106	103	97	104	111	103	115	100	99	100	100	99	103
10-14	117	126	115	113	106	114	108	105	109	117	109	123	106	105	107	107	106	112
15-19	98	106	98	99	110	96	83	101	80	108	107	108	87	102	83	124	123	106
20-24	75	102	71	83	106	77	61	83	58	107	120	99	66	109	53	143	155	99
25-29	74	111	69	87	107	82	60	84	57	110	124	102	66	113	47	143	159	93
30-34	84	126	79	100	118	96	74	95	71	120	138	110	61	104	51	149	164	106
35-39	109	126	107	118	124	116	89	102	88	135	143	131	65	99	61	144	148	121
40-44	117	124	117	116	126	114	93	105	91	131	142	126	76	109	68	139	147	117
45-49	130	116	131	137	135	137	106	109	105	146	123	146	86	112	81	135	138	156
50-54	118	108	122	122	119	123	93	90	94	142	139	144	84	110	79	126	125	127
55-59	117	109	118	155	138	160	106	99	107	155	149	160	99	124	94	134	136	131
60-64	119	1.00	121	132	118	136	93	84	94	148	139	152	97	110	95	122	118	132
65-69	118	113	119	162	141	168	107	100	108	151	144	155	115	126	113	134	130	144
70+	119	.85	121	135	123	139	94	79	96	127	123	129	106	104	106	113	106	128
TOTAL	103	112	102	106	110	105	91	97	90	117	118	116	88	105	84	121	126	108



For the analysis of single year of age, two methods will be employed for measuring the extent of age heaping and digit preference within the population.

Whipple's index is used to reflect preference or avoidance of a particular terminal digit or of each terminal digit. (Shryock, 1976, 16-17). The heaping on multiples of five (terminal digit zero and five combined in the range 23 to 62), is shown in Table 2.3.1 by comparing the sum of the population at the ages in the range ending in "0" and "5" and one fifth of the population in the same range. The United Nations scale of accuracy for the index is:

<u>Quality of Data</u>	<u>Whipple's Index</u>
Highly accurate	Less than 105
Fairly accurate	105-109
Approximate	110-114
Rough	125-174
Very rough	175 and over

TABLE 2.3.1 WHIPPLES INDEX FOR THE RURAL-URBAN POPULATION OF SUDAN AND ITS REGIONS, 1973

Region	Whipples Index		
	Total	Urban	Rural
Sudan	269.2	252.0	275.8
Western	315.4	239.9	318.9
Central	291.3	266.6	304.7
Eastern	281.0	264.6	290.4
Khartoum	245.6	235.5	282.4
Northern	241.8	233.5	244.2
Southern	208.8	207.9	208.9

$$W.I. = \frac{\sum (P_{25} + P_{30} + \dots + P_{55} + P_{60})}{1/5 \sum (P_{23} + P_{24} + \dots + P_{61} + P_{62})}$$

As can be seen from Table 2.3.1, an index value of 269.2 for the Sudan as a whole indicates the very high inaccuracy of age reported. It is more inaccurate for rural than for urban Sudan population, and in all regions.

The Whipples index shows considerable variation from region to region. The highest values being found in the Western, Central and the Eastern regions, respectively. The lowest -- supposedly indicating a better quality of age reporting -- somewhat surprisingly found in the Southern region being 22.4 percent better than the country's average and 13.6 percent better than the nearest low value of the Northern region of 241.8. Further, unlike all other regions, both rural and urban Southern region populations exhibited similar values for the index. In the rest of the regions higher values of the index are obtained for rural than for urban populations.

Compared to other countries of similar patterns, the Sudan has a much higher index.

<u>Country</u>	<u>Whipples Index</u>
Uganda (1969) <sup>1</sup>	186
Kenya (1969) <sup>2</sup>	158
Philippines (1960) <sup>3</sup>	156
Sudan (1973)	269.2

As can be seen from the above comparison, the index for Sudan is 72.6 percent higher than the lowest index of the Philippines.

On the other hand, Myer's index is developed to measure the overall heaping at each terminal digit (Shryock, 1976, 17-18). The method is used to avoid the bias in indices like Whipple's index, due to the fact that the numbers ending in "0" would normally be larger than the following numbers ending in "1" to "9" because of the effect of mortality. The method yields an index of preference for each terminal digit, representing the deviation from 10 percent of the

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1 Vol. IV, Analytical Report, Statistical Division, Uganda

2 " " " " Statistical Bureau, Kenya

3 Shryock, 1976, 17.

proportion of the total reporting on the given digit. A summary index of preference is obtained as one-half of the sum of the deviations, from 10 percent without regard to the sign. Non-existent age heaping will be represented by the zero value of the index. A summary of Myer's indices for the regions of the Sudan is given in Table 2.3.2.

TABLE 2.3.2. PREFERENCE INDEX FOR TERMINAL DIGITS BY MYER'S BLENDED METHOD, SUDAN REGIONS, 1973

Region							
Terminal Digit	Northern	Southern	Khartoum	Central	Eastern	Western	Sudan <sup>1</sup>
0	+11.06	+11.10	+11.83	+16.73	+15.96	+19.59	+14.38
1	3.99	4.16	4.69	5.77	5.61	6.27	5.08
2	1.14	1.95	1.00	1.38	1.62	3.31	1.73
3	2.69	4.43	2.94	4.34	3.89	4.77	3.84
4	3.86	3.93	4.24	5.15	5.33	6.43	4.82
5	+10.45	+ 6.55	+10.37	+13.78	+13.48	+16.65	+11.88
6	3.11	2.11	3.59	4.39	4.13	5.31	3.77
7	1.87	3.35	1.87	2.39	2.39	2.07	2.32
8	1.11	+ 2.53	.32	1.21	1.59	2.35	1.52
9	3.74	.25	3.53	5.45	4.88	5.73	3.93
TOTAL	43.02	40.36	44.38	60.59	58.88	72.48	53.29
Summary index of preference = total÷2	21.51	20.18	22.19	30.30	29.44	36.24	26.65

<sup>1</sup>Regional average.

N.B. Figures without sign have minus values.

The values of the index which remain all above 20 indicate the considerable age heaping reported. As can be seen from the table, again the Western, Central and Eastern regions scored higher values of the index relative to the national average, while other regions remain also with higher scores but below the national average of 26.65. Surprisingly, the Southern region again scored the lowest score though not significantly different from that of the Northern and Khartoum regions.

The scores of the indexes obtained from urban and rural populations are given in Tables 2.3.3 and 2.3.4. As can be seen from the two tables,

TABLE 2.3.3 PREFERENCE INDEX FOR TERMINAL DIGITS BY MYER'S BLENDED METHOD, URBAN SUDAN AND REGIONS, 1973

Region Terminal Digit	Northern	Southern	Khartoum	Central	Eastern	Western	Sudan "Regions Average"
0	+10.46	+ 9.93	+11.02	+14.30	+13.65	+16.12	+12.58
1	- 3.99	- 4.29	- 4.53	- 5.30	- 5.12	- 5.87	- 4.85
2	- .97	- 1.32	- .90	- 1.36	- 1.28	- 2.44	- 1.38
3	- 2.48	- 4.08	- 2.69	- 3.6	- 3.06	- 3.9	- 3.30
4	- 4.33	- 3.94	- 4.08	- 4.73	- 4.84	- 5.52	- 4.57
5	+ 9.38	+ 7.37	+ 9.55	+11.49	+12.22	+14.56	+10.76
6	- 3.18	- 2.62	- 3.41	- 4.05	- 4.19	- 4.71	- 3.69
7	- 1.07	- 3.17	- 1.67	- 1.6	- 2.08	- 1.7	- 1.88
8	- .39	+ 3.02	- .08	- .82	- 1.09	- 1.63	- .80
9	- 3.15	- .9	- 3.21	- 4.33	- 4.2	- 4.92	- 3.45
TOTAL Summary Index	39.4 19.7	40.64 20.32	41.14 20.57	51.58 25.79	51.73 25.87	61.37 30.69	47.64 23.82

TABLE 2.3.4 PREFERENCE INDEX FOR TERMINAL DIGITS BY MYER'S BLENDED METHOD, RURAL SUDAN AND REGIONS, 1973

Region Terminal Digit	Northern	Southern	Khartoum	Central	Eastern	Western	Sudan "Regions Average"
0	+11.27	+10.39	+14.74	+23.77	+16.98	+20.13	+16.21
1	- 3.98	- 4.17	- 5.3	- 6.29	- 5.94	- 6.32	- 5.33
2	- 1.17	- 2.00	- 1.37	- 2.2	- 1.92	- 3.46	- 2.02
3	- 2.74	- 4.6	- 3.86	- 5.05	- 4.45	- 4.92	- 4.27
4	- 3.87	- 3.9	- 4.83	- 5.71	- 5.68	- 6.52	- 5.09
5	+10.79	+ 7.21	+13.33	+12.04	+13.92	+16.97	+12.38
6	- 3.08	- 2.00	- 4.25	- 4.97	- 4.97	- 5.41	- 4.11
7	- 2.01	- 3.34	- 2.59	- 3.31	- 2.67	- 2.14	- 2.68
8	- 1.31	+ 2.53	- 1.2	- 2.14	- 2.00	- 2.48	- 1.83
9	- 3.9	- .11	- 4.67	- 6.14	- 3.27	- 5.86	- 3.99
TOTAL Summary Index	44.12 22.06	40.26 20.13	56.14 28.07	71.62 35.81	61.80 30.90	74.21 37.11	58.03 29.01

the urban and rural populations do not exhibit a different pattern from that of the national total population. However, there seems to be a systematic pattern of age reporting; probably this may be due to the systematic procedure of the interviewers to "age" the population due to predetermined pattern as the appearance of the person, or the

knowledge about the region or the specific area, e.g. whether the area constitutes emigrants, etc.

Compared to other African and non-African populations, Sudan experienced an inaccurate data represented by a considerable age heaping, especially on digits "0" and "5".

<u>Country</u>	<u>Myer's Index</u>
Sudan (1973)	26.65
Kenya (1969) <sup>1</sup>	10.82
Philippines <sup>2</sup>	10.04
U.S. (1960) <sup>2</sup>	.80

As can be seen from the comparison above, Sudan experienced a much inaccurate data by age.

#### 2.4 Analysis of Grouped Data:

The indices discussed in the preceding section provide only a measure of the extent of heaping, not of the quality of the distribution by five year age groups. This latter pattern is much better shown by the sex ratio and age scores obtained for all age groups in each region. Table 2.4.1 shows age ratios of both male and female population of the Sudan. The age ratios of the five-year age groups were obtained, and a summary of the total deviation without regard to sign is obtained by getting the average. An age ratio above 100 indicates a concentration of the population in that particular age group. Table 2.4.1 shows that the gaining age groups, with a ratio above 100, are 5-9, 25-29, 35-39, 45-49, 50-54 and 60-64 for males, and 5-9, 25-29, 35-39, 50-54 and 60-64 for females. A much higher concentration of females in the age group 25-29 was reported.

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1 Ibid, 1969, Statistical Bureau, Kenya

2 For ease of comparison

TABLE 2.4.1 CALCULATION OF AGE-ACCURACY INDEX FOR SUDAN, 1973

Age Group	Analysis of Age Ratio			
	Male		Female	
	Ratio	Deviation from 100	Ratio	Deviation from 100
0-4	-	-	-	-
5-9	121.2	+21.2	121.6	+21.6
10-14	87.7	-12.3	81.2	-18.8
15-19	92.5	- 7.5	94.40	- 5.6
20-24	79.5	-20.5	85.60	-14.4
25-29	12.45	+24.5	133.8	+33.8
30-34	82.5	-17.5	82.4	-17.6
35-39	127.3	+27.3	117.2	+17.2
40-44	87.7	-12.3	89.6	-10.4
45-49	102.1	+ 2.1	91.5	- 8.5
50-54	104.5	+ 4.5	116.40	+16.4
55-59	70.9	-29.1	63.6	-36.4
60-64	135.5	+35.5	150.50	+50.5
TOTAL irrespective to sign		214.3		251.2
Mean		17.86		20.90

Age Ratio defined:

$$\frac{5P_a}{\frac{1}{2}(5P_{a-5} + 5P_{a+5})}$$

The age accuracy index is less for males than for females by 14.5 percent.

Table 2.4.2 summarizes the age accuracy indices for the region's urban male and female population. At the urban centres, all urban females scored higher values of the index than males.

TABLE 2.4.2. SUMMARY OF AGE-ACCURACY INDEX FOR REGIONAL URBAN-RURAL POPULATION, SUDAN REGIONS, 1973

Region	URBAN		RURAL	
	Males	Females	Males	Females
Southern	15.4	16.90	20.2	15.7
Western	15.2	21.0	25.1	29.4
Central	13.4	18.6	19.3	24.1
Eastern	13.5	14.7	21.7	22.4
Northern	9.6	11.8	18.8	19.1
Khartoum	11.6	14.6	16.7	18.0
SUDAN	12.61	16.48	19.82	22.14

The United Nations has developed an index called United-Nations Age-Sex Accuracy Index, employing both age and sex ratios. In this index the mean of the differences from age to age in the reported sex ratios, without regard to sign, is taken as a measure of the accuracy of the observed sex ratios, on the assumption that these age to age changes should approximate to zero. (Shryock, 1976, 126). A value of the index of 20, 20-40, and over 40, are assumed to indicate accurate, inaccurate and highly inaccurate data, respectively.

Table 2.4.3. shows an application of the method to the population of Sudan as a whole.

TABLE 2.4.3. CALCULATION OF U.N. AGE-SEX ACCURACY INDEX FOR SUDAN, 1973

Age Group	Analysis of Sex Ratios		Analysis of Age Ratios			
	Sex Ratio	Successive Differences	Male		Female	
			Ratio	Deviation from 100	Ratio	Deviation from 100
0-4	105	-	-			
5-9	107	- 2.0	12.12	+21.2	121.6	+21.6
10-14	112	- 5.0	87.7	-12.3	81.2	-18.8
15-19	97	+15.0	92.5	- 7.5	94.4	- 5.6
20-24	82	+15.0	79.5	-20.5	85.6	-14.4
25-29	80	+12	124.5	+24.5	133.8	+33.8
30-34	90	-10	82.5	-17.5	82.4	-17.6
35-39	106	-16	127.3	+27.3	117.2	+17.2
40-44	109	- 3	87.7	-12.3	89.6	-10.4
45-49	122	-13	102.1	+ 2.1	91.5	- 8.5
50-54	110	+12	104.5	+ 4.5	116.40	+16.4
55-59	123	-13	70.9	-29.1	63.6	-36.4
60-64	112	+11	135.5	+35.5	150.5	+50.50
TOTAL (irrespective of sign)		127		214.3		251.2
Mean: Index		10.58		17.86		20.9
= $3 \times 10.58 \times 17.86 + 20.9$	( 70.5 )					

With a value of 70.5 for the United-Nations age-sex accuracy index, Sudan may be said to have very inaccurate raw data. The problem, although bad for both sexes, is worse for females than for males.

Compared to other African and non-African countries, as can be seen from the comparison below, Sudan has the least accurate age-sex data.

<u>Country</u>	<u>U.N. Age-Sex Index</u>
Kenya (1969)	33.1
Philippines (1960)	32.8
Tanzania (1967)	66.5
U.S. (1960) <sup>1</sup>	12.2
Sudan	70.5

As can be seen from this comparison, Sudan has an index which is 6 percent higher than the highest index of Tanzania, and 478 percent higher than that of the United States.

The index for regional urban and rural population is given in Table 2.4.4.

TABLE 2.4.4. SUMMARY OF THE U.N. AGE-SEX ACCURACY INDEX FOR THE REGIONAL POPULATION BY URBAN-RURAL RESIDENCE, SUDAN REGIONS, 1973

Region	Urban	Rural
Southern	57.56	66.41
Northern	40.90	76.15
Central	55.48	87.14
Western	62.21	90.50
Eastern	51.45	74.34
Khartoum	60.46	53.96
Sudan	46.10	77.21

As can be seen from the table, both the reported sex and age ratios in the rural and urban areas can only be classified as highly inaccurate, as the indices' values all remain above 40.

#### 2.50 Data Graduation

Populations subject to approximately constant mortality and

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1 For ease of comparison.



fertility schedules come to have constant proportions at each age. The approximate constancy of fertility is very common, if not universal, feature of populations that are mainly agricultural, and low in literacy and income, except when fertility has been affected by wars, revolutions, major epidemics or other such episodes. (U.N. 1967, 12). The absence of major trends in mortality has also been a common characteristic of less developed areas until the past few decades when very rapid declines in death rates have been frequent.

The characteristics of an actual population can be estimated by locating the model stable populations that best fit certain recorded or calculated features of the population in question, and then assigning the characteristics of the model stable to the actual population.

Also, stable models can be used to graduate data and compare it with the actual population distribution. This can be done if knowing the mortality level (i.e. life table) and a growth rate, assuming that mortality and fertility are not significantly changed or altered in the near past, and migration is not common.

Assuming the above for the Sudan population in 1973, we will compare the actual distribution of the female population of the Sudan to a selected stable model. With a life expectancy at birth<sup>1/</sup> of 44.6 years for the female population in 1973, Sudan's female population corresponds to a stable age distribution in the Northern model series of a mortality level of 10.8. The needed growth rate was set at 2.7.<sup>2/</sup>

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<sup>1/</sup> Life expectancy at birth for Sudan's female population is estimated at 44.6. (Unpublished Vol. II, 1973, Dept. of Statistics, Khartoum, Sudan).

<sup>2/</sup> The growth rate for the Northern regions of the Sudan in 1973 is 2.7. We excluded the Southern region due to the state of unrest and war which resulted in a growth rate of 0.05 percent annually.

We will compare the recorded age distribution with the stable ogive as a way of uncovering typical patterns of deviation from the stable ogive in certain categories of the 1973 census. The comparison is twofold:

1. The calculation of  $C(x) - \bar{C}_s(x)$ , where  $C(x)$  is the cumulative age distribution of the female population, and  $\bar{C}_s(x)$  is that of the chosen stable population ogive which agrees with  $C(5)$ ,  $C(10)$ , .... $C(50)$ .

2. The calculation of:

$$\frac{C(0-4)}{\bar{C}_s(0-4)} \dots\dots\dots, \frac{C(45-49)}{\bar{C}_s(45-49)}$$

where  $C(0-4)$  is the proportion aged 0-4 in the given population, and  $\bar{C}_s(0-4)$  is the proportion aged 0 to 4 in the stable population already defined. If the given age distribution conformed exactly in the model stable  $C(x) - \bar{C}_s(x)$  would be zero at each age, and  $\frac{C(x-y)}{\bar{C}_s(x-y)}$  would be one in each age interval. A positive value of  $C(x) - \bar{C}_s(x)$  implies age understatement that shifted persons across age  $x$ , and a  $\frac{C(x-y)}{\bar{C}_s(x-y)}$  greater than one implies that age-misreporting has inflated the reported number of persons in the given age interval. Both of these comparisons for cumulative age to age interval are given in Figures 2.5.A. and 2.5.B, respectively.

From the two graphs we notice that the female age distribution is of the sort affected by large-scale misreporting which shows the following characteristics in the patterns of the cumulative age distributions, as revealed by  $C(x) - \bar{C}_s(x)$  :

1. The cumulative age distribution rises/relative to the stable/ from age 5 to 10.
2. It falls from age 10 to 15, 15 to 20 and 20 to 25.

Fig. 2.5-A: THE CUMULATIVE  $C_x$  OF THE REPORTED MINUS THE CUMULATIVE  $C_{x_s}$  OF STABLE SUDAN FEMALE POPULATION: SUDAN, 1973.

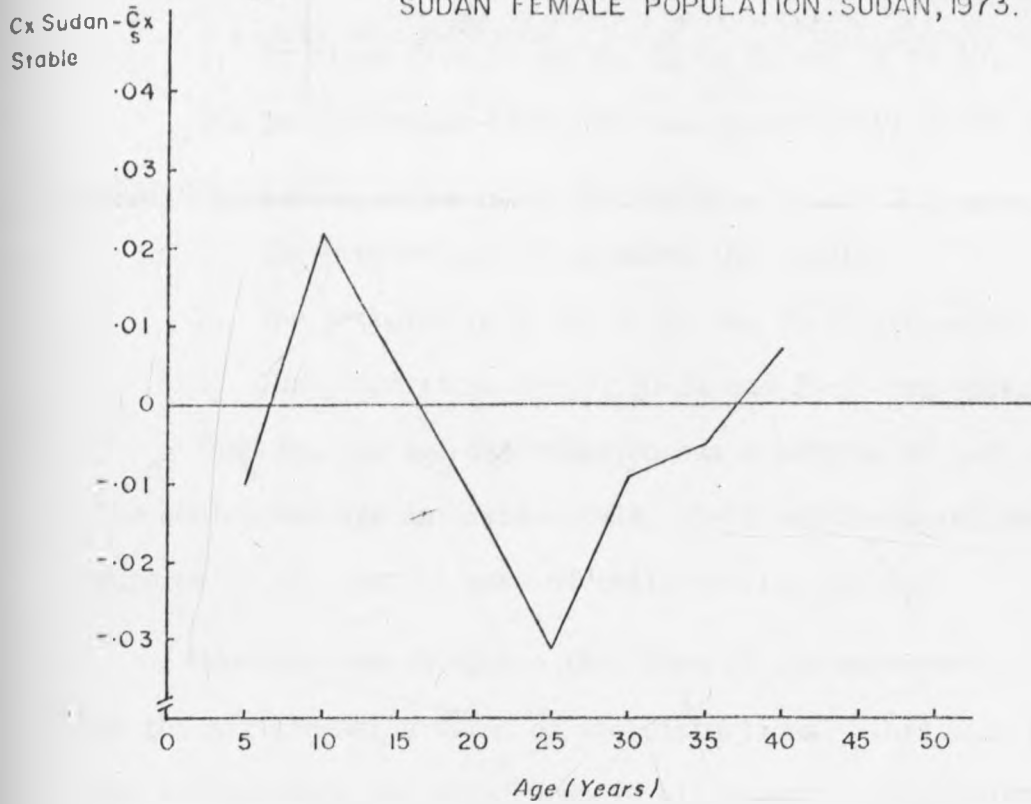
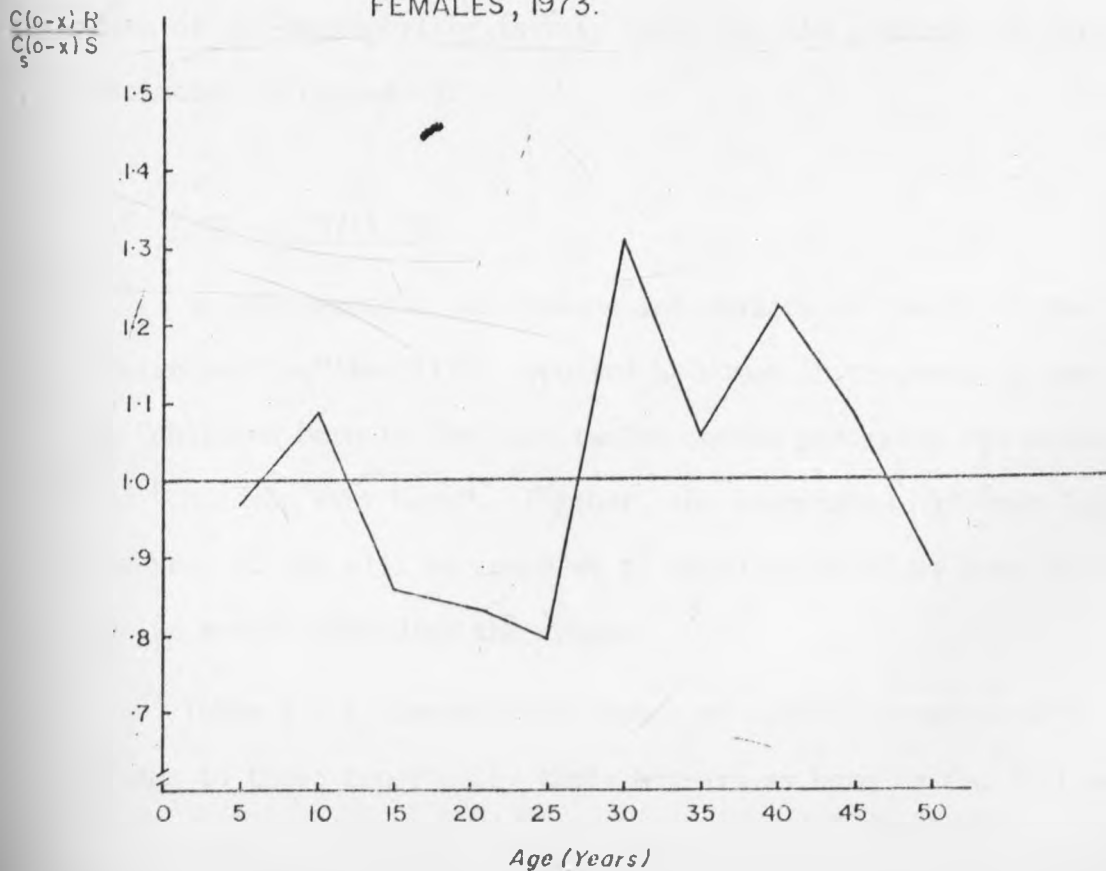


Fig. 2.5-B: THE RATIO OF THE REPORTED FEMALES DISTRIBUTION TO THE STABLE. SUDAN FEMALES, 1973.



3. It rises from 25 to 30, 30 to 35 and 35 to 40.

The proportion in five-year intervals  $C(x-y)$  shows the following characteristics, relative to the stable:

1. The proportion 5-9 is above the stable.
2. The proportions 10-14, 15-19 and 20-24 are below the stable.
3. The proportions 25-29, 30-34 and 35-39 are above the stable.

That is, the age distribution has a surplus at 5-9, a deficit in the adolescent age intervals 10-14, 15-19 and 20-24 followed by a surplus in the central ages of child-bearing (25-39).

Hence we can recognize this form of age misreporting to conform to the African-Asian forms of age distortions. This same pattern of age misreporting has been shown in all countries of Tropical Africa, India, Indonesia, Morocco and Pakistan. (Ibid, 1967, 19). This same kind of age misreporting is caused by common biases in the estimation of women's ages by the interviewers rather than the transcription of a number supplied by the respondent. The identification of this form of age-misreporting is very useful for the accuracy of fertility estimates in Chapter IV.

## 2.6 Data on Fertility

In this section, we examine information on "current" and "retrospective" fertility reported by women in response to questions on "children born in the last twelve months preceding the census date", and "children ever born". Further, the enumerated children less than one year of age will be compared to those reported as born in the last twelve months preceding the census.

Table 2.6.1 compares the number of infants enumerated in the 1973 Census to those reported by their mothers as born in the last year

preceding the census date.

TABLE 2.6.1 COMPARISON BETWEEN CHILDREN LESS THAN ONE YEAR OF AGE ENUMERATED AND CHILDREN BORN IN THE LAST 12 MONTHS PRECEDING THE CENSUS, SUDAN, 1973

	Total	Urban	Rural
(1) Children less than one year, enumerated, 1973	345,055	90,451	254,604
(2) Children born in the last 12 months reported, 1973	471,537	100,188	371,349
% of (1) to (2)	73.18	90.28	68.56
% Loss of (1) to (2)	-26.82	- 9.72	-31.44

As indicated by the figures in the table, the infants enumerated are far behind those reported by their mothers by 26.8 percent, and understated more in rural than urban Sudan; the percentages being 31.33 and 9.7, respectively. The disagreement of the two figures can be attributed to the factors:

- (1) An over estimation of infants reported by their mothers as born in the last twelve months preceding the census, that is, some children born in a longer period than twelve months has been reported.
- (2) There is a possibility that, the enumerated infants have already been reduced to an unknown extent by mortality, while children born in the last twelve months reported by their mothers include all the births.
- (3) An underenumeration of children aged less than one year of age.

It seems more likely that the last factor explains the larger portion of the differences, as it is the typical case of almost all censuses in the underdeveloped countries, with varying degrees of underenumeration. We believe that an underenumeration occurred, and, as can be seen from the table, was more severe for rural than urban population.

At the regional level, Table 2.6.2 shows the percentages of children enumerated, to the reported and the percentage deviation of the first from the second.

TABLE 2.6.2 PERCENTAGES OF CHILDREN LESS THAN ONE YEAR OF AGE ENUMERATED TO THE CHILDREN BORN IN THE LAST TWELVE MONTHS REPORTED, SUDAN REGIONS AND BY RURAL-URBAN AREAS, 1973

Variable	Northern		Eastern		Central		Western		Southern		Khartoum	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Percentage	80.02	67.92	86.41	66.65	95.03	69.74	93.10	65.55	88.54	70.83	90.15	76.53
Deviation	-19.98	-32.08	-13.59	-33.35	- 4.97	-30.26	- 6.9	-34.45	-11.46	-29.17	- 9.85	-23.47

As can be seen from the table, the deviation is higher in rural than urban centres, and more serious for Western, Eastern, Northern and the Central regions, respectively. On the other hand, a relatively better enumeration of the infants is noted in urban Central population, and surprisingly in Western urban population, than in urban Khartoum for example. Finally, the Southern and the Northern regions, which show a relatively better quality of data in the preceding analysis, have been affected by underenumeration of infants, especially in their rural areas.

(ii) Children-Ever Born

number

The mean/number of children born alive coincides very much with W. Brass's expectations. Excluding the Southern region, the mean number of children reported increases with age until age group 35-39 or 40-44, and then declines. Table 2.6.3. shows the mean number of live-borns for Sudan and its regional populations.

TABLE 2.6.3. MEAN NUMBER OF LIVE-BORN CHILDREN REPORTED, SUDAN AND ITS REGIONS, 1973

Age Group	Sudan	Central	Khartoum	Northern	Eastern	Western	Southern
15-19	.3694	.4115	.2976	.2284	.4369	.3746	.3838
20-24	1.7922	2.4290	1.5689	1.5062	1.9138	1.7619	1.7607
25-29	3.2835	4.4195	3.2213	3.3615	3.4819	3.1570	2.9751
30-34	4.3576	5.2290	4.4558	4.8587	4.7275	4.1252	3.7218
35-39	5.0102	5.1204	5.4968	5.6011	5.2846	4.6428	3.8199
40-44	4.9428	4.9900	5.3488	5.8380	5.4247	4.3534	4.3687
45-49	4.8447	4.0834	5.2454	5.6550	5.0261	4.3904	4.4400
50-54	4.3772	3.9151	4.4027	5.1647	4.4690	4.0005	4.2009
55+	3.8366	2.7266	3.7145	4.3757	3.8590	3.7403	3.6932

As can be seen from the above table, the mean number of children born declines with age increases at older ages. This pattern of decline at older ages is attributed by Brass to memory lapse. (Brass, W., 1968, 91).

However, the pattern exhibited by the Southern female population in reporting their past fertility differs slightly from that of the Northern regions. The reported numbers of children ever born alive increases with age increase and starts to decline only after child-bearing ages. Such behaviour has been noticed in some of the Latin American countries, and also by Brass in some African populations. Brass attributed such behaviour either to higher fertility in the past, or perhaps by errors in reporting made in an over zealous effort to avoid memory failures. (W. Brass, 1975, 13). Another feature is that, the Southern and Western regions have shown low values of mean number of children born alive when compared to other regions. However, as the values of mean number of children born alive decreases with age increase, they do not show any peaks or serious irregularities, which encourage the use of the Brass P/F ratio that it gives good results (to be done in Chapter IV).

In the following Table 2.6.4. we compare the cumulative fertility derived from annual fertility rates (F), and parity (P).

TABLE 2.6.4. THE COMPARISON OF MEAN NUMBER OF LIVE-BORN (P) AND CUMULATIVE FERTILITY (F), SUDAN RURAL-URBAN POPULATIONS, 1973

Age Group	Total		Rural		Urban	
	F	P	F	P	F	P
40-44	5.246	4.9428	5.0865	4.9496	5.5865	4.9142
45-49	5.4035	4.8447	5.1010	4.8583	5.7195	4.8300

As can be seen from the table, the cumulative fertility (F) is higher than the parity (P) for all older age groups in both the rural and urban population. If we assume constant fertility, then the figures would indicate that older women have underestimated their parity probably due to memory lapse.



At regional levels, Table 2.6.5. shows the mean number of children born alive for both urban and rural populations. As can be seen from the table, rural areas have shown higher values of mean number of children born than urban areas, except in the Western region, where it shows some irregularities.

TABLE 2.6.5. MEAN NUMBER OF LIVE-BORN REPORTED BY AGE GROUP, SUDAN URBAN-RURAL REGIONAL POPULATION, 1973

Region	A G E G R O U P								
	15-19	20-24	25-29	30-34	35-39	40-45	45-49	50-54	55+
SUDAN									
Urban	.3223	1.6262	3.1264	4.2550	5.0748	4.9142	4.8300	4.1592	3.5917
Rural	.3828	1.8440	3.2335	4.3824	4.9943	4.9496	4.8583	4.4304	3.8956
NORTHERN									
Urban	.2188	1.4132	3.2144	4.7774	5.7878	5.6201	5.6621	4.8170	4.0385
Rural	.2311	1.5338	3.3962	4.8775	5.8055	5.8851	5.6535	5.2317	4.4349
KHARTOUM									
Urban	.2806	1.4735	3.0600	4.2805	5.3047	5.2539	5.2005	4.4964	3.7214
Rural	.3557	1.9549	3.8700	5.2397	6.0739	5.6181	5.4730	4.1254	3.4001
CENTRAL									
Urban	.3196	1.7710	3.4892	4.8727	5.7222	5.4150	5.2813	4.4860	3.7354
Rural	.4302	2.0665	3.8955	5.3236	6.0892	5.8972	5.6733	4.8520	3.9568
EASTERN									
Urban	.3592	1.7525	3.2028	4.4218	5.0997	4.9313	3.9569	3.9788	3.5743
Rural	.4927	2.0221	3.6335	4.8826	5.3843	5.6687	5.2464	4.7124	4.0022
WESTERN									
Urban	.3317	1.7573	3.2300	4.0521	4.6853	4.2738	4.1084	3.5838	3.1746
Rural	.3767	1.7627	3.1468	4.1160	4.6366	4.3649	4.4327	4.0597	3.822)
SOUTHERN									
Urban	.4522	1.6383	2.7167	3.3563	3.7486	3.8540	3.8701	3.5891	3.6277
Rural	.3752	1.7782	3.0084	3.2326	4.2912	4.4196	4.4983	4.3619	3.6988

(iii) Women Not Stating Their Parity  
and Data on Childlessness

Data on children born alive for ever-married females seems to be affected not only by memory lapses of the reporters, but also possibly by the relatively higher percentages of women not stating their parity. Table 2.6.6. shows the percentages of women not stating their parity for urban and rural population for Sudan as a whole and its regions.

TABLE 2.6.6. PERCENTAGES OF WOMEN NOT STATING THEIR PARITY AMONG EVER MARRIED FEMALES 12-YEARS OF AGE AND ABOVE FOR RURAL-URBAN POPULATION, SUDAN REGIONS, 1973

Region	Total	Urban	Rural
Sudan	17.4	18.6	17.1
Central	13.50	15.4	13.1
Khartoum	16.90	17.2	16.0
Eastern	17.3	19.1	16.3
Western	18.4	18.8	18.3
Southern	20.4	26.2	19.8
Northern	13.9	16.0	13.4

The table shows that substantial proportion amounting to 17.4 percent for Sudan as a whole did not state their parity. The proportion not stating their parity is higher for urban than for rural population in all regions. The Southern region exhibited a higher proportion of women not stating their parity. In exploring some of the questionnaires of the 1973 census, the staff of the Census Department attributed such higher proportions of women not stating their parity to: either these women have chosen deliberately not to state their parity, or the question has not been put to them. Later they discovered that in many cases whenever more than one female above 12-years of age was found in one household, only the wife of the head of the household was asked about her fertility. (Unpublished Vol. II, Census Department, Khartoum). Also it has been pointed out that similar cases were observed with

widowed and divorced females relatives living with the household.

In contrast, very few proportions amounting to less than 0.5 percent for Sudan as a whole have reported as childless. Table 2.6.7 shows the percentages of women who are childless for regional urban and rural populations.

TABLE 2.6.7 PERCENTAGES OF CHILDLESS WOMEN REPORTED AMONG EVER-MARRIED FEMALES 12-YEARS OF AGE AND ABOVE FOR RURAL-URBAN POPULATION OF SUDAN AND ITS REGIONS, 1973

Region	Total	Urban	Rural
Sudan	0.14	0.16	0.14
Southern	0.08	0.12	0.08
Northern	0.18	0.28	0.16
Central	0.12	0.16	0.12
Western	0.18	0.15	0.18
Khartoum	0.12	0.11	0.15
Eastern	0.19	0.25	0.15

As can be seen from the table, the values which do not exceed (0.25 percent) for the highest, depict the small number of childless women among the urban and rural settled population. In fact, lower proportions of childless women are expected among urban and rural settled populations than among nomads, but, however, not such very low proportions. Some women who do not state their parity, might have been of zero parity, but refused to state that. Another possibility might be done in classification where women with zero parity might have been left blank in the paper, and then regarded as not stating their parity.

## 2.7 Summary and Conclusions:

From the preceding analysis, we can summarize the following points:

- (i) Data on age is highly inaccurate. It is affected by age heaping and age misreporting that can only be classified as highly inaccurate. Although the region's populations

differ in the degree of age heaping and age misreporting, but all have shown a very high inaccuracy.

- (ii) There is a systematic pattern of age misreporting for the female population. This comes mainly from the erroneous age estimation put by the interviewers for women. We have identified this form of age misreporting as conforming to the pattern found in the "African-Asian" population. Being common to all these countries, because of the common bias done by interviewers in ageing women from their appearance and other characteristics.
- (iii) Data on fertility have also shown some errors. The children under one year of age enumerated in the 1973 census is suspicious and we believe that they have been under-enumerated. Data on children ever born though affected by those not stating their parity, show less fluctuations and irregularities that encourage the use of Brass P/F ratio. that could give reasonable estimates for fertility level. This will be done in Chapter IV.

### CHAPTER III

#### ANALYSIS OF MARITAL CONDITIONS

##### 3.0 Introduction:

In this chapter we attempt to study the marital conditions of the rural and urban female and male population for Sudan as a whole and its regions. The proportion of the population that marries, the age at which marriages are dissolved by death or divorce, or both, and the age at which dissolution occurs can all affect the birth rate. Moreover, death rates and migration rates both vary substantially according to marital status, so that marital status conditions all aspects of population dynamics. (Bogue, J.D., 1968, 312).

Customs in general, and marriage customs in particular, are important determinants of fertility, especially in rural areas where birth control is almost unknown. The age at which people first marry, the form which the married union takes, and the prevalence of polygamy, divorce and separation of husbands, all have their effect on women's fertility. The earlier the age at marriage, the longer will be the period of reproductive life -- other things remaining the same -- the higher the fertility. In areas where the population have little or no knowledge of modern contraceptives, the frequency of divorce, polygamy and the pattern of remarriage are prime determinants of the effective reproductive period. For that reason we are paying considerable attention to marriage practices and customs in the Sudan.<sup>1/</sup>

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<sup>1/</sup> The following analysis of marriage customs and practices have been purposely limited to Muslim and pagan tribes of the Sudan. Christians - - who account for only less than half a million of the population and found mainly in the urban centres of the Southern region -- follow the same traditional customs and practices of marriage, i.e. their marriages involve the payment of bridewealth, as well as some of them being polygamous.

Among the Muslims who predominate in the Northern regions of the Sudan, marriage is confirmed by obtaining the "Gasima" -- Islamic legal documentation of marriage -- after which sexual duties between the married couples can start. Sexual practices before marriage are strictly prohibited according to Islam. For that reason the proportion of illegitimate births is negligible.

The pagan Nilotic "tribes" of Dinka, Nuer and Shilluk are cattle keepers and homesteaders. They have wealth in cattle. In all these communities, payments by a man and his kin to the kin of a woman taken as a wife always involve the transfer of cattle. Such a transfer has a symbolic significance in the establishment of mutual obligations between two kin groups, as well as important economic value. Once the transfer of marriage cattle is made, but not until then, a woman becomes a proper wife, or one of the proper wives of a man. Henceforth he is her husband and the father of children that she may bear, regardless of who may be their genitors. Ordinarily, of course, the husband is the genitor of children born to him while he is living. If a man dies without having achieved adequate paternity, it is the responsibility of a legal kinsman to endenger children on his behalf.

Evans-Pritchard recognized four types of reproductive unions among the Nuer of Southern Sudan. True marriages, ghost-marriages, leviritic marriages and concubinage. (Ghost marriages are instituted on the behalf of a dead brother, paternal uncles, maternal uncles and physiological fathers). Leviritic marriages occur when kinsmen of the deceased, who contributed to his bride-wealth, can beget children from the wife of the dead man, and accounted to him. (Evans-Pritchard Pritchard, 1945, 11-15). Similar, though not identical practices exist among other cattle-keeping "tribes".

Other small communities in the Southern and the Western regions, which follow traditional religions and are characterized by strong kinship systems, on Paternal lines, adopt similar marriage customs and practices. Marriage is confirmed within the "Nuba" of the Western region and the inhabitants of the "Ingassana" in the Southern part of the Central region, by reciprocation of gifts and services, especially among the cultivators and less wealthy "tribes".

Sudan society is prolific and polygamous. The prime objective of marriage is the production of children. Among almost all the communities of the Southern region, bride-wealth is usually paid back in the case of childlessness and divorce. Widowed women in these communities are usually taken over by the deceased's brothers or legal kinsmen, which reduces the impact of widowhood on fertility. Islam, on the other hand, allows the taking of four wives and attaches high values to children and wealth. "Polygamy is commonly practiced among the pagan tribes of the Sudan and is only limited by the wealth of the husband". (Seligman, 1965, 265).

Divorce though frequent, is very much hated. The breaking of marriages -- divorce -- among the bride-wealth "cattle" payers means the return of the "cattle" to the bridegroom, a difficult matter, as though the bride wealth is paid to one man, the bride's father or brother, it is immediately distributed and may soon play its part in another's marriage. Thus a man has every reason to desire his sister's marriage to be stable. It is very rare for a husband to divorce his wife; it is usually the wife or her family who initiates the separation. "It seems that, on the whole, divorce is amicably arranged, as a man usually only seeks divorce if his wife has left him for another man, in which case the latter would have to hand over bride-wealth to her

father, who would return the original bride-wealth to her first husband". (Seligman, 1965, 67).

### 3.1 Marital Conditions by Age, Sudan

The 1973 population census made the following categories of marital conditions available, for the urban and rural female and male populations, for Sudan as a whole and its regions. The categories are as follows:

- (i) Never married
- (ii) Married
- (iii) Widowed
- (iv) Divorced

Such a classification can limit our discussions on polygamy since it is not classified. However, the ratio of married females to married males is a reliable index of polygamy only for a population not appreciably affected by migration. (E. Van de Walle, 1968, 195). The number of married woman per married man for Sudan as a whole was 1.16 -- i.e. 116 married women per 100 married men . No attempt is made to get polygamy indices for the different regions of the Sudan due to the effect of migration.

The investigation of the proportion of female population which remains single (never married) helps us in studying fertility differentials by marital conditions between the different regions of the Sudan. For those who are married, it is useful to know the proportion who remain in stable marriages. For that reason, we will consider those widowed and divorced as unstable marriages due to the death and separation of husbands, respectively.

Table 3.1.1 on the following page presents the distribution of Sudan's female population by marital conditions. The most remarkable



TABLE 3.1.1 PERCENTAGES OF FEMALE POPULATION BY MARITAL CONDITIONS AND AGE. SUDAN, 1973

Age Group	Never married	Married	Widowed	Divorced	Not Stated	Total
Less than 15	99.20	0.75	0.02	0.02	0.01	100.00
15-19	56.87	41.01	0.40	1.69	0.03	100.00
20-24	15.03	80.24	1.38	3.33	0.02	100.00
25-29	4.58	89.58	2.6	3.23	0.01	100.00
30-34	2.74	88.62	4.8	3.82	0.01	100.00
35-39	1.82	85.75	8.05	4.35	0.03	100.00
40-44	1.83	77.14	15.08	5.92	0.02	100.00
45-49	1.70	69.16	22.06	7.06	0.02	100.00
50-54	1.64	57.39	33.04	7.90	0.03	100.00
55+	2.0	33.82	56.64	7.32	0.03	100.00
TOTAL	52.10	38.87	6.67	2.33	0.03	100.00

feature in the table is the very low permanent celibacy that characterizes the female population. That is, by the age group 45-49 only 1.7 percent of the females remain never married. The table also shows that by age 29 almost 90 percent of the female population were found to be currently married. The proportion married rises sharply from 41 percent for the age group 15-19 to 80.2 percent for the age group 20-24 and to 89.6 percent for the age group 25-29, after which it starts to decline sharply; yet by the age group 40-44 more than 77 percent are currently married.

The decline of the proportion currently married reveals the result of the increasing effect of widowhood. The proportion found widowed at the census time increases sharply from 8.1 percent for the age group 35-39 to 15.1 percent for the age group 40-44 and to 22 percent for those aged 45-49. Such high percentages for widowhood would suggest high mortality for married males, who usually marry females who are considerably younger than themselves. For all ages, however, marriages dissolved due to the death of the husband are more than twice those caused by divorce, the percentages being 6.7 and 2.3, respectively.

The proportion of rural married females in the reproductive life ages is higher than the proportions of their counterparts in urban areas, at each age group. Table 3.1.2 shows the proportions of married rural and urban females at the ages 15-49 for Sudan as a whole.

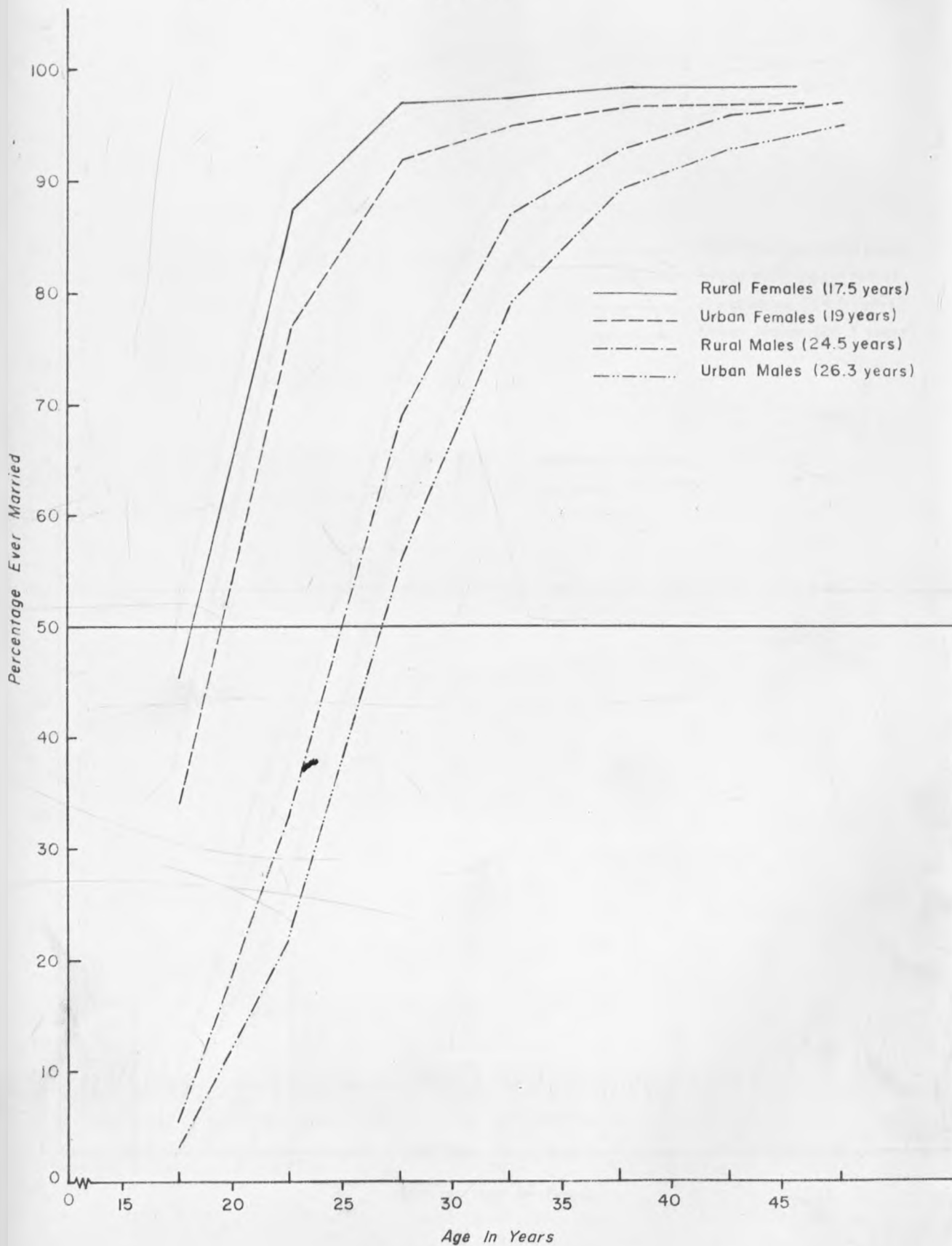
TABLE 3.1.2. RURAL-URBAN FEMALES MARRIED BY AGE, SUDAN, 1973  
(Percentages)

Age Group	Married		% Difference Rural - Urban
	Urban	Rural	
15-19	32.81	43.66	10.85
20-24	72.24	82.73	10.49
25-29	84.74	90.80	6.06
30-34	84.87	89.52	4.65
35-39	82.68	86.51	3.83
40-44	74.19	77.86	3.67
45-59	65.74	70.02	4.28
Total (15-49)	69.0	77.6	8.6

As can be seen from the table, the proportion of rural females found currently married at the census time, substantially exceeds their counterparts in the urban area, especially at the younger ages. The difference between them decreases with age increase. While the difference between the proportion of rural-urban females married at the younger age groups would explain for the greatest part differences in age at marriage, the difference of the proportions married at the older age groups is also related to the extent of re-marriage of the widowed and the divorced women, which is presumably quicker in rural than in urban areas. Certainly, this nuptiality pattern would favour higher rural than urban fertility.

Both rural males and females marry earlier than their counterparts in the urban areas. This is revealed in Figure 3.1.A. In the figure the proportion of ever married males and females in both the rural and

Fig.3.I.A: MALES AND FEMALES MEDIAN AGE AT FIRST MARRIAGE RURAL-URBAN POPULATION : SUDAN , 1973 .



urban areas is plotted against the average age in each age group. The median age at first marriage -- which corresponds to 50 percent of those ever married -- is shown in the graph. The graph shows the universality of marriage of the female population in both the rural and the urban areas of the Sudan. The median age at first marriage is slightly high in the rural than urban areas, for both males and females: a difference of 2 years. The median age at marriage is 17 years for rural females, 19 years for urban females, 24 years for rural males and 26 years for urban males. That is, the difference in the median age of marriage between males and females is 7 years in rural and urban areas.

The effect of marriage instability due to the death of the husband and divorce in rural and urban areas is shown in Table 3.1.3 which presents the proportion of widowed and divorced rural-urban females in the reproductive age groups (15-49).

TABLE 3.1.3. PERCENTAGES OF WIDOWED AND DIVORCED RURAL-URBAN FEMALES FROM EVER-MARRIED FEMALES, SUDAN, 1973

Age Group	URBAN		RURAL	
	Widowed	Divorced	Widowed	Divorced
15-19	0.83	4.6	0.95	3.73
20-24	1.26	5.36	1.73	3.52
25-29	2.23	5.36	2.85	2.91
30-34	4.4	6.30	5.07	3.37
35-39	7.46	7.04	8.38	3.81
40-44	15.44	8.32	15.35	5.49
45-49	22.94	9.72	22.3	6.45
TOTAL	6.07	6.35	6.57	3.86

As can be seen from the table, divorce in the urban areas is more frequent or permanent than in the rural areas, and it accounts for -- depending on the time the divorced woman spent outside the reproductive union -- more marriage instability and loss in fertility than widowhood. On the other hand, rural women are affected more by the death of the

husband than by divorce. The proportion widowed is substantially higher than those divorced, in rural areas.

In fact, it is not only the rates of divorce and widowhood that account for the loss of fertility among the divorced or widowed women, but more important is the period that the widowed and divorced women have to spend outside the reproductive union. The longer the period a divorced or widowed woman has to spend outside the reproductive union, then, the greater would be the loss in fertility. The smaller proportion of divorced in rural than in urban areas at the census time, would also indicate quicker remarriage for the rural divorced women than for urban women. This seems likely to be the case owing to the strong family ties in the rural areas.

Among the Muslims of the Northern regions, widowed women -- according to Islamic prescriptions -- have to wait for a period just over four months before they enter into a new union, but in practical terms, a longer period usually elapses before the widowed remarry. Divorced women usually wait for some time before they return to their former husbands, or longer periods before they re-marry to others. Among the pagan tribes of the Sudan, divorce usually or frequently means the termination of marriage where the divorced often goes to another husband. Widowed women among these tribes usually do not spend long periods out of reproductive unions, since they are usually taken by the deceased's kinsmen or relatives. On the whole, both the frequency and the time spent by the divorced and widowed women, are more likely to affect urban than rural females' fertility.

The comparison of the proportion of males and females widowed in the population is useful in knowing the likelihood of widowhood

and the extent of remarriage by sex. Table 3.1.4 presents the proportion of urban-rural males and females widowed by age.

TABLE 3.1.4. PERCENTAGES OF URBAN-RURAL MALES AND FEMALES WIDOWED BY AGE FROM THEIR TOTAL POPULATIONS, SUDAN, 1973

Age Group	URBAN		RURAL	
	Males	Females	Males	Females
Less than 15	0.01	0.02	0.01	0.02
15-19	0.04	0.29	0.07	0.43
20-24	0.18	0.97	0.33	1.51
25-29	0.38	2.05	0.74	2.74
30-34	0.72	4.18	1.09	4.95
35-39	0.92	7.22	1.29	8.26
40-44	1.62	15.03	2.03	15.10
45-49	2.15	22.39	2.66	21.98
50-54	3.58	35.44	3.65	32.46
55+	8.76	58.91	7.31	56.09
TOTAL	0.89	6.29	1.03	6.77

As can be seen from the table, the proportion of rural and urban males widowed is smaller than that of females at each age. This is also related to differences in the age at marriage. As revealed earlier in Figure 3.1.A., males marry females who are substantially younger than themselves, with the effect that fewer widowed males than widowed females were left to be counted at the census time. On the other hand, the figures in the table are also influenced by the rate of remarriage for the widowed females where re-marriage is quicker, then fewer widowed females would be counted at the census time. This is clear in the above table, where fewer proportions of widowed females are counted than in the urban areas especially at older ages. Hence old widowed females are more likely to re-marry in rural than in urban areas.

### 3.2 The Extent of Polygamy

The proportion of polygamous unions can be estimated in two

different ways:

- (a) Its incidence: A good measurement of the incidence is provided by the proportion of polygamists among married males.
- (b) Its intensity: The index used here is the average number of wives per polygamist.

Unfortunately, data to compute these two ratios are not available in the Sudan, and under these circumstances, one can merely obtain a measurement in which incidence and intensity are combined, that is, the number of married women per married man. The ratio of the married females to the married males is a reliable index of polygamy only for a population not appreciably affected by migration. For Sudan as a whole, the index was 1.16 (i.e. 116 married women per 100 married men). Any attempt to get the same index for the different regions, or for the urban and rural populations, is upset by the effect of migration, and consequently the resultant different age structures of the urban and rural populations. However, since Islam allows the marriage of up to 4 wives, and polygamy starts with 2, then an average of 3 wives per polygamist is plausible.<sup>1/</sup> Then with 16 married women over the 100 married men, this implies that there are 8 married men who are polygamous, each with an average of 3 wives. So, the number of wives associated with polygamous husbands is 24 out of every 116 married women. It follows from this that the proportion of women living in polygamous unions is 0.21 in the whole population, and those associated with monogamous husbands is 0.79.

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<sup>1/</sup> Among the pagan communities, the polygamists might have more than 4 wives, however, it has been rarely reported. For practical terms, we have assumed that the maximum wives per polygamist is 4.

More evidence of the extent of polygamy can be obtained when we compare the proportion of females and males married at each age. Table 3.2.1 shows the proportion of married males and females in the urban and rural areas.

TABLE 3.2.1. PERCENTAGE OF MALES AND FEMALES MARRIED AT EACH AGE BY URBAN-RURAL RESIDENCE, SUDAN, 1973

Age Group	URBAN		RURAL	
	Males	Females	Males	Females
Less than 15	0.02	0.43	0.02	0.84
15-19	2.48	32.84	4.89	43.66
20-24	21.18	72.24	31.61	82.73
25-29	53.72	84.74	66.59	90.80
30-34	75.99	84.87	83.82	89.52
35-39	85.66	82.68	89.81	86.51
40-44	88.70	74.19	91.37	77.86
45-49	89.57	65.74	91.49	70.02
50-54	88.24	53.43	90.34	58.36
55+	81.68	30.97	85.01	34.52
TOTAL	32.34	35.80	33.28	39.67

Females marry earlier than males in both the rural and urban areas. Furthermore, the table shows that the proportion of married females is higher in the rural than urban areas at each age group. Equal proportions of married males and females at each age do not necessarily indicate monogamous marriage, even when the numbers of males and females at each age are identical. This is due to the fact that males usually marry females who are younger than themselves. Therefore, polygamists are most likely to take extra wives who are younger than their older wives. Younger females are more attractive and have greater reproductive potential than older females. However, high proportions of married males at older ages and married females at younger ages (Table 3.2.1) would partly indicate that younger females are married to older males who are most likely to be polygamists at that age.



### 3.3 Differentials Marital Conditions by Region.

In the following section we attempt to study differences in marital conditions within (i.e. rural-urban) and between the different regions of Sudan.

#### (i) The Proportion Married:

The nuptiality pattern in each region is best represented by the proportion of females married at each age. We have to bear in mind that while marriage is well defined among the overwhelming majority of the Northern region's populations, the proportion married among the population in the Southern region might not have included those who are in free unions, i.e. concubinage. If that is the case, then, some of the females who are in the free unions might have been included in the category of those who are never married.

Table 3.3.1 below shows the proportion of rural-urban females married at each age in each region. The overall pattern does not differ greatly from the pattern of the national level already discussed.

The proportion of rural females married is greater than their counterparts' in the urban areas at each age in all regions, except in the Southern region. The proportion of younger urban females married -- those less than 20 years of age -- in the Southern region is greater than their counterparts' in the rural areas, with the effect that the proportion of urban females married for the total of the Southern female population is slightly higher for urban than for rural. Young rural females who are in free unions might have not reported themselves as married. Furthermore, with the exception of the Northern and Southern regions, all regions show that by age 25-29 more than 90 percent of rural females are married. The respective percentages for the Northern

TABLE 3.3.1 PERCENTAGES OF MARRIED REGIONAL RURAL-URBAN  
FEMALE POPULATION BY AGE, SUDAN REGIONS, 1973

Age Groups	SUDAN		NORTHERN		KHARTOUM		CENTRAL		EASTERN		WESTERN		SOUTHERN	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Less than 15	.43	.84	.36	.45	.36	.70	.43	.67	.42	.92	.46	1.23	.64	.63
15-19	32.81	43.66	23.61	27.09	28.86	43.19	30.59	44.04	36.65	54.48	34.71	52.19	46.22	37.2
20-24	72.24	82.73	64.88	68.40	66.50	82.05	72.95	83.61	74.87	83.31	76.64	84.57	79.74	83.1
25-29	84.74	90.80	81.57	84.10	82.42	91.89	87.08	92.65	85.81	93.39	86.93	92.34	83.70	88.52
30-34	44.87	89.52	83.92	86.23	83.98	92.89	88.07	93.24	86.11	91.62	86.06	90.47	79.51	85.98
35-39	82.68	86.51	84.80	84.82	83.87	90.41	87.36	90.37	83.11	89.46	82.44	88.17	71.73	81.34
40-44	74.19	77.86	77.69	77.61	77.12	84.20	79.68	82.76	74.44	81.92	71.27	78.78	59.1	70.71
45-49	65.74	70.02	69.01	71.97	71.02	76.74	72.97	75.25	64.60	74.15	61.32	70.14	49.61	64.53
50-54	53.43	58.36	56.94	60.24	56.74	67.45	58.68	62.28	52.90	61.09	48.65	55.93	41.43	56.10
TOTAL	35.8	39.67	32.93	3.42	34.88	37.04	34.76	37.37	36.0	40.41	35.70	41.33	41.72	41.22

and Southern regions are 84.1 percent and 88.5 percent, respectively. The low proportion of rural and urban married females in the Northern region relative to other regions can be attributed mainly to the heavy male out-migration from this region.

The proportion of married females in the urban areas, although less than that of the rural females, is still high. The table shows that by age group 25-29 no less than 80 percent of urban females are married in all regions, with the Central, Western and Eastern regions, having the higher values of 87.08 percent, 86.93 percent and percent, respectively. Both Northern and Khartoum exhibited the lowest percentages of 81.6 and 82.4, respectively.

(iii) The Proportion Never Married

To study fertility differentials by marital conditions, it is necessary to investigate the proportion of the female population which remains unmarried in the age group 20-24. The choice of the age group 20-24 is due to the fact that most of the women in most of the underdeveloped societies would have married by that age. The proportion never married in the age group 20-24 is also useful when related to age of marriage.

Table 3.3.2 below shows the percentages of women who remain "unmarried" for the age group 20-24 for all urban and rural populations in each region.

Females in the rural areas marry earlier than their counterparts in the urban areas. The proportions "never married" among the urban females are substantially higher than among their rural counterparts in all regions, except in the Southern region where the proportions are

Table 3.3.2 PERCENTAGES OF "NEVER-MARRIED" FEMALES AGED "20-24" IN EACH REGION BY RURAL AND URBAN RESIDENCE, SUDAN AND ITS REGIONS, 1973 (Percentages)

Region	% "Never Married" - 20-24		Difference Urban - Rural
	Urban	Rural	
Sudan	22.60	12.67	9.93
Northern	30.34	25.76	4.58
Khartoum	29.63	14.29	15.34
Central	22.85	12.14	10.71
Eastern	18.88	10.66	8.22
Western	18.31	10.96	7.35
Southern	12.0	12.21	-0.21

almost equal. The difference between the proportion "never married" by the age group 20-24 for urban and rural female population is higher for Khartoum by 15.34 percent; Central 10.71 percent; Eastern 8.22 percent; Western 7.35 percent; and lower for the Northern region amounting to only 4.58 percent. However, in the Southern region the difference between the two proportions for rural and urban females is slightly higher for rural than urban females. The Northern region, on the other hand, stands with higher proportions of "never married" females in both its urban and rural areas.

Figure 3.3.A and 3.3.B, show the median age at first marriage for rural and urban populations in all regions. In the rural area, the median age at first marriage ranges from 15.5 years for Eastern to 19.5 years in the Northern region. In the urban areas, the median age is as low as 17 years for Southern and as high as 20 years for the Northern region. The situation in the Northern region reflects the possible effect of migration on age at marriage. The median age at first marriage is higher for rural than urban population in all regions, except the Southern region. As stated earlier, the situation in the Southern region might have been affected by the exclusion of women who

Fig. 3.3.A: MEDIAN AGE AT MARRIAGE FOR RURAL FEMALES : SUDAN REGIONS 1973.

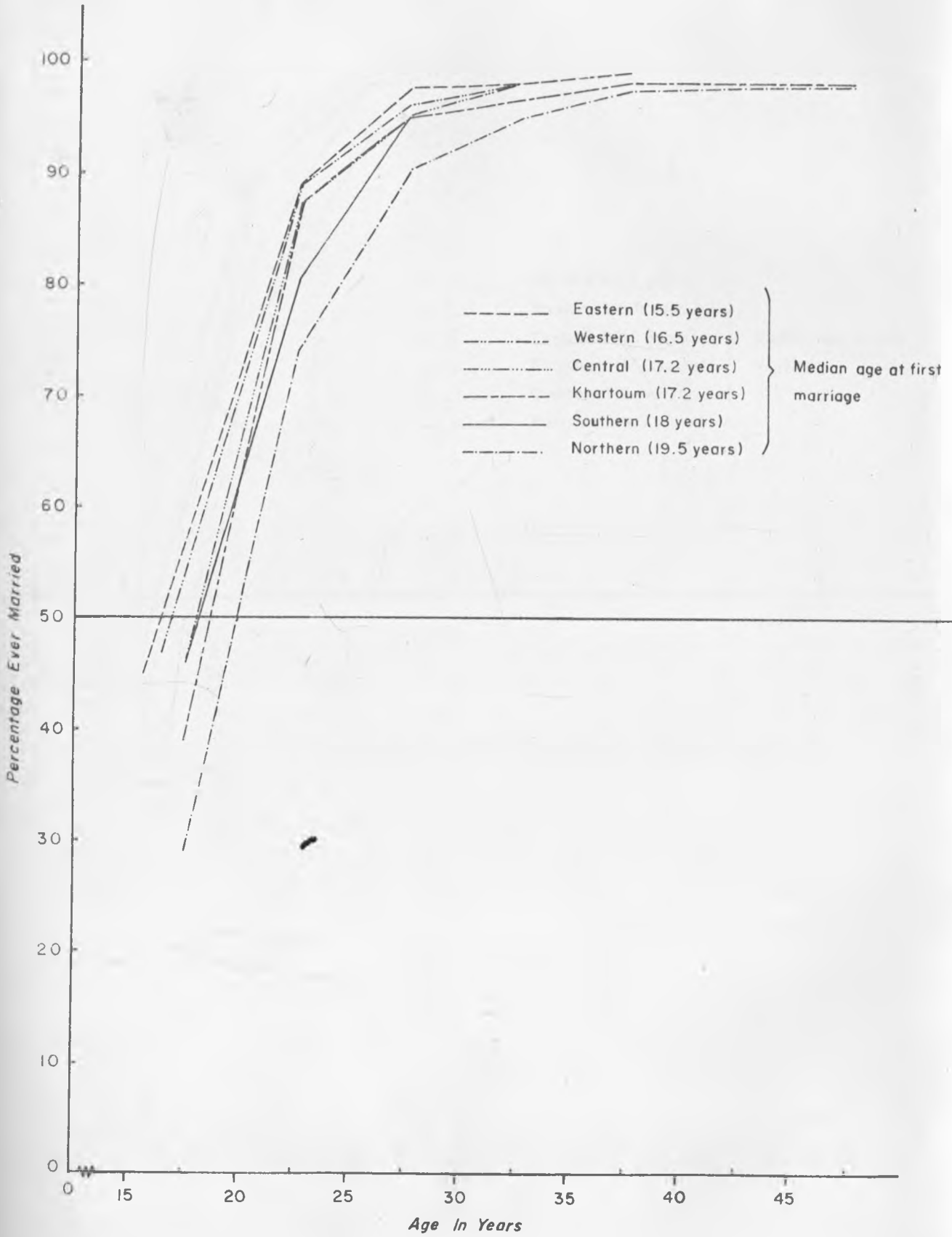
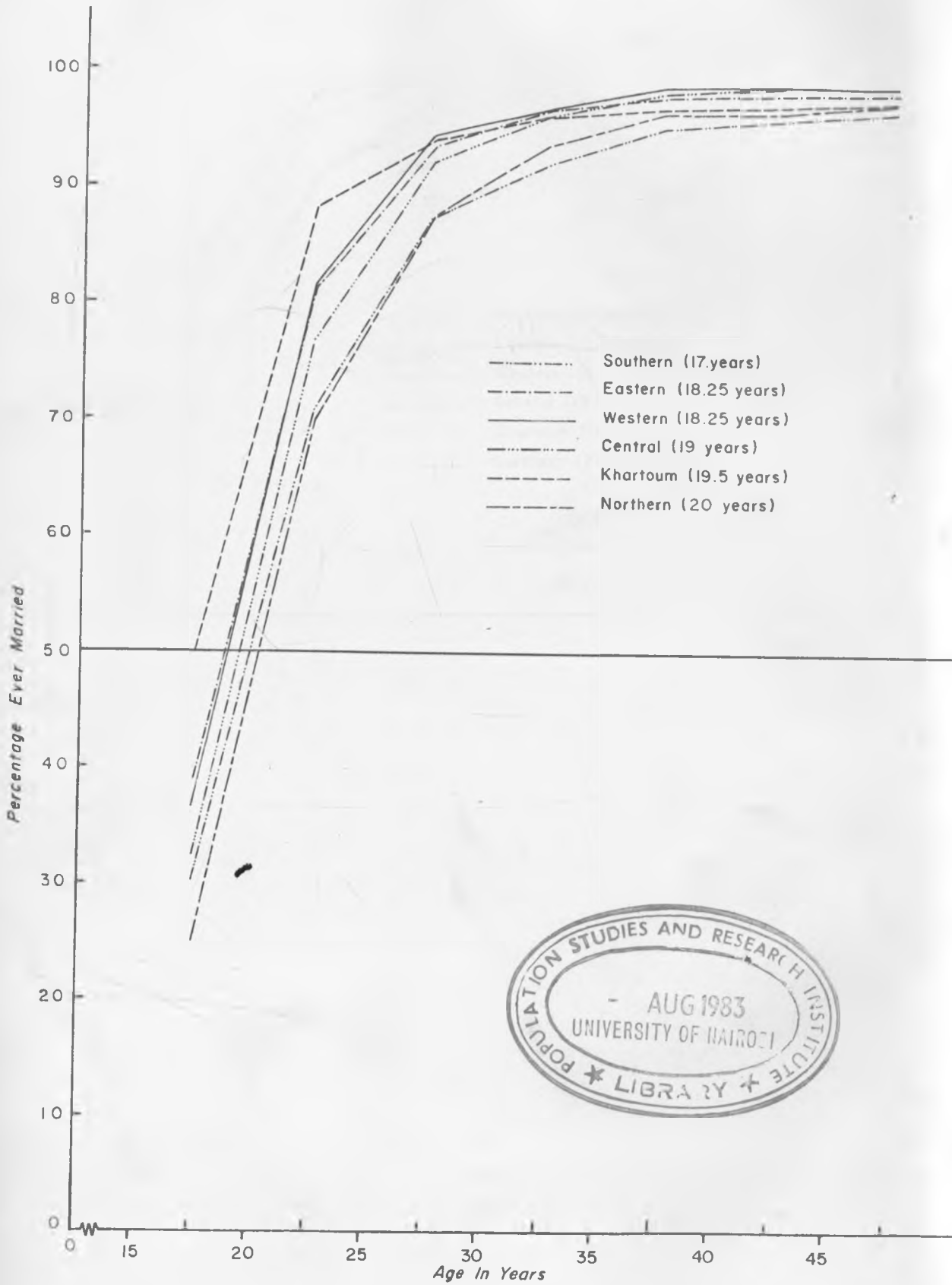


Fig.3.3.B : MEDIAN AGE AT FIRST MARRIAGE FOR URBAN FEMALES ,  
SUDAN REGIONS, 1973.



are in free unions. The differences in the median age at marriages range between 2.75 years in the Eastern region to only half a year in the Northern region in favour of the rural females.

(iv) Marriage Instability

Instability of marriage as discussed here, is that related to widowhood and divorce among rural and urban females in all regions as reported in the 1973 census. For that reason, the proportions of widowed and divorced females indicate not only the frequency of widowed or divorced women, but they are also related to the extent of remarriage. That is, low proportions of widowed or divorced women indicate not only lower incidences of widowhood and divorce, but also quicker rates of remarriage, than higher proportions, with the effect that smaller numbers of widowed or divorced women are left to be counted at the time of the census.

Table 3.3.3 shows the proportions of rural and urban females widowed at the time of the census in each region. These proportions are limited to the peak reproductive ages (20-39) to establish the effect of widowhood on fertility.

TABLE 3.3.3 PERCENTAGES OF RURAL-URBAN FEMALES WIDOWED (20-39 YEARS), SUDAN REGIONS, 1973

Age Group	R E G I O N											
	Khartoum		Central		Western		Eastern		Southern		Northern	
	U	R	U	R	U	R	U	R	U	R	U	R
20-24	0.8	1.35	0.65	1.11	0.85	0.85	1.02	0.93	3.3	3.27	1.19	1.28
25-29	1.46	1.63	1.55	1.68	1.51	1.18	1.80	1.60	5.57	6.05	2.0	1.68
30-34	3.23	1.95	3.29	2.02	3.33	2.78	3.70	2.97	10.58	9.70	4.13	4.97
35-39	5.9	4.71	5.64	6.25	6.03	4.76	7.24	5.55	16.8	15.20	6.43	8.38
TOTAL												
20-29	2.56	2.25	2.64	2.79	2.84	2.31	3.18	2.63	7.92	8.1	3.38	3.19

One common feature in the table above is that the proportions increase with age, indicating also the relative difficulty of remarriage of the widowed at older ages. However, remarriage is easier and quicker in rural than in urban areas, in all regions except in the Northern region. The very high percentages of widowed males and females in the Southern region reflect the high mortality in this region where life expectancy for both males and females is much lower than for their counterparts in the Northern regions.

On the other hand, divorce is more frequent or permanent in urban than in rural areas. The proportions of divorced women in Table 3.3.4 are higher for urban than for rural women at each age (20-39). This would partly indicate that the rate of remarriage of the divorced women in the rural areas might have been quicker than in the urban areas. The proportions of divorced rural women in the Southern region are lower than in all other regions.

TABLE 3.3.4. PERCENTAGES OF RURAL-URBAN FEMALES DIVORCED (20-39 YEARS), SUDAN REGIONS, 1973

Age Group	R E G I O N											
	Southern		Northern		Western		Eastern		Central		Khartoum	
	U	R	U	R	U	R	U	R	U	R	U	R
20-24	6.08	2.10	5.65	6.58	5.24	4.15	6.67	4.7	4.66	3.70	4.71	2.91
25-29	5.85	1.76	5.16	5.58	6.34	3.75	6.50	2.88	4.14	2.55	4.63	2.75
30-34	6.59	1.83	6.26	4.76	7.83	5.11	6.99	4.04	4.76	2.18	5.73	3.31
35-39	8.56	1.48	5.61	4.90	9.87	6.16	7.38	3.98	4.77	2.58	5.93	3.46
TOTAL												
20-39	6.54	1.80	5.63	5.40	7.26	4.70	6.80	3.8	4.54	2.76	5.15	3.06

Combining the two tables, they tell us that the effect of divorce on women's fertility at these ages (20-39) might have been higher than the effect of widowhood. The latter, however, is not frequent and presumably not permanent at younger ages. Beyond those ages, the effect of widowhood is much greater. (See Table 3.1.1).



3.4 Estimation of The Mean Age of Fertility  
From the Proportion Married:

The mean age of fertility ( $\bar{m}$ ) can be estimated directly from the proportions married (15-49), by assuming that marital fertility follows standard patterns. (U.N., 1976, 24). The method, however, is not applicable in populations with high proportions of births outside of marriage, or in which there is a variety of sanctioned sexual unions, including for example, widespread consensual unions. Under these circumstances, the method can be expected to give reliable estimates for the Sudan, especially for the Northern regions.

Mean ages of fertility for the various rural-urban populations of Sudan and its regions are given in Table 3.4.1.

TABLE 3.4.1. THE ESTIMATED MEAN AGES OF FERTILITY FROM THE PROPORTION MARRIED FOR RURAL-URBAN POPULATIONS, SUDAN AND ITS REGIONS, 1973

Region	Urban	Rural
	$\bar{m}$	$\bar{m}$
Sudan	29.6	29.2
Northern	30.1	29.9
Central	29.8	29.4
Khartoum	29.9	29.4
Eastern	29.4	29.2
Western	29.4	29.1
Southern	28.6	29.2

For application see Appendix I. (p.172)

The mean age of fertility is higher for urban than rural populations, in all regions except in the Southern region. Higher proportions of married females characterize urban than rural Southern females especially before age 20. The mean age of fertility is higher for urban and rural females of the Northern region, due probably to male out-migration that characterizes this region and consequently delays the marriage of the females in this area. The mean age of fertility is also related to age at first marriage, especially among populations who practice little or

no birth control. That is, the low mean age of fertility in the rural areas indicates an earlier age at marriage than is found among their urban counterparts. That is the case in all rural areas except in the Southern region. The situation in the Southern region is possibly due to the exclusion of the females in free unions from the category of those who are married.

### 3.5 Summary and Conclusions:

The preceding analysis of marital conditions has shown that, the usual classification of the female population as never married, married, divorced and widowed has concealed a lot of useful information. One obstacle to the efficient use of the tabulated data is that they have not been published in sufficient detail to permit systematical development. For instance, there is little information on polygamy. Secondly, a multiplicity of marital categories exist, especially in the Southern region, posing a dilemma for any analysis. Unfortunately, these different forms of reproductive unions have not been identified in the census.

However, the analysis did manage to establish the following points:

(1) Low permanent celibacy characterizes the female population in the Sudan. By the age group 45-49 less than 2.0 percent have "never married".

(2) Median ages of marriage are low for most of the regions. In the rural areas, Eastern females revealed a very low median age at marriage of 15.5 years, followed by Western (16.5 years), Central and Khartoum (17.2 years) and Southern (18 years). Northern region rural females remain with the highest median age at first marriage of 19.5 years.

In the urban areas, the Southern region has shown the lowest median

age of marriage of 17 years and the Northern region again has shown the highest of 20 years. Other regions remain within this range, with the Eastern region revealing the lowest of 18.25 years. The case in the Southern region where the median age of marriage is lower for urban than for rural, might have been affected by the exclusion of many of the rural females from the category of married females, or, on the other hand, many of the urban females might have been reported as married, while those in rural areas were not. The high median age at marriage in the Northern region reveals the possible effect of migration in delaying the age at marriage.

· On the other hand, the difference in median age at marriage between rural and urban males and females amounts to 7 years in favour of the male population. Of course, greater difference is expected in the case of polygamous marriages. The latter accounts for approximately 21 percent of all marriages for Sudan as a whole.

(3) The effect of divorce and widowhood on a woman's fertility depends to a great extent on the period that a divorced or widowed woman has to spend outside reproductive unions. Rural widowed women, however, spend less reproductive time outside marriage than do urban females. Divorce, on the other hand, is more frequent or permanent in urban than rural areas.

(4) The higher incidences of widowhood of the married females in the Southern region, even though the rate of remarriage of the widowed depresses its effect on fertility, it also lead to polygamy which in effect has a depressing effect on fertility; owing to less frequency of intercourse among co-wives and the effect of favouritism. (

CHAPTER IV  
REGIONAL FERTILITY ESTIMATES

4.0 Introduction

Information about fertility in most of the African countries -- Sudan being one of them -- is indeed far from satisfactory. The conventional source of accurate knowledge about births -- complete birth registration -- is simply not found or incomplete for most of the region's population. Hence, there is no choice but to try to estimate the number of events "births" from less direct evidence. The indirect evidence is of two sorts: (1) evidence about the age and sex composition of the population from a census or a demographic survey sometimes supplemented by an indication of the rate of natural increase from two enumerations of the same population, and (2) evidence about fertility from responses to questions about children ever born to women and from responses to questions about births occurring in the year before the census or survey. (Brass, W., et. al., 1968, 88). Even when this evidence apparently provides the desired data, it cannot be accepted at face value without critical appraisal. For example, respondents frequently make mistakes about the duration of the reference period during which events are to be reported, and there is also the problem of age misreporting, especially among the illiterate populations of Africa. For these reasons, increasing efforts have been placed on inventing and applying methods that yield best estimates from data which are incomplete, inaccurate or both.

In this chapter, we attempt principally to use the information on fertility obtained in the 1973 population census to arrive at

plausible fertility levels for Sudan as a whole and its regions. Rural and urban estimates are presented in a different section of this chapter. The basic data utilized in this chapter concern "current" and "retrospective" information on fertility obtained from each women over age 12. Such information is essential for the use of the Brass technique to estimate the total fertility rate.

In addition, the age distribution of the population can be useful for the estimation of fertility by stable analysis if both fertility and mortality rates have been relatively constant and migration has been uncommon. The 1973 census provides an age distribution for each sex. Further, a modification of the assumptions of constant mortality to allow for a decline in mortality level permits the use of quasi-stable population models.

Considering the characteristic forms of age distortion already discussed in Chapter II, -- which conform to the "African-Asian" forms of distortion -- estimates obtained from the female age distribution is thought to be satisfactory. (U.N., 1967, 22). The total female population of the country is chosen to stand for the regions' respective populations since the regions are affected by migration. The objective is to estimate the fertility level by the Brass technique and to choose a stable population model to conform to these estimates. (Ibid., 1967, 21).

#### 4.1 Earlier Estimates of Fertility:

Previous studies on the basic demographic measures of Sudan have had to rely on the information collected in the 1955/56 census and the 1964/65 housing survey which covered the urban areas of the

six provinces of Northern Sudan. The reported demographic measures from the 1955/56 census are presented in Table 4.1.1. The figures for the Western and Southern regions are reported here as weighted averages.

TABLE 4.1.1 POPULATION, SEX RATIO, VITAL RATES AND COMPLETED FAMILY SIZE (CFS) FOR THE REGION'S PROVINCES, SUDAN, 1955/56

Region	Pop. both sexes (000)	Males per 100 females	Birth Rate	Death Rate	Rate of natural Increase	Infant Death Rate	"CFS"
1. Southern	2784	101.7	69.8	28.9	40.9	128.9	4.9
Bahr-el-gaza	991	103.9	84.6	27.3	57.3	111.8	5.3
Upper Nile	889	104.8	69.3	32.6	36.7	143.9	5.5
Equatoria	904	96.2	54.1	27.0	27.1	132.9	4.0
2. Western	3091	96.9	46.5	14.4	32.0	75.6	4.5
Kordofan	1762	101.5	50.0	15.5	34.5	76.0	4.4
Darfur	1329	90.8	41.8	13.0	28.8	75.0	4.7
3. Eastern	941	114.8	42.6	17.5	25.1	82.0	4.4
4. Central	2070	106.1	45.7	14.7	31.0	72.2	4.9
5. Northern	873	93.7	43.0	12.1	30.9	66.7	5.1
6. Khartoum	505	117.5	40.7	14.9	25.8	71.4	4.5
SUDAN	10263	102.2	51.7	18.5	33.2	93.6	4.7

Source: Compiled from 1955/56 Final Report, Vol. 1, Dept. of Statistics, Sudan.

Unquestionably, the most striking feature in the table is the extremely high birth rates in the Southern provinces: Bahr-el-Gazal, Upper Nile, and, to a lesser extent, Equatoria. The associated rates of natural increase in the first two provinces are also unusual, despite the high death rates that were registered in these areas. Another observation is the apparent existence of great differences among the regions and their provinces with respect to both fertility and

mortality, and the most pronounced differences between the Southern and Northern regions. In the Northern provinces the level of birth rates is more in conformity with what one tends to consider "normal" or "typical" African fertility, thus offering a sharp contrast with provinces having much higher birth rates.

Many scholars using the demographic information obtained from the 1955/56 census with stable population model, were able to arrive at different estimates of fertility and mortality for the population. Later K.C. Zachariah using the 1964/65 housing survey data was able to arrive at some estimates of fertility and mortality for Sudan. The different results of these studies are presented in Table 4.1.2.

TABLE 4.1.2 ESTIMATES OF BIRTH RATES, DEATH RATES AND GROWTH RATES, SUDAN, 1955/56 AND 1964/65

Source of Data	Birth Rate per 1000 pop.	Death Rate per 1000 pop.	Growth Rate per 1000 pop.
1. The 1955/56 census	51.7	18.5	33.2
2. Kortki's study	60.0	32.0	28.0
3. U.N. Sudan study	45-54	20-25	20-34
4. Paul Demeny's study	48.7	21.3	27.4
5. Zachariah study 1964/65	49.0	21.0	28.0

Source: Research Monograph Series No. 1, Cairo Demographic Centre, Cairo, 1970.

As can be seen from the table, most of the estimates remain within the range set in the U.N.-Sudan Government Joint Study. The novelty of Paul Demeny's study is that its basic unit of analysis was the major tribal subdivision (people's) of the Sudan. These tribal subdivisions form more or less closed populations. (Demeny, P., 1968, 473). Table 4.1.3. shows the various estimates of Demeny's for the various provinces of the country obtained as a weighted average according to the tribal

distribution within each province.

TABLE 4.1.3. PAUL DEMENY'S ESTIMATES OF BIRTH RATES, DEATH RATES AND RATES OF NATURAL INCREASE, SUDAN, PROVINCES, 1955/56

Region	Birth Rate	Death Rate	Rate of Natural Increase
1. Southern:	54.4	31	23.4
Bah-el-Gazal	56.0	31	25.0
Upper Nile	58.0	31	27.0
Equatoria	49.0	31	18.0
2. Western:	46	17.6	28.4
Kordofan	46	18.0	28.0
Darfur	46	17.0	29.0
3. Eastern	45	18.0	27.0
4. Central	47	18.0	29.0
5. Northern	47	17.0	30.0
6. Khartoum	47	17.0	30.0
Sudan	48.7	21.3	27.4

Source: Brass, W., Et. al., 1968, p. 511.

Demeny's estimates resulted in modification of the reported rates. The "abnormal" birth rate of the Southern region was reduced to 54.4 per 1000 population and the death rate to 31.0. Birth rates of the Northern regions vary between 45 to 47. For the country as a whole, the birth rate was 48.7 leaving the average birth rate of the Northern provinces 5 percent under it and that of the Southern provinces 12 percent above it. Greater variations of the birth rates are among the Southern than the Northern provinces.

#### 4.2 Further Discussions on "Current" Fertility and "Parity" Data Reported in the 1973 Census

The discussion on "current" and "retrospective" fertility, reported in the 1973 population census in Chapter II, suggests that the census might have been incomplete for infants, and that the number of



children ever born reveals evidence of memory lapse of older women in reporting their parities. In this section, further investigation of this information will help us to arrive at preliminary estimates of fertility levels for each region.

(a) Retrospective Data on Fertility:

Reported parities summarize the fertility histories of different cohorts of women.

(i) Completed Parity and Fertility at Early Ages "Parity 20-24"

The reported parities of women aged 45-49 is a useful summary of the fertility history of a cohort of women. On the other hand, reported parities of women aged 20-24 are a valuable measure of recent fertility and of the importance of fertility at the younger ages. The comparison of the two is useful in knowing the peaks of fertility. Table 4.2.1. presents parity of women aged 20-24 and the completed family size (CFS) for women aged 40-49 for the different regions of Sudan.

TABLE 4.2.1. COMPARISON BETWEEN EARLY PARITY (20-24) AND COMPLETED FAMILY SIZE "(CFS)" (45-49). SUDAN AND ITS REGIONS, 1973

Region	Parity 20-24	Rank	CFS 45-49	Rank
Central	2.01	1	6.11	1
Eastern	1.91	2	5.42	3
Western	1.76	3.5	5.01	5
Southern	1.76	3.5	4.72	6
Khartoum	1.57	5	5.30	4
Northern	1.51	6	5.56	2

If we rank correlate the parity 20-24 to completed family size 45-49, a weak and positive correlation ( $r = +0.24$ ) is observed. That is, low start in fertility does not necessarily indicate low completed

family size and vice versa. For example, although fertility starts low in the Northern and Khartoum regions, with average parities ranking 6 and 5, respectively, it continues relatively high beyond that age group, so that their completed family sizes rank 2 and 4, respectively. From this point we can speculate that these regions have age-specific fertility schedule which fit a "late" peak category. This is related to: age at marriage, state of health, use or non-use of contraceptions or traditional practices for avoiding pregnancy, nutrition, etc.

The situation in the Northern region suggests the possible effect of male out-migration in delaying the age at marriage of the female population, while on the other hand, the high fertility exhibited by the Central region's females both in early parity and completed family size, reflects possibly not only the nutritious food and better health conditions available to its women, but also suggests the absence of the use of modern contraceptives. Khartoum, on the other hand, stands as the most urbanized, industrialized area and trade centre in the country; the lower parity (20-24) and the relatively lower completed family size (45-49) "ranking 5 and 4 respectively"; would suggest that its relatively lower fertility -- presumably not strongly influenced by bad health conditions or nutrition relative to other regions -- might be due to some efforts made by some of its women to control fertility either by delay in age at marriage or the deliberate use of contraception. Unlike Khartoum, the low completed family size exhibited by the Western and Southern regions -- despite their relatively high average parity at age 20-24 -- might be strongly influenced by the unfavourable health conditions that these two regions are known to have. (See Chapter I).



(ii) Childlessness and Women not Stating Their Parity:

The level of zero parity, reported in the 1973 census is extremely low. Less than 0.5 percent of ever-married females 12 years of age and over are reported as childless. In contrast, a large percentage, amounting to 17.4 percent for Sudan as a whole, did not state their parity. The latter will affect the birth rate if these women have genuinely had zero parity. If we relax all other factors affecting the fertility level between the different regions, and correlate the ranking of women not stating their parity in each region to the ranking of the total fertility rate reported, a strong inverse relationship ( $r = -0.94$ ) is observed. If that is the case, then more than 88 percent of the variance in the total fertility rate reported, is caused by the variations in the proportions of women not stating their parity in the different regions. It has been shown that such high percentages of women not stating their parity might be due to two factors: either the question has not been put to them, or these women have chosen not to state their parity for one reason or the other. (Refer to Chapter II, p. 59).

If we can assume that these women did not have zero parity, and that their births distribution is the same as that of women who stated their parity, -- since there is no reason to assume that they have different birth distributions -- then the birth rate for each region has been underestimated by the same percentages of the women not stating their parity.<sup>1/</sup> In Table 4.2.2 the reported age-specific fertility

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<sup>1/</sup> Since women not stating their parity have deliberately chosen that, or the question has not been put to them, then it is natural or safer to assume that these women have denied answering both questions of "children ever born" and "children born in the last twelve months preceding the census date". cont....

1/ Women not stating their parity would affect the current fertility (F) and parity differently. However, to estimate fertility levels for the Sudan and its region we hypothesize that: Since many of these women are not married during census time - divorced, widowed or separated - then this will not affect their current fertility greatly, but it does underestimate the reported parity. On the other hand, if these women are left out altogether this would lead to an overestimation of their reported parity.

rates were revised to include the omitted births by those who did not state their parities, and the resultant total fertility rates are presented.

TABLE 4.2.2. THE REPORTED AND REVISED TOTAL FERTILITY RATES FOR SUDAN REGIONS, BY RURAL-URBAN RESIDENCE, 1973

Region	RURAL			URBAN		
	Reported	Revised	% Increase	Reported	Revised	% Increase
Central	6.2	7.0	12.9	5.7	6.5	14.0
Northern	6.2	7.1	14.5	5.3	6.1	15.1
Eastern	5.5	6.4	16.4	5.3	6.3	18.9
Khartoum	5.7	6.5	14.0	5.2	6.0	15.4
Western	5.0	5.9	18.0	5.3	6.2	17.0
Southern	4.7	5.7	21.3	4.6	5.8	26.1

As can be seen from the table, the revised total fertility rates indicate that women not stating their parity have probably resulted in an underestimation of the total birth rates varying from 13 percent to 21 percent for rural areas and from 14 percent to 26 percent for urban areas. However, the revised rates do not alter significantly the ranking of the regions by their reported total fertility rates.

#### 4.3 1973 Reported Fertility : "Sudan and Its Regions"

Measures of fertility used in this study are:

- (i) The crude birth rate (CBR), defined as the number of live births per 1000 population. Clearly this rate is affected by variations in the sex structure of the population.
- (ii) The general fertility rate (GFR), defined as the number of live births registered in a year per 1000 women in the child-bearing period (15-49).
- (iii) Child-woman ratio (CWR); a ratio of children less than five

years of age to the child-bearing age women (15-49).

Both the GFR and CWR have the same denominator. The numerators of the above rates are affected by the under-enumeration of infants and mortality levels, especially in infancy and early childhood in the case of the CWR. (Barclay, 1958, 171-174).

- (iv) Age-specific fertility rates (ASFRs); ratios of births by age of mothers to women in each interval (5 years of age). These rates provide a great improvement in precision over the above rates, in that they are not significantly distorted by variations of age composition, either in the total population, or among the women of child-bearing ages.
- (v) Total fertility rate (TFR) and gross reproduction rate (GRR). The former is the sum of age-specific fertility rates, and the latter is their sum for daughters only.

Table 4.3.1 presents the reported CBR, GFR and CWR for Sudan as a whole and its regions.

TABLE 4.3.1. REPORTED CBR, GFR AND CWR, SUDAN AND ITS REGIONS, 1973

Region	CBR	GFR	CWR
Sudan	39.9	173.8	783.9
Central	42.2	202.4	922.8
Northern	40.4	173.1	739.3
Eastern	37.3	177.9	814.4
Western	39.4	165.6	764.5
Khartoum	36.8	175.1	774.2
Southern	40.4	158.6	701.7

The numerator for the CBR and the GFR is the reported children born in the last twelve months preceding the census rather than the enumerated infants.

As can be seen from the table, the reported crude birth rates (CBRs) vary from the highest of 42.4 for the Central region, to 36.8 for Khartoum, a difference of nearly 15 percent. In general, regional variations in fertility levels are certainly affected by: the accuracy of the births reported, variations of age structure of the regions' populations, and by the mortality levels in infancy and early childhood. The GFR and the CWR vary from the highest of 202.4 and 922.8 for the Central region, to the lowest of 158.6 and 701.7 for the Southern region; a difference of more than 43 percent and 31 percent, respectively. Much of the variations within a region may be attributed to the shortcomings of these rates. For example, the Southern region, though it has a high CBR of 40.4 ranking 2, also has a low GFR and a CWR ranking last in both categories, that is, the Southern region might have a high proportion of women in their childbearing years in its population or an earlier average start of child-bearing. (Coale, J.A., 1961, 631-646). The Central region, however, exhibited a higher level of fertility relative to other regions when measured by the above reported rates, ranking 1 in all. Other regions differ in the ranking of these rates. The relatively higher birth rates reported for the Northern and Western regions, and the relatively higher GFRs reported for them, reveal the possible effect of out-migration in these regions, while, on the other hand, the same comparison of these rates reveals the effect of in-migration for Khartoum and the Eastern region.

(ii) Age Patterns of Fertility:

The shape of the age-specific fertility schedule is an interesting and important part of the study of fertility. The mean age of child-bearing, which is closely related to the mean of this schedule, is important to the relation between the total fertility rate and

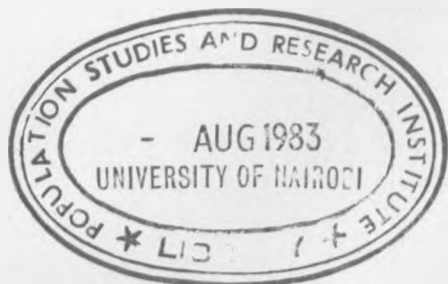
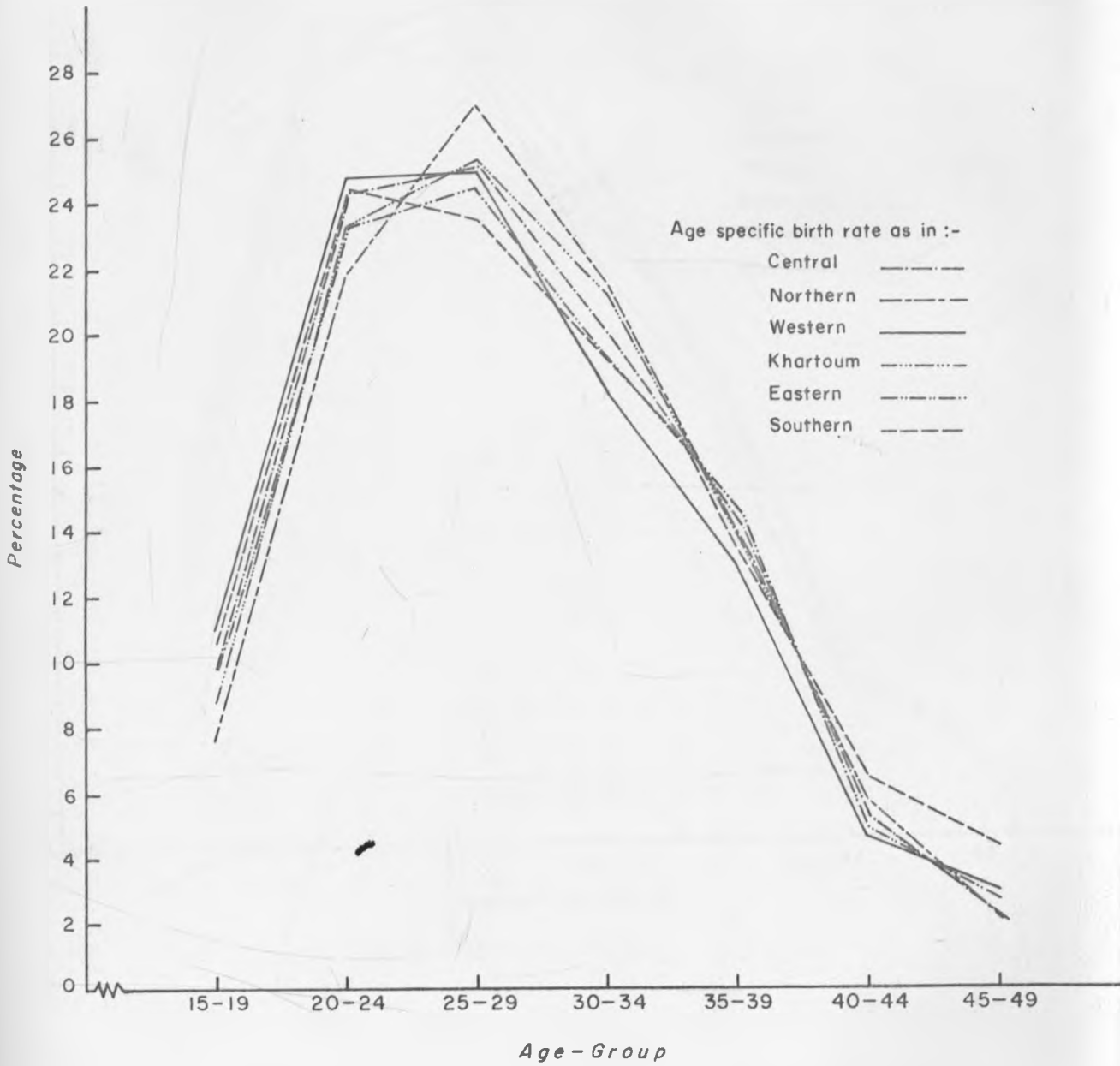
population growth. The shape of the age-specific fertility curve is also the link between the total fertility rate and such variables as the age at first marriage and menopause. For example, a decrease in the age at marriage will affect the early part of the age-specific fertility schedule and will affect the total fertility rate through this part of the curve. Furthermore, the total fertility schedule is vital to the estimation of fertility by the Brass method of combining current and retrospective data on fertility.

Figure 4.3.A. shows the percentages of age-specific birth rates plotted against the average age in each age group. Three major types are discernible with respect to the peak age of fertility.

- (i) An early peak-type, in which the maximum fertility occurs in age group 20-24; this, as can be seen from the graph is exhibited only by the Southern region.
- (ii) A late-peak type, in which the maximum is in the age group 20-25. This peak characterizes the Northern, Central, Khartoum and the Eastern regions. The difference between them lies only in the degree of concentration at the peak ages and skewness of the distribution of fertility rates. At this peak, the Northern region reached a maximum of 27 percent contribution to its total fertility rate followed by Khartoum, Central and the Eastern regions.
- (iii) A broad-peak type, in which the age-specific birth rates for women 20-24 and 25-29 differ only slightly, while greatly exceeding the rate for younger and older ages. This type is exhibited by the Western region, the percentage distribution of its age specific birth rates for the ages



Fig. 4.3.A: PERCENTAGE OF TOTAL FERTILITY CONTRIBUTED BY WOMEN FOR THE DIFFERENT REGIONS OF SUDAN. 1973.

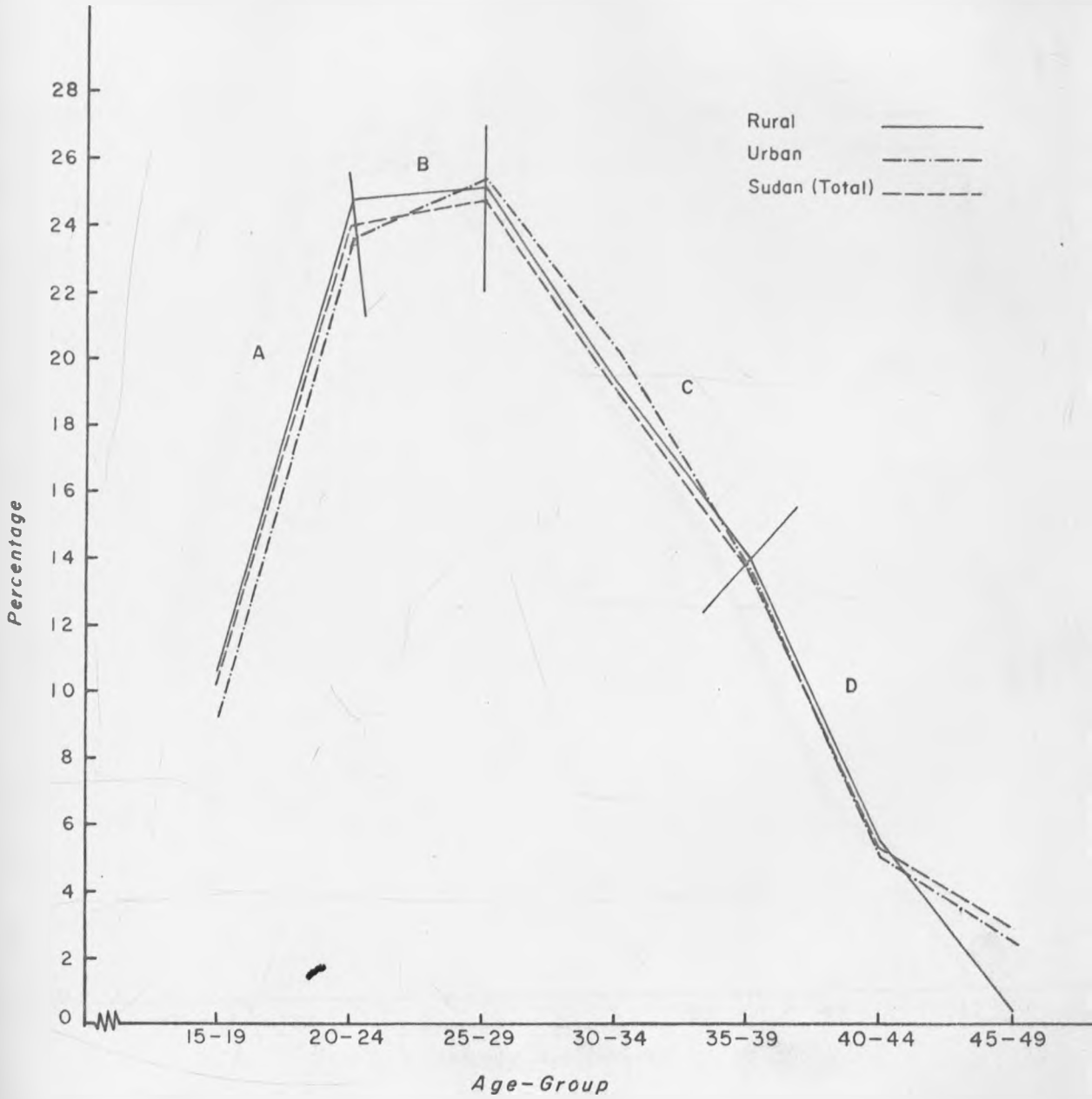


20-24 and 25-29 being almost equal.

Further, Figure 4.3.B shows the percentage distribution of the age-specific fertility rates for the total, urban and rural females for the Sudan as a whole, plotted against the average age in each age group. The two curves exhibit many similarities. Much of the difference between the two curves (rural-urban), on the other hand, may be attributed to the concentration and acceleration of fertility at the different ages. For better understanding of the two curves, we divide the curves in Figure 4.3.B into four segments, A, B, C and D. In segment A, which covers the ages 17 to 22 on the average, we note that rural fertility starts high and accelerates at a rate which is higher than urban fertility, reaching a peak at age 22 on the average. In segment B (ages 22 to 27 on the average), while rural fertility remains high, the urban fertility curve rises more steeply reaching a peak at age 27 on the average, leaving that of the rural females at a lower peak but not different from its first peak. That is, in segment B, the rural female fertility curve approaches a broad peak, while that of urban females defines a late peak. In segment C, which covers the average ages 27 to 37, both curves slope downwards, with urban fertility remaining higher than rural fertility. In the last segment, both curves continue falling downwards but more steeply than before, with the fertility of urban females (in the last age group of child-bearing - 45-49), remaining higher than that of rural females.

The preceding analysis of the two curves suggests that differences in rural-urban fertility could possibly be attributed to differences in factors such as: age at first marriage, nuptiality pattern, state of health and nutrition and a host of factors, that affect infecundability. While the first two factors could possibly explain the behaviour of the

Fig. 4.3 B : PERCENTAGE OF TOTAL FERTILITY CONTRIBUTED BY TOTAL, URBAN AND RURAL WOMEN IN EACH 5-YEAR AGE INTERVAL SUDAN, 1973 .



two curves in segments A and B, the latter factors might explain the higher urban than rural fertility in segments C and D.

Table 4.3.2. presents the reported total fertility rate and mean age of fertility for the Sudan as a whole, and its regions. The mean age of fertility ( $\bar{m}$ ) is calculated by the use of the reported age-specific fertility rates.

TABLE 4.3.2. REPORTED TOTAL FERTILITY RATE AND MEAN AGE OF FERTILITY, SUDAN AND ITS REGIONS, 1973

Region	TFR	$\bar{m}$	GRR
Sudan	5.2	28.6	2.6
Central	6.1	28.5	3.0
Northern	5.6	28.9	2.8
Eastern	5.4	28.5	2.7
Khartoum	5.3	28.6	2.6
Western	5.0	28.2	2.5
Southern	4.7	28.7	2.3

N.B. For the calculation of GRR, sex ratio at birth was set at 1.03.

As can be seen from the table, the reported total fertility rates vary from the highest of 6.1 for the Central region to 4.7 for the Southern region, a difference of nearly 30 percent. The mean age of fertility for Sudan as a whole, is 28.6. For the regions, the small variations in their mean ages of fertility are explained by the shape of the age-specific rates. The Southern region has shown an early peak, but relatively higher mean age of fertility due to the very slow decline of its age-specific fertility rates with age increase. On the other hand, the Northern region has shown both higher fertility and higher mean age of fertility due probably to the steep rise and decline in its age-specific fertility rates.



#### 4.4 Regional Fertility Estimates

(i) Estimates of Total Fertility Rate and Mean Age of Fertility By Use of Reported Parity

In the absence of age-specific fertility rates, parity reported by women in the 1973 census can be used to estimate the total fertility rates. The method considers that the ratio of the average parity of women at the end of child-bearing to the average parity of young groups (say 25-29) is clearly related to the relative parity of women early and late in their twenties. That is, the ratio of  $TF/P_3$  and  $P_3/P_2$  are gratifyingly close, and is well represented by the formular

$$TF = P_3^2/P_2$$

where,  $TF$  = total fertility rate, and  $P_3$ ,  $P_2$  the average parities of the age group 25-29 and 20-24, respectively. (U.N. Manual IV, 1967, 33).

However, the method assumes that:

- (a) Fertility of the age 25-29 has been constant in the recent past.
- (b) The age pattern of fertility conforms to the typical age relationship found in populations practicing little birth control, implying (1) that the age pattern of declining fecundability is typical and (2) that widowhood, divorce and other forms of dissolution of sexual unions do not have age incidence from age 30 to 45 in the population in question. (Ibid, 1967, 34).

Further, the mean age of fertility can also be estimated by the use of parity from the relationship of average parity at age 20-24,  $P_2$ , and the average parity at ages 25-29,  $P_3$ . That is, if the ratio  $P_3/P_2$  (in a population not practicing birth control) depends merely on the ages at which women begin their childbearing, a high value of  $P_3/P_2$  indicates a late start, and a low value an early start. So the mean

age of fertility ( $\bar{m}$ ) is expressed in the following linear equation:

$$\bar{m} = 2.25 P_3/P_2 + 23.95$$

The following table (4.4.1) presents the reported TFRs,  $\bar{m}$  and the estimated ones by the above equation, for Sudan as a whole and its regions.

TABLE 4.4.1 REPORTED AND ESTIMATED TOTAL FERTILITY RATES (TFRs) AND MEAN AGES OF FERTILITY ( $\bar{m}$ ). SUDAN AND ITS REGIONS, 1973

Region	TFR		$\bar{m}$	
	Reported	$P_3^2/P_2$	Reported	Estimated
Sudan	5.2	6.02	28.6	28.1
Central	6.1	7.3	28.5	28.2
Northern	5.6	7.5	28.9	29.0
Eastern	5.4	6.3	28.5	28.0
Khartoum	5.3	6.6	28.6	28.7
Western	5.0	5.7	28.2	28.0
Southern	4.7	5.0	28.7	27.8

The use of  $P_3^2/P_2$  results in an increase in the reported total fertility rates in all regions. The Northern region now ranked 1, due to its late start in fertility and the relative low parity of the age group 20-24. The rates now vary from 7.50 for the Northern region to 5.0 for the Southern region, a difference of 50 percent. The estimated mean ages of fertility do not vary greatly from the reported ones, except for the Southern region. They are still high for Northern, Khartoum, Eastern and Central regions, but low for the Southern region. In fact the assumptions underlying the estimates are very much in conformity, especially in the Northern regions.

(ii) Estimates Based on the Brass  
P/F Ratio: Method:

Both "current" fertility and parity reported in the 1973 census can be combined by the use of the Brass P/F ratio method to estimate

the total fertility rate for the country as a whole and its regions. The method requires the estimation of average values of cumulative fertility by age over the same age interval, (say 15-20, 20-25, etc.) for which the average number of children born is reported. It is then assumed that the source of the difference between the estimated average value of cumulative fertility at the younger ages (such as to 20-24 or 25-29) and the average number of children ever born at these ages is an erroneous perception of the reference period by the respondents. (Brass, et. al, 1968, 91). The multiplier that would be needed to bring cumulative fertility at younger ages in line with the reported average number of children born is determined and the reported number of births at all ages are multiplied by this factor.

The assumption of constant fertility in the past for applying the method, seems plausible since the traditions and cultural factors that affect fertility are unlikely to have changed dramatically in the recent past. An application of the method for the total population of the Sudan is shown in Table 4.4.2. The last column presents the P/F ratios among which the correction factor will be chosen.

For the different regions of the Sudan, the P/F ratios are presented in Table 4.4.3.

The table shows that the sequence of P/F values of the various regions follows the pattern expected from the assumptions underlying the Brass method of estimating fertility. The level of P/F decreases with age. The  $P_2/F_2$  value -- the recommended value as a correction factor -- varies from the highest of 1.508 for the Southern region, to the lowest of 1.3365 for Khartoum, indicating that the fertility level has been underestimated by 33.6 percent to 51 percent. For the

TABLE 4.4.2 AN APPLICATION OF BRASS P/F RATIO FOR THE SUDAN, SUDAN, 1973

Age Group	No. of Women	Children born in the last 12 months	Children ever born	ASFR $f_i$	Reported cumulative fertility $F_i$	C. Fertility at the beg. of age $i$ $\phi$	Multiplier factor $w_i$	Estimated C. Fert. $F_i = f_i w_i + \phi_i$	$P_i$	P/F
1. 15-19	505,307	54,091	186,665	.1071	.5350	0	2.2121	.2367	.3694	1.5606
2. 20-24	457,180	114,830	819,362	.2512	1.7910	.5350	2.8769	1.2577	1.7922	1.4250
3. 25-29	563,088	145,887	1,848,924	.2591	3.0865	1.7910	3.0285	2.5757	3.2835	1.2748
4. 30-34	384,731	78,852	1,676,502	.1998	4.0855	3.0865	3.1220	3.7103	4.3576	1.1745
5. 35-39	371,225	53,442	1,859,916	.1440	4.8055	4.0865	3.2490	4.5534	5.0102	1.1003
6. 40-44	248,563	13,976	1,228,587	.0562	5.0865	4.8055	3.520	5.0033	4.9428	.9879
7. 45-49	183,390	5,779	888,461	.0315	5.2440	5.0865	4.4185	5.2257	4.8447	.9271

$$f_1/f_2 = .426, \bar{m} = 28.6.$$

For the calculation of the multiplier factor  $w_i$ ,  $f_1/f_2$  is used for the first 3 age groups and  $\bar{m}$  for the rest.



regions, the sequence of P/F values  $P_2/F_2$ ,  $P_3/F_3$  and  $P_4/F_4$ , indicates that fertility has been underestimated. Certainly these values are distorted by age misreporting. For the regions of the Sudan, it is found that the P/F ratio at age 15-19 is greater than at 20-24, which in turn, exceeds P/F ratio at age 25-29 and so on, with age increase. This sequence may be due to a systematic pattern of age misreporting, perhaps related to parity or fertility. (E. Van De Walle, 1968, 150). The choice of the correction factor -- to be done at the end of this section -- has to accommodate this fact.

TABLE 4.4.3 THE BRASS P/F RATIOS FOR THE DIFFERENT REGIONS OF SUDAN, 1973

Region	A G E G R O U P						
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
	$P_1/F_1$	$P_2/F_2$	$P_3/F_3$	$P_4/F_4$	$P_5/F_5$	$P_6/F_6$	$P_7/F_7$
Sudan	1.5606	1.4250	1.2748	1.1745	1.1003	.9879	.9271
Central	1.5311	1.4104	1.2934	1.2110	1.1261	.9376	.9180
Northern	1.3515	1.3571	1.3254	1.2503	1.1559	1.0924	1.0193
Eastern	1.9247	1.4421	1.3096	1.2377	1.1188	1.0442	.9294
Khartoum	1.5388	1.3365	1.2800	1.1865	1.1801	1.047	.9912
Western	1.5066	1.3899	1.2368	1.1394	1.0566	.9085	.8783
Southern	1.6907	1.508	1.2781	1.1363	1.0618	.987	.9456

(iii) Fertility Estimates Based on the Age Distribution:

A population which has constant fertility and mortality rates and no migration over a long period of time, will have a stable age distribution. Although the assumption of constant fertility for most of the underdeveloped countries seems plausible, due to the prevalence of strong cultural traditions and practices that keep fertility at that level, the assumption about migration can hardly be held. To overcome this difficulty, the age distributed is that of the female population since migration is commonly dominated by the male population. On the

other hand, it is noted that mortality is on a continuous decline in most of the underdeveloped countries, a decline that was brought about by the use of modern medical technology and at a cheaper cost. That is, it is also necessary to assume that mortality has not been constant.

The basic technique for estimating fertility from the age distribution is fully described in the United Nations' Manual VI (pp. 61-72). In theory, the age distribution could be used for estimating either fertility or mortality if a previous estimate of the latter was available. The characteristics forms of age misreporting discussed in Chapter II, conform to the forms of age distortions found in "African-Asian" countries. (U.N., Manual IV, 1967, 19). The female age distribution has a surplus at 5-9 and a deficit in the adolescent age intervals (10-14 and 15-19) followed by a surplus in the central ages of child-bearing (25-34). (See Chapter II).

For the above reason, the female age distribution for total Sudan is used to estimate fertility and the parameters that correspond to the cumulative ogive of age 35, i.e. C35, is thought to be satisfactory. (U.N., Manual IV, 1967, 29). The parameters of fertility estimated are for those indicated by the cumulative ogive  $C(x)$  and the growth rate. The growth rate was set at  $2.7\frac{1}{100}$ . Eight estimates corresponding to each  $C(x)$  for the crude birth rate and GRR are presented in the following Table 4.4.4.

As can be seen from the table, the estimates, related to  $Cx$  and the growth rate are bracketing different levels of mortality extending from level 7 to level 14 in the Northern set model of stable population of Coale and Demeny. The estimated birth rates have a peak at  $C(10)$ ,

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1/ See Chapter II, section on Data Graduation.

TABLE 4.4.4 ESTIMATES OF THE FEMALE POPULATION PARAMETERS  
BY USE OF Cx AND r = 2.7, SUDAN, 1973

Cx	Reported Cx	Mortality Level	CBR	GRR m=28.6	TFR	e <sup>0</sup>
C(5)	.1774	12.1	44.57	3.52	7.15	47.75
C(10)	.3489	7.5	55.20	3.87	7.86	36.25
C(15)	.4536	9.97	48.77	3.38	6.86	42.40
C(20)	.5398	12.5	43.87	3.46	7.02	48.75
C(25)	.6178	13.9	41.56	2.85	5.79	52.25
C(30)	.7139	10.5	47.70	3.30	6.70	43.75
C(35)	.7796	9.90	48.95	3.39	6.88	42.3
C(40)	.8429	7.96	53.95	3.76	7.63	37.4

Sex ratio at birth = 1.03. TFR = GRR X 2.03

a minimum at C(25) and C(20) and another peak at C(35) and C(40).

Considering the pattern of age misreporting that characterizes the Sudan's female population, it is possible to assert with a high degree of certainty that the female birth rate was higher than 48.7 -- the estimate associated with C(15) -- (U.N., Manual IV, 1967, 67). On the other hand, the value of 55.2 of the crude birth rate obtained by C(10) can be considered as a fair upper estimate of the birth rate. The estimated birth rate of 49.0 by C(35) seems plausible and differs only slightly from the minimum estimate.

In Table 4.4.5, the median and the mean of the eight estimates above and the estimates associated with C(35) are presented for female, male and the total population. The male and the total population parameters are obtained from the estimates of the female population by the following equations:

1. Male birth rate = female birth rate X  $\frac{\text{Sex ratio at birth}}{\text{Sex ratio of the Pop.}}$
2. Birth rate for the total population (Both sexes) =  
Female birth rate X  $\frac{\text{female population}}{\text{total population}}$  X (1 + sex ratio at birth)

(U.N., Manual IV, 1967, 63).

TABLE 4.4.5 MEDIAN AND MEAN OF THE ESTIMATES OF FEMALE, MALE AND THE TOTAL POPULATION, SUDAN, 1973

Variable	Female			Male			Total Pop. (both sexes)		
	CBR	GRR $\bar{m}=28.6$	TFR	CBR	GRR	TFR	CBR	GRR	TFR
Median	48.24	3.34	6.78	48.96	3.39	6.88	48.57	3.36	6.83
Mean	48.1	3.44	6.99	48.82	3.48	7.09	48.43	3.46	7.04
C(35)	48.95	3.39	6.88	49.66	3.44	6.98	49.29	3.41	6.93

The estimates for the total population parameters, as can be seen from the table, differ slightly from the female and male parameters. The birth rate estimated by C(35) for the total population is 49.3 per 1000 population.

(iv) Allowing for Mortality Reduction:

It is necessary as stated earlier, to modify the assumptions of constant mortality by allowing for a reduction in mortality level between the two censuses (the 1955/56 and 1973 population censuses). This will permit the use of quasi-stable population models. Under such conditions, stable estimates should be adjusted to take care of the effect of that decline.

Paul Demeny has estimated a crude birth rate of 48.7 and a death rate of 21.3 from the 1955/56 census data for Sudan as a whole. This implies a natural growth rate of 2.74 percent annually, which is greater than the growth rate of 2.2 percent between the two censuses. (See Chapter II). If we assume a constant birth rate over the intercensal period and consider the mortality level at the 1973 census as one associated with a crude death rate of 18.9, <sup>1/</sup> this implies a natural growth rate of approximately 3.0 percent annually. This is

<sup>1/</sup> The CDR (females) in 1973 is 17.5 and for males is 20.3, which imply a CDR of 18.9 for the population as a whole. (Unpublished, Vol. II, Dept. of Statistics, Sudan, 1973).

equivalent to a drop in the crude death rate of 2.4 percent over the period of 17 years. Having time  $t = 17$  years, the multiplying factor  $K = 17.8 \frac{(r_n - r_o)}{t} = 17.8 \frac{(3.0 - 2.7)}{17} = .00314$ .

Table 4.4.6 shows an application of quasi-stable population by allowing the specified decline in mortality, for Sudan as a whole.

TABLE 4.4.6 AN APPLICATION OF QUASI-STABLE POPULATION MODEL TO THE DATA OF SUDAN, 1973

1	2	3	4	5	6	7
	Stable ests. by r & cx	Adjustment k=.01 t=17 yrs.	Adjustment k = .00314 t = 17 yrs	Adjustment	Adjusted Estimates	Adjusted Estimates
	CBR		.314XCol.3	1+Col.4	CBR	GRR
C(5)	44.57	-.0362	-.0114	.9886	44.1	3.5
C(10)	55.20	-.206	-.0065	.9935	54.8	3.8
C(15)	48.77	+.0070	+.0022	1.0022	48.9	3.4
C(20)	43.87	+.0394	+.0124	1.0124	44.4	3.5
C(25)	41.56	+.0648	+.0203	1.0203	42.4	2.9
C(30)	47.7	+.0778	+.0244	1.0214	48.9	3.4
C(35)	48.95	+.0832	+.0261	1.0261	50.2	3.5
C(40)	53.96	+.0840	+.0264	1.0264	55.4	3.9

The method resulted in an increase of the birth rate that corresponds to C(35) to 50.2 per 1000 population, a GRR of 3.5 and an implied total fertility rate of 7.1.

The Choice of the Correction Factor:

In choosing the correction factor among the Brass P/F values, we consider two things:

- (i) The Characteristic forms of age distortions already discussed, and,
- (ii) The the above stable estimates should conform to the Brass estimates.

In Table 4.4.7, the P/F values for the first four age groups of child-bearing are shown against the ratio of the reported to the stable female distribution (R/S) at each age group for the Sudan as a whole. A value of unity for R/S indicates the agreement of the reported distribution to the stable one. Values of R/S greater than unity and less than unity indicate age overstatement and understatement, respectively.

TABLE 4.4.7 P/F RATIOS AND THE RATIO OF THE REPORTED TO STABLE FEMALE DISTRIBUTION FOR THE AGE GROUPS 15-19 ... 30-34, SUDAN, 1973

Age Group	P/F	R/S $\left( \frac{(y-x)R}{(y-x)S} \right)$
15-19	1.561	.8369
20-24	1.425	.8025
25-29	1.275	1.3057
30-34	1.175	1.0648

Excluding the first P/F ratio, other ratios indicate that fertility for Sudan as a whole has been underestimated by 18 percent to 43 percent. Clearly the pattern of P/F values would be affected not only by the inaccuracy of the reported fertility, but also by the shifts of women from one age group to another, due to age misreporting. Both the 25-29 and 30-34 age groups have been inflated.

The final P/F ratio chosen as a correction factor will take place among the following ratios:

- (1)  $P_2/F_2$  (A)
- (2)  $P_3/F_3$  (B)
- (3) The average of the second three ratios, i.e.  $1/3(P_2/F_2 + P_3/F_3 + P_4/F_4)$ . (C)
- (4) Correction factor (C) weighted by parity ( $C_{W/P}$ )
- (5) Correction factor (C) weighted by current fertility ( $C_{W/C}$ )

In table 4.4.8 these correction factors are shown for the Sudan as a whole and its regions:

TABLE 4.4.8 CORRECTION FACOTRS FOR SUDAN AND ITS REGIONS, 1973

Region	A	B	C	$C_{W/P}$	$C_{W/C}$
Sudan	1.425	1.275	1.291	1.257	1.297
Central	1.410	1.293	1.305	1.276	1.309
Northern	1.357	1.325	1.311	1.293	1.312
Eastern	1.442	1.310	1.330	1.301	1.335
Khartoum	1.337	1.280	1.268	1.245	1.270
Western	1.390	1.237	1.255	1.222	1.266
Southern	1.508	1.278	1.307	1.264	1.375

Further, Table 4.4.9 presents the ranks of the reported total fertility rates against the ranks obtained for total fertility rates corrected by the different correction factors.

TABLE 4.4.9 RANKS OF THE REGIONS BY THE REPORTED TOTAL FERTILITY RATE AND THE CORRECTED TOTAL FERTILITY RATES, SUDAN, 1973

Region	Rank Due to Reported	A	B	C	$C_{W/P}$	$C_{W/C}$
Central	1	1	1	1	1	1
Northern	2	3	2	2	2	2
Eastern	3	2	3	3	3	3
Khartoum	4	4.5	4	4	4	4
Western	5	6	5	5	5	6
Southern	6	4.5	6	6	6	5
Sudan	-	-	-	-	-	-
S.D.	.48	-	.73	.71	.74	-

S.D. is the Standard Deviation of the different total fertility rates of the regions in each column.

As can be seen from the table, both correction factors A and  $C_{W/C}$  have distorted the ranks of the reported total fertility rates of the regions. The chosen correction factor among the others is (C), that is, the average value of the second three P/F values (i.e.

$1/3(P_2/F_2 + P_3/F_3 + P_4/F_4)$ . It defines less variation among the corrected total fertility rates, relative to other correction factors and the nearest to the variation among the reported rates (SD = .71 and .48, respectively). The chosen correction factor gives an adjusted crude birth rate of 51.5 per 1000 population for the Sudan as a whole which does not vary greatly from the 50.2 crude birth rate obtained from the earlier estimates of the quasi-stable population model. The regional correction factors suggest that reported fertility has been underestimated within the range of 26 percent to 33 percent for the different regions.

In Table 4.4.10, the final adjusted fertility rates are presented for the Sudan as a whole and its regions.

TABLE 4.4.10 THE FINAL ADJUSTED FERTILITY RATES FOR THE SUDAN AND ITS REGIONS, 1973

Region	CBR	GFR	GRR	TFR
Sudan	51.5	224.4	3.3	6.7
Central	55.1	264.1	3.9	8.0
Northern	53.0	226.9	3.6	7.3
Eastern	49.6	236.6	3.5	7.2
Khartoum	46.7	222.0	3.3	6.7
Western	49.4	207.8	3.1	6.3
Southern	52.8	207.3	3.0	6.1

Sex ratio at birth = 1.03

As can be seen from the table, the use of the correction factor results in an increase in the reported rates, and yet, it does not alter the ranking of the regions by the total fertility rate. The final estimates for the Sudan as a whole suggest a crude birth rate of 51.5 per 1000 population, a general fertility rate of 224.4 and a total fertility rate of 6.7 live births per woman. The Central region exhibited the highest fertility, in that the average woman in this region would have had 8.0 live births by the end of her reproductive life.



Among all the regions, the Southern region shows the lowest fertility, with a total fertility rate of 6.1 live births. The relatively higher crude birth rate of 52.8 in the Southern region suggests that the babies in this region are coming earlier than in all other regions. The difference between the highest and the lowest total fertility rates accounts for more than 30 percent.

#### 4.5 Rural-Urban Fertility Estimates:

Rural and urban fertility estimates follow the pattern established for the country as a whole. The rural and urban female age distributions reported in Chapter II revealed the same pattern of age distortions and age misreporting. Both have a surplus at 5-9, a deficit at adolescent age groups, 10-14 and 15-19, followed by a surplus at the central age group 20-25, for the rural population and at the ages 20-29 for the urban female population, and hence, conform to the forms of distortions found in "African-Asian" countries.

However, the urban female population at child-bearing ages 15-49 is slightly more inflated than the rural female population. On the whole, the net effect of overstatement of age is such that even when the births are correctly estimated, the general fertility rate, total fertility rate and the age specific rates are understated by the inclusion in the denominator of women from outside the fertile ages.

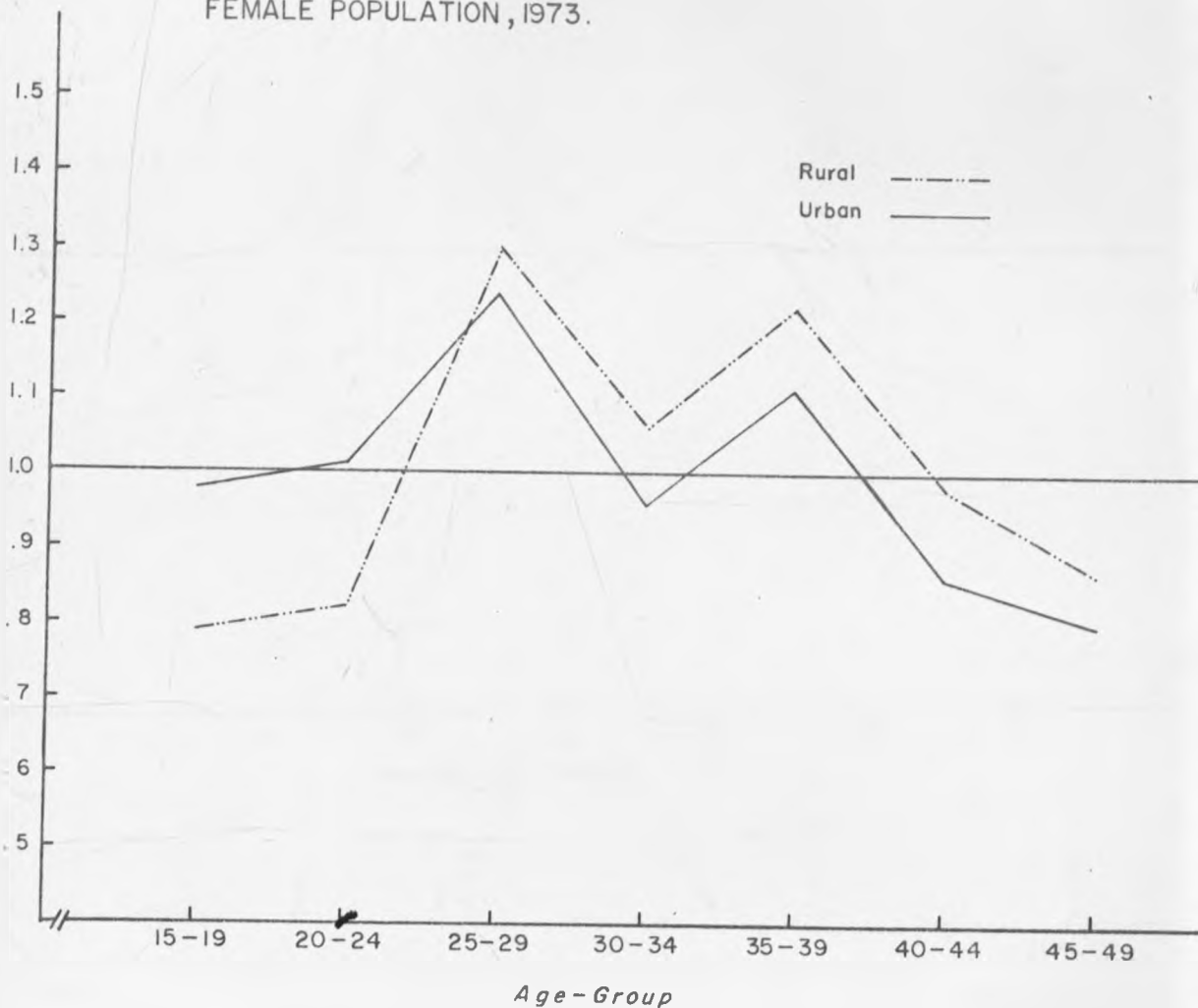
In Figure 4.5.A rural and urban females at the fertile ages (15-49) reveal the same pattern of age misreporting.

In Table 4.5.1, the mean ages of fertility are presented for Sudan as a whole and its regions.

For Sudan as a whole, the mean age of fertility is slightly higher

Fig. 4.5.A: THE RATIOS OF THE REPORTED FEMALE DISTRIBUTIONS TO THE STABLE IN FIVE YEARS AGE GROUP : SUDAN , RURAL AND URBAN FEMALE POPULATION, 1973.

$$\frac{(0-x)R}{(0-x)S}$$



for urban than for rural females. Both the Central and Western regions exhibited the same patterns as that of the country's total. On the other hand, the higher mean age of fertility for rural than urban females reveals the effect of migration on the mean age of fertility. This pattern is more pronounced for the rural areas of the Northern and Southern regions than for the urban areas.

TABLE 4.5.1 RURAL-URBAN MEAN AGES OF FERTILITY ( $\bar{m}$ ),  
SUDAN AND ITS REGIONS, 1973

Region	Rural ( $\bar{m}$ )	Urban ( $\bar{m}$ )
Sudan	28.0	28.5
Central	28.4	28.8
Northern	30.1	29.1
Eastern	28.5	28.3
Khartoum	28.7	28.6
Western	28.1	28.4
Southern	28.8	27.8

The correction factor for rural and urban population chosen among the P/F ratios follows the same rule of combining the second three ratios. For Sudan as a whole, the correction factor is higher for rural than for urban population. A higher rural than urban correction factor is also obtained for the Southern, Western, Khartoum, and Eastern regions. On the other hand, the Northern and Central regions exhibited higher urban than rural correction factors.

Table 4.5.2 presents the reported and adjusted fertility rates for rural and urban populations for the Sudan as a whole and its regions. In the last two columns, rural-urban correction factors are presented.

Use of the correction factors have considerably raised the reported fertility rates in the rural and urban areas in the different regions. Khartoum obtained the highest correction factor for its rural population, while the Southern region obtained the lowest for its

TABLE 4.5.2 THE REPORTED AND ADJUSTED FERTILITY RATES FOR RURAL AND URBAN POPULATIONS, SUDAN AND ITS REGIONS, 1973

Region	RURAL						URBAN						Correction Factor	
	Reported			Adjusted			Reported			Adjusted			Rural	Urban
	CRB	GFR	TFR	CBR	GFR	TFR	CBR	GFR	TFR	CBR	GFR	TFR		
Sudan	40.4	174	5.3	52.0	224.5	6.8	38.5	173.1	5.2	48	215.9	6.5	1.290	1.247
Central	43.0	206.9	6.2	55.6	267.7	8.02	38.7	183.7	5.7	51.8	246.0	7.6	1.294	1.339
Northern	41.3	174.4	6.2	53.8	227.1	8.1	36.8	163.1	5.3	49.7	219.7	7.1	1.302	1.347
Eastern	37.1	180.0	5.5	50.9	246.8	7.5	37.7	174.0	5.3	47.2	217.8	6.6	1.371	1.252
Khartoum	38.3	187.5	5.7	54.2	265.3	8.1	36.3	171.1	5.2	44.8	211.3	6.4	1.415	1.235
Western	39.4	164.4	5.0	49.4	206.5	6.3	39.7	173.5	5.3	49.1	214.8	6.6	1.256	1.238
Southern	40.0	158.0	4.7	53.4	210.8	6.3	43.7	163.8	4.6	48.8	182.8	5.1	1.334	1.116

urban population. While the use of a rural-urban correction factor does not alter the pattern of rural-urban fertility within the regions, it has slightly modified the rankings of rural and urban total fertility rates reported between the different regions. For example, the reported total fertility rates are equal for the Northern, Eastern and Western regions, but the use of the correction factor has raised the reported rate of the Northern region to 7.6 live births, leaving that of the Eastern and Western regions at 6.6 live births for each. A similar pattern is observed for the rural estimates. The rural areas of the Western and Southern regions with a reported total fertility of 5.0 and 4.7, respectively, both are raised to 6.3 live births.

#### 4.6 Summary and Conclusions:

From the preceding analysis in this chapter, we summarize the following points:

- (1) The fertility estimates for the Sudan as a whole, its regions and its rural-urban populations, by combining both the Brass P/F ratio method, and the quasi-stable population method, are the most plausible that can be obtained.
- (2) With a gross reproduction rate of 3.3 for the Sudan as a whole, and gross reproduction rates varying between 3.0 to 3.9 for its regions, Sudan is clearly located among the African countries whose fertility is high, or perhaps very high.
- (3) Rural-urban fertility curves have shown many similarities. The difference between the two curves, which is related to the degree of fertility concentration at the different ages, suggests that differences in the rural-urban fertility might

have been very strongly affected by factors such as : age at marriage, the proportion married, marriage instability, use or non-use of contraceptions and other traditional methods of avoiding pregnancy, and the general state of health and nutrition.

- (4) The estimates of fertility levels for the different regions have shown that there exist differences in the fertility levels within (rural-urban) and between the different regions of the Sudan; the difference between the highest and the lowest estimated total fertility rates being 31.1 percent. In the following chapters, further analysis will be undertaken to explain these differences in fertility within and between the different regions of the Sudan.



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CHAPTER V

RURAL-URBAN FERTILITY DIFFERENTIALS

PART I: "FACTORS BEHIND RURAL-URBAN  
FERTILITY DIFFERENTIALS"

5.0 Introduction:

One of the questions of principal interest in research on fertility is the pattern of fertility among population groups such as the inhabitants of rural and urban areas, social and economic groups defined in terms of educational level, income, occupation, size of land holdings, or other indicators of social and economic status, and ethnic groups defined in terms of race, national origin, language or religion. (U.N., 1963, 22). Information about such differences in fertility is useful both in assessing the factors and prospects of change in the composition of the population in respect to such characteristics, and in an effort to reach an understanding of the determinants of fertility level and to forecast its changes in the population as a whole.

The aim of the present chapter is twofold. First, is to look at the general determinants of regional fertility differences. The second aim is to summarize present information on rural-urban differences in fertility in the various regions of the Sudan. Rural-urban differences are singled out for attention here because urbanization is among the most impressive and significant social and economic changes currently taking place in the Sudan -- as well as in most of the underdeveloped countries -- and its possible effect on the future trends of fertility is a question of major interest.

One of the major limitations of this study is the unavailability of information required, -- i.e. the mean number of children born to women by women's socio-economic characteristics -- for a detailed study

of the factors responsible for fertility differences within and between the various regions of the Sudan. Nevertheless, and in the light of the previous studies that established some of such factors, one can always give the distribution of the population in each region by these factors. That is, the fertility level within and between the different regions of the Sudan, will be investigated against the respective distribution of the population by the above-mentioned socio-economic characteristics.

In many societies, fertility has been affected by factors accompanying the process of development or modernization such as urbanization, women's education, higher incomes, women's participation in the labour force, etc. The effect has taken different directions and varying magnitudes.

In the Sudan, we have no clear evidence of the impact of socio-economic factors on fertility other than those given by Henin (1969), Abbas, (1978) and M. Khalifa, (1979). The first research showed that the settlement of the nomads in the Gazera (in the Central region) has contributed to a rise in their fertility which otherwise would be low due to poor nutritional standards, bad health conditions, and the absence of public health and medical services. Other factors involved were the higher incidence of malaria and venereal disease, as well as the hard work performed by nomadic women which causes a high proportion of miscarriages. (Henin, R.A., 1969, 171-198).

In his study, Abbas covered only four provinces (Blue Nile, Red Sea, Bahr-el-Gazal and Upper Nile). In the rural areas of these provinces, Abbas observed that the fertility measures (TFR, GFR and the standardized parity of the economically active <sup>1/</sup> female population

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<sup>1/</sup> According to the 1973 census, the economically active population comprises of employed persons and those seeking work for the first time. It is clear that this definition excluded: student, full-time house wives, disabled, etc.



are considerably lower than for the non-active females. He also showed that literate rural females have slightly higher fertility than illiterate women. (Abbas, I., 1978, 47). For the socio-economic indicators of fertility (educational level and occupation), Abbas has excluded rural females due to the smaller numbers involved, especially for higher occupations and higher educational levels (higher secondary schools and above). For urban females, Abbas found that, female primary school leavers in urban areas have higher fertility than those with no education or those with higher educational level (above 10 years of education: higher secondary education and above). While the difference between the fertility level of primary school leavers and those with no education is not significant, the fertility of those with above 10 years of education was significantly lower. (Abbas, I., 1978, 49). With regard to female occupation in urban centres, Abbas asserted that urban females involved in white collar<sup>1/</sup> jobs have lower fertility than those involved in blue collar jobs<sup>2/</sup> and those involved in agriculture and related works. The fertility of the latter group is the highest among all occupational groups.

The study of M. Khalifa covered only urban Khartoum. She found that some fertility differentials exist among the different socio-economic groups. Some factors, e.g. the husband's education, the wife's education and substantial changes in income are found to be inversely related to the fertility level of the couple. She asserted that "although it was shown that these factors may be operating through

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1/ This includes: professionals, administrators, and clerks.

2/ This includes: sale and service workers, and those involved in the production and retail works.

their effect on the age at marriage, which is strong predictor of fertility, other factors, e.g. attitude to family size and family planning cannot be ignored. (Khalifa, M.A., 1979, 7).

5.1 The Fertility Level and Socio-Economic Factors:

Although sufficient and detailed data to prove or disapprove the findings of the first research are not available, a glance at Table 5.1.1 -- which gives the total fertility rates by region -- sheds some light on the relationship between development and fertility. The regions in Table 5.1.1 are grouped by their fertility levels from high to low.

TABLE 5.1.1 REPORTED AND ADJUSTED TOTAL FERTILITY RATES, SUDAN REGIONS, 1973

Region	Total Fertility Rate	
	Reported	Adjusted
Central	6.1	8.0
Northern	5.6	7.3
Eastern	5.4	7.2
Khartoum	5.3	6.7
Western	5.0	6.3
Southern	4.7	6.1

As can be seen from the table, the order and magnitude of the differences between the regions is such that it also represents genuine fertility differentials. Fertility is higher in the Central, Northern and Eastern regions, and is lower in the Western and Southern regions. It is difficult to claim that where fertility is relatively low, it is because of voluntary control. Fertility is even high in Khartoum, the most urbanized, industrialized and commercially advanced trade centre in the country. Both the Western and Southern regions are

experiencing the lowest levels of socio-economic development in the country. Low fertility in the Southern region may also be because of -- amongst other factors -- the prevalence of malaria and venereal diseases which are conducive to higher rates of miscarriage and childlessness.<sup>1/</sup> On the other hand, the Central and Eastern regions are the most economically developed parts of the country. Similarly, the Northern region, stands as one of the best regions in terms of education and health services.

(i) Female's Education and Fertility:

The relationship between female's education and fertility has been debated around the world. The general explanation is that as education rises, fertility falls. The basis for this assumption would appear to be the belief that fertility in traditional societies is as high as it can be, and that therefore any change must be in downward directions.

Yet, there is now general agreement that a minimal degree of education in Africa serves to raise, rather than to lower, fertility. Evidence from Africa shows that women with primary education have higher fertility than women with no formal education at all, and that at least some secondary education is needed before fertility begins to fall. Examples of this relationship are those of Tanzania (Henin, et. al., 1976, Table 7.10) and Ibadan (Sembajwe, 1977, Table 7.3).

Apparently contradictory findings have resulted in some cases where only a limited categorization has been employed. Thus, using the division "no education" and "primary and above", Olusanya (1971)

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<sup>1/</sup> Among the Azande of the Southern Sudan, higher incidences of venereal disease is thought to be the cause of the existence of a high frequency of sterility. (Romanuik, A., 1968, 332).

found the average number of children ever born to be higher for the educated. It is also possible to arrive at a neat pattern showing fertility declining with education if inadequate controls for age are employed, as education and youth are strongly associated. (Okediji, 1967).

There are a number of reasons why fertility of women with only limited formal education might well be higher than that of women with none. The most popular suggestions are that the primary educated are better nourished, more hygienically aware, and generally healthier, and therefore experiencing lower levels of foetal wastages and therefore higher numbers of live births; or that their limited degree of education has been sufficient to render them less scrupulous in the observance of post-natal taboos. It is generally accepted that reporting errors, which are likely to be greater among the illiterate who are reluctant to discuss or report dead children, still showed not to be great enough to account for the major part of the fertility differentials between the primary educated and the illiterate. Olusanya (1967) has shown that education is associated with shorter ideal birth intervals. Overall, his argument that a little education suffices to break down the traditional fertility regulation system, without being effective enough to support the regular practice of modern contraception, is very plausible.

On the other hand, it has been demonstrated both that the educated marry later and that as the level of education of a population rises, so too does the age at marriage. (Caisie and Aryee, 1979). But it has yet to be demonstrated that the later age at marriage of the more highly educated is associated with lower lifetime fertility levels. Mott (1974) has pointed out that often it is possible to show that

among the young, lower fertility is associated with higher education, but then it is not possible to confirm whether differences at younger ages will ultimately disappear as the better educated women ultimately "catch up" with the others. Available evidence for West Africa strongly suggests that, once started, educated women do in fact bear children at a more rapid pace than the illiterate. (Adegbola and Page, 1979).

Earlier findings in the Sudan which relate education to fertility -- discussed earlier -- show that fertility is higher among the literate than among the illiterate, and also higher for primary school leavers than those with higher secondary school education and above.

Table 5.1.2 below presents literacy<sup>1/</sup> rate for the rural and urban males and females in all the regions. The regions are grouped geographically from North to South.

TABLE 5.1.2 PERCENTAGES OF RURAL-URBAN FEMALES WHO ARE LITERATE. SUDAN REGIONS, 1973

Residence	R E G I O N					
	Northern	Eastern	Western	Khartoum	Central	Southern
Females:						
Urban	48.0	35.0	30.0	50.0	42.0	20.0
Rural	27.0	21.0	6.0	29.0	20.0	6.0
Males						
Urban	76.0	62.0	61.0	72.0	66.0	47.0
Rural	56.0	49.0	38.0	57.0	51.0	16.0

As can be seen from the table, literacy rate varies between and within the different regions of the Sudan. But Khartoum and the Northern regions exhibited higher rates of male and female literacy in both the rural and urban areas, followed by the Central and Eastern regions.

<sup>1/</sup> Literate person according to the 1973 census is one who has ever attended school and one who knows how to read and write.

The Western and Southern regions reveal very low literacy rates for both the males and females in the rural areas. Another marked feature of the table is that literacy rates for females are substantially lower than for males.

For literate females aged 15-44, Table 5.1.3 presents rural and urban levels of education. The analysis is limited to females aged 15-44, that is, the reproductive ages.

TABLE 5.1.3 PERCENTAGES OF RURAL-URBAN FEMALES AGED 15-44, WITH EDUCATIONAL ATTAINMENT, BY EDUCATIONAL LEVEL, SUDAN AND ITS REGIONS, 1973

Region/Ed.Level	Sudan	Northern	Eastern	Western	Khartoum	Central	Southern
URBAN							
Primary <sup>1</sup>	87.0	88.0	93.1	92.3	79.9	91.4	95.9
Higher Secondary <sup>2</sup>	13.0	12.0	6.9	7.5	20.1	8.6	4.1
RURAL							
Primary	96.6	95.8	99.2	96.3	95.0	96.7	98.2
Higher Secondary	3.4	4.2	0.8	3.7	5.0	3.3	18.0

<sup>1</sup> Includes all levels lower than higher secondary schools, including Khalwa, i.e. "Coranic School". This is equivalent to 9 years of education: primary 6 years and junior secondary schools 3 years.

<sup>2</sup> This includes higher secondary schools and above, i.e. more than 10 years of education.

Among the literate women in rural Sudan, more than 95 percent are primary school leavers, in all regions. Considering the lower literacy rates in the rural Sudan, especially in the rural areas of the Western and Southern regions, this implies that the overwhelming majority of the rural females fall into the categories of "no education" and at best "primary education" which have shown, by far, higher fertility than those with secondary or higher education. The latter, however, is more

accessible to urban females, especially in Khartoum, the Northern and Central regions, respectively. Within the rural areas, higher education is scant, however, rural females in Khartoum and the Northern region are relatively better than in all regions in finding chances for higher education.

(ii) The Effect of Women's Occupation on Fertility:

As stated earlier, rural females who are economically active have shown lower fertility than those who are non-active (op. cit. 1978, 47). In the urban areas, women involved in white collar jobs have shown a lower level of fertility than those involved in blue collar jobs, who in turn have lower fertility than women involved in agriculture, animal husbandry and the related works. (op. cit. 1978, 49). In Table 5.1.4 we give the percentages of the economically active female population by occupation.

TABLE 5.1.4 THE PERCENTAGES OF RURAL-URBAN ECONOMICALLY ACTIVE FEMALES AND THEIR OCCUPATIONS, SUDAN REGIONS, 1973

Region/ Economic Activity	R E G I O N					
	Northern	Eastern	Western	Khartoum	Central	Southern
Urban Eco. Active Pop. (15Yrs+)	5.0	10.2	17.4	9.9	6.3	11.9
a. White collar jobs (15-44)	53.8	15.7	8.6	36.4	32.8	10.9
b. Blue collar jobs (15-44)	41.8	71.6	37.1	51.1	40.0	36.6
c. Agriculture (15-44)	1.3	9.4	51.2	1.7	22.6	45.2
d. Not classified by occ.	3.1	3.3	3.0	10.8	4.7	7.3
Rural Eco. Active Pop. (15 Yrs +)	2.7	7.9	49.8	2.6	10.1	17.3
a. White collar jobs (15-44)	24.7	3.3	0.3	27.7	3.4	0.7
b. Blue collar jobs (15-44)	26.1	23.9	1.5	49.9	5.9	3.0
c. Agriculture (15-44)	45.7	70.5	97.8	16.7	88.6	94.2
d. Not classified by occ.	3.5	2.4	0.3	5.6	2.1	2.1

As can be seen from the table, the economically active female population in both rural and urban Sudan is small. This is due to the exclusion of the full-time house-wives. The urban females who are economically active range between 5.0 percent in the Northern region to 17.4 percent in the Western region. Among the economically active females in the urban areas, the majority in most of the regions are involved in blue collar jobs, except in the Western and Southern regions, where the majority are still involved in agriculture and pastoral life.

Within the rural areas, very small proportions amounting to 2.7 percent and 2.6 percent for Northern and Khartoum, respectively, are economically active. The same regions have shown higher rural than urban fertility than in all other regions. The rural areas of the Western and Southern regions have shown high proportions of economically active females amounting to 49.8 percent and 17.3 percent, respectively, the majority of whom are involved in agriculture and related work, which indicates the hard work performed. A higher proportion of economically active females is also observed in rural than in urban areas of the Central region, where the settled population is involved in agriculture.

It is often useful to combine both educational and occupational levels to shed some light on the effect of these together on fertility. Table 5.1.5 presents the white collar jobs female workers by the educational level for the various regions of the Sudan.

Apart from rural Khartoum, more than 50 percent of the rural-urban females in white collar jobs, are actually primary school leavers, a category that is associated with the highest level of fertility. The higher proportion of female white collar workers with higher education exhibited by many rural areas, can be attributed to the smaller sample



of white collar jobs in rural areas, which does not exceed 1.0 percent for rural Sudan as a whole.

TABLE 5.1.5 PERCENTAGES OF WHITE COLLAR FEMALE WORKERS BY EDUCATIONAL LEVEL, SUDAN REGIONS, 1973

Educational Level	R E G I O N					
	Northern	Eastern	Western	Central	Khartoum	Southern
URBAN						
Primary	55.2	66.4	58.3	52.6	52.6	77.8
Higher Education	44.8	33.6	41.7	47.4	47.4	22.2
RURAL						
Primary	52.2	52.6	58.7	51.1	42.4	79.7
Higher Education	47.8	47.4	41.3	48.9	57.6	20.3

It has been argued that, in the underdeveloped countries, it is the occupation of the husband which is more important than that of the wife. The occupation and education of the husband is found to be inversely related to the fertility level of the couple. (Khalifa, M.A., 1979, 4-5). M. Khalifa asserted that "the groups of professionals, administrators and sale workers (i.e. white collar workers), [in urban Khartoum], have slightly lower fertility than the blue collar workers". Table 5.1.6 shows the proportion of rural-urban male population by occupation for the various regions of the Sudan.

It is clear from Table 5.1.6 that small proportions of the economically active males are involved in white collar jobs in rural-urban areas of the various regions. The proportion does not exceed 16.0 percent for its highest in the urban areas of the Northern region and 5.5 percent in rural Northern. More than 50 percent of the rural economically active males in all regions (except rural Khartoum) are engaged in agriculture and related work. Furthermore, more than 80 percent

TABLE 5.1.6 PERCENTAGES OF RURAL-URBAN ECONOMICALLY ACTIVE<sup>1</sup> MALES BY OCCUPATION, SUDAN REGIONS, 1973 (%)

Occupation	R E G I O N					
	Northern	Eastern	Western	Khartoum	Central	Southern
URBAN <u>Economically active (15 yrs &amp; over)</u>	79.4	87.0	86.7	83.4	84.6	85.2
(a) White collar workers	16.0	9.0	8.8	14.2	9.3	7.6
(b) Blue collar workers	65.0	63.5	55.8	63.4	54.1	45.9
(c) Agricultural worker	9.9	18.5	25.9	5.2	21.6	22.6
(d) not classified by occ.	9.1	9.0	9.5	17.4	15.0	23.9
RURAL <u>Economically active (15 yrs &amp; over)</u>	80.8	90.0	91.6	81.6	90.1	92.7
(a) White collar workers	5.5	2.8	1.5	5.2	2.7	2.4
(b) Blue collar workers	32.9	18.2	9.4	50.4	17.6	8.7
(c) Agricultural workers	55.5	74.4	85.6	31.4	68.1	67.8
(d) Not classified by occ.	6.1	4.5	3.5	13.1	11.7	21.1

of all rural-urban economically active males are involved in blue collar jobs and agriculture. The two categories, however, assume higher fertility than the first category.

If we combine both educational level and occupation, we find that more than half of the white collar workers in all rural-urban areas -- except in Khartoum -- are primary school leavers. Table 5.1.7 presents white collar male workers by educational level.

Apart from Khartoum, more than 50 percent of the white collar

1 The percentages of the economically active population; [employee, employers, own work, seeking work for first time]: from population aged 15 years and above.

workers, are primary school leavers, in all rural and urban areas of the various regions of the Sudan. Yet, the proportion is still higher in rural than in urban areas in most of the regions. The proportion of white collar jobs occupied by rural primary school leavers, reaches 67.4 percent and 87.2 percent in the rural areas of the Western and Southern regions, respectively.

TABLE 5.1.7 PERCENTAGES OF WHITE COLLAR WORKERS BY EDUCATIONAL LEVEL. SUDAN REGIONS, 1973

Educational Level	R E G I O N					
	Northern	Eastern	Western	Khartoum	Central	Southern
URBAN						
Primary	50.7	58.7	58.5	41.4	51.6	70.5
Higher Education	49.3	41.3	41.5	58.9	48.4	29.5
RURAL						
Primary	60.3	57.2	67.4	46.9	51.6	87.2
Higher Education	38.7	42.8	32.6	53.1	48.4	12.8

It is clear from the preceding analysis that the socio-economic characteristics of the male and female population discussed above, are working in such a way that they imply:

- (a) High fertility for the Sudan as a whole, and
- (b) Higher rural than urban fertility.

## 5.2 Rural-Urban Fertility Differentials

The question as to whether urbanization is associated with an increase or decrease in fertility level is evidently closely linked with a number of other issues. Thus, for example, any educational differential, should be reflected in a rural-urban differential, since urban populations, are better educated and constantly recruiting the rural emigrants who are like

ly to be more educated. Equally, rural fertility may be held in check by disease-induced subfertility, while the medical facilities in towns and cities can result in higher urban fertility. Conversely in some cases the social intermingling and crowding associated with urban life might serve to spread sterilization and other fertility reducing factors in areas where little is known about them in the rural populations. There may be a direct effect on fertility of urban populations as such, so that even illiterate women are less likely to adhere to traditional birth-spacing norms in the cities (or the relationship may be much more complex than that). (Swartz, 1969, 73-88). There is also the strong possibility that economic decisions relating to the value of children vary substantially as between urban and rural areas. (Ruzicka, 1977). Pool (1971, 25-32) has suggested that the diverse patterns of differential fertility between rural-urban areas may be related to different stages of urbanization; urban fertility may be low because of unbalanced sex ratios of the population and the attraction of prostitutes and infertile women to the city. Later, family migration may make the age and sex structure more normal and urban fertility may be equal to or greater than rural fertility. Finally, modernization and education may result in the successful adoption of birth control and thus lower urban fertility. Morgan (1976) claims that "modernization is associated with higher fertility". His conclusion is that "since so few persons in Nigeria today are in the upper class or in modern social statuses associated with reduced fertility, the net effect for the population as a whole is rising fertility rates as people move from rural to urban places and from traditional to modern norms. Ware (1976), asserted that only small elites move directly from birth spacing by abstinence to birth spacing by contraception. For the rest it remains to be seen whether the tradition of birth spacing in the culture will, in the long run, serve to hasten the

adoption of family size limitation practices. (Dow, 1977, 208-214). Morgan's most important argument is that "economic security and meaningful social status, rather than upper class social status, lead to lower fertility rates". His theory is that the transitional groups, torn by the conflicts of their transitional status and trying to keep a foot in both transitional and modern reference groups, over-compensate for their disorientation of the traditional world by deliberately raising their fertility.

Morgan's study has the virtue of making his theory of fertility transition explicit and open to refutation. Much fertility research in Africa is based on an implicit model in which modernization, industrialization and urbanization result in changes in economic and social structure and attitudes, which lead to changes in family reactions and attitudes, which finally, by means of changes in Blake-Davis intermediate variables, result in lower fertility.

In an interesting study in Lagos, R. Lesthaeghe and others (1981, 148-179), have related modernization or more specifically (Westernization) and education to fertility. Some of the interesting conclusions that emerged are : (i) the increase in age at marriage as a function of increasing education will reduce fertility at the youngest reproductive ages; and (ii) the decline of traditional forms of child-spacing i.e. prolonged lactation and abstinence especially among the educated groups of women -- is leading to a shortening of the birth intervals pushing fertility levels up in the central reproductive ages.

In this context rising fertility levels in the urban areas especially among the educated groups is seen as a result of shortening of the traditional birth spacing, as a result of modernization, which is not compensated for sufficiently by the use of modern contraceptives. That is, while women involved in increasing levels of education might

marry or start producing children at a later point than those with lower educational levels, but once started, their fertility remains high.

In the Sudan, however, little is known about such differences in fertility levels between rural and urban areas, between and within the different regions of the Sudan. In the following pages we will try to throw some light on this topic.

(i) The level of Urbanization in The Sudan

The 1973 population census of the Sudan defines an urban area as one which constitutes 5000 population or more. Table 5.2.1 presents the percentages of rural and urban populations for the Sudan as a whole and its regions.

TABLE 5.2.1 THE PERCENTAGES OF RURAL-URBAN POPULATION, SUDAN AND ITS REGIONS, 1973

Residence	R E G I O N						
	Sudan	Northern	Eastern	Western	Khartoum	Central	Southern
Urban	18.5	18.5	26.0	11.0	71.6	14.3	10.3
Rural	81.5	81.5	74.0	89.0	28.4	85.7	89.7

For Sudan as a whole, the urban population is 18.5 percent of the total population. Compared to the 7.4 urban population in the 1955/56 census this difference indicates that Sudan is experiencing a rapid rate of urbanization amounting to 7.4 percent annually. Khartoum is the most urbanized region in the country with nearly 72 percent of its population living in urban settings. Both the Western and Southern regions are the least urbanized regions of the country, the percentages of their urban populations of total population being 11.0 percent and 10.3 percent, respectively.

(ii) The Reported and Adjusted Rural-Urban  
Total Fertility Rates:

The proper interpretation of results of studies of fertility differentials often depends on the statistical measures of fertility that are used and on the definitions of population groups to which the measures relate. For example, data are often insufficient to explain fertility differences that can be traced to differences in age at marriage, stability of marriage, etc. Comparisons of such measures as crude birth rates, suffer various types and degrees of limitations in accounting for the factors of differentials fertility and eliminating extraneous influences. One of the poorest measures used widely for rural-urban fertility differences, the child-woman ratio, is often greatly influenced by variations in infant and child-mortality and by errors in the enumeration and age classification of the children and their mothers, as well as by the effect of migration on population structure. Nevertheless, it constitutes one of the measures used in this study, besides the reported and the adjusted total fertility rates. Since the reported rates suffer various degrees of incomplete reporting of live birth, especially by older women, the adjusted rates, however, supply us with the relatively most reliable measures. Table 5.2.2 presents the reported and the adjusted total fertility rates for the rural and urban Sudan and its regions.

The reported rates for the Sudan as a whole do not show a significant difference between rural and urban areas; the difference is nearly 2 percent in favour of the rural areas. The adjusted rates, however, have confirmed that rural fertility is slightly higher than urban fertility, but the difference is small, nearly 5.0 percent in favour of the rural fertility. For all the regions of the Sudan, the use of the adjusted total fertility rates do not alter the pattern of

rural-urban fertility differentials, but make them more clear.

TABLE 5.2.2 REPORTED AND ADJUSTED TOTAL FERTILITY RATES FOR RURAL-URBAN AREAS OF THE SUDAN AND ITS REGIONS, 1973

Region	Reported			Adjusted		
	Rural	Urban	% Difference R - U	Rural	Urban	% Difference R - U
Sudan	5.3	5.2	1.9	6.8	6.5	4.6
Northern	6.2	5.3	17.0	8.1	7.1	14.1
Eastern	5.5	5.3	3.8	7.5	6.6	13.6
Western	5.0	5.3	-6.0	6.3	6.6	-4.8
Khartoum	5.7	5.2	9.6	8.1	6.4	26.6
Central	6.2	5.7	8.8	8.0	7.6	5.5
Southern	4.5	4.6	2.2	6.3	5.1	23.5

By and large, the adjusted total fertility rates are higher in rural than in urban areas in five regions, namely: Khartoum, Southern, Northern, Eastern and the Central regions, respectively. The Western region, on the other hand, exhibited slightly higher adjusted total fertility rate for its urban than for rural population. What has been confirmed by the adjusted total fertility rates is supported by the reported child-woman ratios in Table 5.2.3.

TABLE 5.2.3 REPORTED RURAL-URBAN CHILD-WOMAN RATIOS, SUDAN AND ITS REGIONS, 1973

Residence	R E G I O N						
	Sudan	Northern	Eastern	Western	Khartoum	Central	Southern
Urban	737	687	755	777	714	832	587
Rural	797	752	849	761	951	945	716
% Difference (R-U)	8.1	9.5	12.4	-2.1	32.3	13.6	22

$$\text{Child-woman ratio} = \frac{\text{Children aged 0-4}}{\text{Women aged 15-49}}$$

As can be seen from the table above, child-woman ratios are higher for rural than for urban in five regions, namely : Khartoum, Southern, Central, Eastern and Northern, respectively. For the Sudan as a whole,



the rate is slightly higher for rural than for urban. In the Western region, however, the child-woman ratio is very slightly higher in urban than in rural areas.

### 5.3 The Influence of Factors Behind Rural-Urban Fertility Differentials "Correlation Analysis"

Socio-economic factors generally discussed in Section 5.1 tend to imply higher rural than urban fertility. However, such factors might affect fertility differently in the different regions and in the rural and urban settings. For example, women involved in agriculture and related work, appear in the different studies as having higher fertility than those involved in higher occupational groups. But at the same time, women in the Western and Southern regions involved in agriculture or pastoral life are bound to hard-work and subject to a difficult life, with implied unfavourable health conditions, which tends to limit their fertility. On the other hand, since the overwhelming majority of the females are considered economically non-active since they are full-time housewives, then the numbers who are actually economically active by the different occupational groups are small. For that reason, the correlation between fertility level and occupation is done for the broad categories: economically active and economically non-active females. (See Table 5.3.1).

The degree to which economic activity and literacy are influential in explaining the differences in regional fertility levels is shown by the correlation analysis in Table 5.3.1. Female socio-economic characteristics, i.e. literacy : primary and secondary education, and above, and economic activity, are correlated each in turn with the fertility level in all regions. The correlation between fertility

level and each one of these factors is given in Table 5.3.1 below for rural-urban areas. (For application see Appendix III).

TABLE 5.3.1 CORRELATION (r) BETWEEN FERTILITY AND SOCIO-ECONOMIC CHARACTERISTICS\* OF THE FEMALE POPULATION IN RURAL-URBAN AREAS OF SUDAN, SUDAN 1973

Residence	Literacy	Primary Education	Higher Education	Economic Activity
Urban	+ 0.69	+ 0.80	+ 0.24	- 0.49
Rural	+ 0.96	+ 0.96	+ 0.82	- 0.77

N.B. Literacy rate is the ratio of literate females who are aged 10 years and over. The educational indices (primary and higher education) are proportions of females in the reproductive age group 15-44 weighted to literacy. That is, the proportion of those with primary education and higher education equals to the proportion who are literate. The index for economic activity is the proportion of active females (15-44) in each region.

Correlating fertility to literacy has shown strong positive relationship for both rural and urban populations. Surprisingly, both educational levels, (primary and higher secondary education and above) are positively correlated with fertility; the relationship being stronger in rural than urban areas. This would suggest that although women with higher education start child-bearing late relative to those with primary education, they apparently "catch up" with earlier starters later on by the end of their reproductive life.

The overall correlation between fertility and female economic activity is negative, especially in the rural areas of the Sudan. This is consistent with the general tendency for women's labour force participation to be inversely related to fertility. However, this does not imply deliberate birth control. With the majority of women involved in agriculture and pastoral life, this implies the hard work performed, and the implied unfavourable health conditions, which are more likely to affect their fecundability.

On the other hand, the correlation between female's economic activity and her literacy is negative, especially in the rural areas (see Appendix III). This is due to the fact that the majority of the economically active females are engaged in agriculture and pastoral life, which, however, do not precondition any educational attainment.

#### 5.4 Summary and Conclusion:

For the Sudan as a whole, rural fertility is slightly higher than urban fertility. The difference accounts to only 5.0 percent by total fertility rates, and 8.1 percent by the reported child-woman ratios. This is also confirmed in five regions, namely: Khartoum, Southern, Northern, Eastern and the Central regions. The Western region, on the other hand, has shown very slightly higher urban than rural fertility.

The results of correlation analysis between literacy, economic activity of the female population and their fertility show that: While literacy is associated with higher fertility, women who are economically active have lower fertility than those who are economically non-active. So, both the Western and Southern regions, which exhibited the lowest levels of fertility, also showed the lowest literacy rates and highest economic activity for its females, the majority of whom are involved in agricultural, animal husbandry and the related works. The latter imply unfavourable health conditions and hard work, which might possibly affect the women's fecundability.

However, these factors (socio-economic) tend to affect fertility indirectly through their effect on the intermediate fertility variables which affect fertility directly. A more comprehensive picture of rural and urban fertility differentials, will be obtained when studying these factors, in the coming chapter.

CHAPTER VI

RURAL-URBAN FERTILITY DIFFERENTIALS

PART II: "QUANTITATIVE ASSESSMENT OF THE  
INTERMEDIATE FERTILITY VARIABLES IN  
RURAL AND URBAN SUDAN"

6.0 Introduction

In general, the biological and behavioural factors through which socio-economic, cultural and environmental variables affect fertility are called intermediate fertility variables. The primary characteristics of an intermediate fertility variable is its direct influence on fertility. These variables are generally recognized since the pioneer work of Blake-Davis in 1956, among which the most important are: age at marriage, proportion married, use or non-use of contraceptions and other traditional methods to avoid or to waste pregnancies, lactation, <sup>abstinence</sup> : and frequency of intercourse.

In an effort to quantify the influence of these factors, John Bongaarts (1978) constructed a set of equations for analyzing the relationship between intermediate fertility variables and the level of fertility. The model includes only a small number of conceptually distinct and quantitatively important intermediate variables: time spent in a reproductive union, contraception and induced abortion, and the natural marital fertility factors (lactational infecundability, frequency of intercourse, sterility, spontaneous intrauterine mortality, duration of the fertile period, etc). The model was first used to analyze recent fertility changes in Korea and the United States. ( Bongaarts, 1978, 105-132).

6.1 Application of Bongaart's Framework to the Sudan:

(i) The Proportion of Reproductive Life Spent in the Reproductive Union:

One of the important determinants of fertility, especially in the underdeveloped societies is the proportion of reproductive life spent in the reproductive union. No doubt this depends on the age at marriage, which is generally early in these societies. To make a quantitative assessment of this relationship, Bongaarts proposed a method to measure the effect of the proportion of the reproductive life spent in a reproductive union on the overall fertility level as measured by the total fertility rate (TFR), total marital fertility rate (TM), and the proportion of reproductive life in a marital union (cm). The relationship between the three variables is:

$$TFR = cm \times TM$$

$$\text{where, } CM = \frac{\sum m(a) g(a)}{\sum g(a)}$$

where a = age group and M(a) = the proportion married at age a. Then the index cm gives the proportion by which TFR is smaller than TM as a result of non-marriage (i.e. the proportion of reproductive life spent outside active union). The three variables are calculated for rural and urban populations in each region in the Sudan and the results are presented in Table 6.1.1. The marital fertility rates for the Sudan as a whole (adjusted for the births omitted) are used as standard, from which the index cm for each region is obtained.

As stated earlier, the index cm gives the proportion by which TFR is smaller than TM as a result of non-marriage, cm = 0 if nobody is married and cm = 1.0 if all women are married during the entire

reproductive period. These indices and the relationship between them provide a convenient way to separate overall fertility (TFR) into two determining components: (i) the prevailing marriage pattern among women of reproductive ages (cm); and (ii) the fertility level within marriage (TM).

The differences among the majority of rural-urban populations in the index cm in Table 6.1.1, suggest the importance of age of marriage as an approximate explanation of fertility variation. For the Sudan as a whole the difference between rural and urban populations in the index cm amounts to 8.0 percent, in favour of rural areas. This in effect means fertility is reduced by life outside of marriage less in rural than in urban areas.

TABLE 6.1.1 TFR, TM and cm FOR RURAL-URBAN AREAS OF THE SUDAN AND ITS REGIONS, 1973

F. Rate	R E G I O N						
	Sudan	Northern	Eastern	Western	Khartoum	Central	Southern
URBAN							
TFR	6.5	7.1	6.6	6.6	6.4	7.6	5.1
TM	9.3	10.8	9.0	9.2	9.4	10.6	7.0
cm	0.70	0.66	0.73	0.72	0.68	0.72	0.73
RURAL							
TFR	6.8	8.1	7.5	6.3	8.1	8.0	6.3
TM	8.7	11.7	9.0	7.6	10.3	10.0	8.4
cm	0.78	0.68	0.83	0.83	0.79	0.80	0.75

In the urban areas of the Sudan, the index cm is 0.70. The Eastern, Central, Western and Southern regions obtained an index slightly higher than the country's average, ranging between 0.72 for the Western and Central regions, to 0.73 for the Eastern and Southern regions. Despite its high index cm, the urban areas of the Southern region, exhibited low potential marital fertility, amounting only to 7.0 live births, compared to 9.3 live births for the national average, obtained by an index of

0.70, only. This in effect implies that urban fertility in the Southern region is low due possibly to longer age intervals or problems of fecundability.

On the other hand, both the Northern and Khartoum regions exhibited a low index amounting to 0.66 and 0.68, respectively, which indicates the considerable amount of reproductive life spent outside a reproductive union. Despite that the two regions have shown a high potential marital fertility, amounting to 10.8 and 9.4 for Northern and Khartoum, respectively. That is, although women in urban Northern and Khartoum start child-bearing late relative to other regions, -- possibly due to the relative availability of higher education than in all regions, and the possible effect of migration, especially in the Northern region -- but once started, their fertility remains high as indicated by their observed TFRs, which also possibly related to shorter birth interval and/or high fecundability.

In the rural areas of the Sudan the index cm is 0.78, which implies less life of reproduction is spent outside of marriage compared to the urban areas. While all regions exhibited an index which does not differ greatly from the country's average, the Northern region exhibited a much lower index of 0.69, which implies that a considerable reproductive life is spent outside of marriage. Despite that, it has exhibited the highest potential marital fertility. This in effect is related to shorter birth interval and/or higher fecundability relative to other areas.

On the other hand, both the Southern and Western regions, exhibited low marital fertility despite their relatively high index cm (i.e. less time is spent outside of marriage). This could also exhibit low fecundity and/or longer birth intervals. There is strong evidence that

women in the Western and Southern regions, who are largely involved in agriculture and pastoral life, suffer unfavourable health conditions and perform hard work, which is related to higher incidences of miscarriages. The same environment would also suggest longer periods of lactation for infants to assure their survival.

Overall then, rural areas of the Sudan have shown less time of reproductive life spent outside of marriage. At the same time rural women in the Sudan suffer unfavourable health conditions, which in turn would be likely to affect their fecundability.

(ii) Use of Contraceptions and  
Induced Abortion:

In the Sudan, the practice of contraception is rare or virtually absent, and marital fertility is high in both its urban and rural areas. (Table 6.1.1). Even where marital fertility is low, there is little doubt that this has been due to factors other than deliberate birth control; factors that are possibly related to the health conditions or the prevalence of traditional methods (e.g. prolonged lactation and/or abstinence) and practices that can substantially produce longer birth intervals between successive births. In fact in this population, the level of contraceptive use is so low that it is practically impossible to detect a measurable effect of contraceptive use on fertility. This is clear especially in urban Khartoum where the marital fertility is as high as 9.4 live births.

On the other hand, if induced abortions are to be found where there are more frequencies of illegitimate births, or undesirable pregnancies, then the value of this in the Sudanese society will be zero. Births actually happen only within marriage, and induced abortion is virtually absent. Hence the effect of both contraceptions and



induced abortion is negligible or almost none. To account for that in the Bongaart's equation, then the value of  $C_c$  (index for non-contraceptives) and  $C_a$  (index for induced abortion) are set at unity. So the equation now becomes:

$$\begin{aligned} \text{TFR} &= \text{cm} \times (C_c \times C_a) \times \text{TNM} \\ &= \text{cm} \times \text{TNM} \end{aligned}$$

$$\text{where } C_c \times C_a = 1.0$$

So, for the urban population of the Sudan is:

$$\text{TFR} = 0.70 \times \text{TNM}$$

and for rural population of Sudan is:

$$\text{TFR} = 0.78 \times \text{TNM}$$

where TNM is the total natural marital fertility.

### (iii) Lactational Infecundability:

One of the principal methods practiced in the Sudan that helps to widen the birth interval is prolonged lactation, especially in the rural areas of the Sudan. This procedure is used to assure the survival of the child in the absence of infant's food other than the mother's milk. The lactational period in the rural Sudan is usually long and often lasts until the next pregnancy occurs. In urban areas, however, we observe that although urban women do lactate, but for a shorter period than in the rural areas. Lactation has an inhibitory effect on ovulation and this increases the birth interval and reduces natural fertility.

Without lactation, a typical average birth interval can therefore be estimated to equal to about 20 months.<sup>1/</sup> With lactation it equals the

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<sup>1/</sup> This includes : (i) An infecundable interval following a birth = 1.5 months in the absence of lactation, plus (ii) 7.5 months average waiting time to conception, plus (iii) 2 months time added to spontaneous intrauterine mortality, plus (iv) 9 months gestation period ending in a live birth. So,  $1.5+7.5+2+9 = 20$  months. (See Bongaarts, J., 1978, 115).

average total duration of infecundable period plus 18.5 months (i.e. 7.5 + 2 + 9). However, for more fecund women, the period (7.5 months, the average waiting time for conception), might be considerably shorter. A rough estimate for the birth interval (B.I) can be obtained by the use of the total fertility rate (TFR):

$$B.I = \frac{(30)(12) \times cm \times 0.875}{TFR}$$

where (30) X (12) is the potential reproductive life (15-45) converted into months and 0.875 is a correction factor suggested by Bongaarts to allow for the heterogeneity among women with respect to fecundability.

This is calculated for the various rural-urban populations of the Sudan in all regions and the results are presented in Table 6.1.2.

TABLE 6.1.2 BIRTH INTERVAL (B.I) FOR THE RURAL-URBAN POPULATION OF THE SUDAN, SUDAN AND ITS REGIONS, 1973

Residence	R E G I O N						
	Sudan	Northern	Eastern	Western	Khartoum	Central	Southern
Urban	33.9	29.3	34.8	34.4	33.5	29.8	<u>45.1</u>
Rural	36.1	26.8	34.9	<u>41.5</u>	30.7	31.5	37.5

As can be seen from the table, the birth intervals (in months) vary between and within the rural and urban areas of the various regions of the Sudan. The longest birth interval among the urban areas of the Sudan is observed in the Southern region, where it equals 45.1 (i.e. 3.8 years) which is extremely high and suggests that some factors related to infecundability or spontaneous abortion might have been working. Likewise, the birth interval in the Western rural areas is also high amounting to 41.5 months (i.e. 3.5 years). These areas have already been reported as having high incidence of miscarriages and pregnancy wastages related to the prevalence of diseases -- as well as the hard

work performed by the pastoral women. (Henin, R.A. , 1969, 171-198).

In all regions, except the rural areas of the Northern and the Southern regions, the birth interval in rural areas is longer -- as expected<sup>1/</sup> -- than in the urban areas, especially in the rural areas of the Western region. In the rural areas of the Northern region the birth interval is shorter than all amounting only to 26.8 months.

The ratio of the average birth interval without and with lactation is called by Bongaarts, the index of lactational infecundability (Ci):

$$Ci = \frac{20}{18.5 + i}$$

where i is the average duration (in months) of infecundability from birth to first post-partum ovulation (Menses), and (18.5 + i) is the birth interval. For the urban and rural population of the Sudan the indices of lactational infecundability are as follows:

$$\text{Urban, } Ci = \frac{20}{33.9} = 0.59$$

$$\text{Rural, } Ci = \frac{20}{36.1} = 0.55$$

The relationship between lactation and total natural marital fertility (TNM) is summarized by Bongaarts by the following equation:

$$TNM = Ci \times TF$$

where TF is the total fecundity rate. In effect this means that rural marital natural fertility in the Sudan is 55 percent the level it would be in the absence of lactation, and that of the urban areas is 59 percent the level it would be in the absence of lactation. The difference between rural and urban in natural marital fertility is small. This is

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<sup>1/</sup> Rural areas are likely to have longer birth intervals due to the longer lactational periods. This is necessitated by the absence of infant's food other than the mother's milk. In the urban areas, however, especially big cities and towns, infant's food is relatively available.

due to the fact that the implied birth intervals are practically the same.

The implied estimates for the duration of breast-feeding can be obtained by the linear equation:

$$\gamma = 1.5 + 0.6X^{1/}$$

where,  $\gamma$  = period of amenorrhea,  $X$  = duration of breastfeeding, and  $\gamma = B.I - 18.5$  months.

For the different regions of the Sudan, both the duration of breast-feeding and the generated amenorrhea are given in Table 6.1.3

TABLE 6.1.3 IMPLIED ESTIMATES OF THE DURATION OF BREAST-FEEDING AND LACTATIONAL AMENORRHEA FOR THE DIFFERENT REGIONS OF THE SUDAN, 1973  
(In months)

Region	Sudan	Northern	Eastern	Western	Khartoum	Central	Southern
URBAN							
Duration of lactation	23.2	15.5	24.7	24.0	22.5	16.3	<u>41.8</u>
Lactational amenorrhea	15.4	10.8	16.3	15.9	15.0	11.3	<u>26.6</u>
RURAL							
Duration of lactation	26.8	11.3	24.8	<u>35.8</u>	17.8	19.2	29.2
Lactational amenorrhea	17.6	8.3	16.4	<u>23.0</u>	12.2	13.0	19.0

As can be seen from the table, both the duration of breast-feeding and the generated amenorrhea vary within and between the rural and urban areas of the Sudan. While the figures vary gently in the urban areas of the Sudan, the Southern region exhibited a very high lactational period

<sup>1/</sup> Carlo A. Corsini expressed the relationship between breast-feeding (X) and amenorrhea ( $\gamma$ ) as  $\gamma = 1.332 + 0.566X$ . The (1.322), interval after birth, is not different from the 1.5 months estimated by Bongaarts. So the equation is put as  $\gamma = 1.5 + 0.6X$ . (See Carlo A. Corsini (197-211) in Henri, L., and Jane, M., eds. "Natural Fertility", International Union for the Scientific Study of Population.

and lactational amenorrhea figures. Likewise, the figures for the rural areas of the Western region are also high. Certainly what is concealed between these rows is the effect of infecundability especially for the urban Southern and rural Western. The same areas suffer unfavourable health conditions, which would be very likely to affect their fecundability. If we set "cf" as an index of fecundability, later we will be able to estimate roughly the fecundability in these areas.

Now, to account for all these factors ( $cm$ ,  $C_c$ ,  $C_a$ ,  $C_i$ ) in Bongaart's equation of total fecundity rate, then

$$TFR = cm \times C_c \times C_a \times C_i \times TF$$

For urban Sudan:

$$6.5 = 0.70 \times 1.0 \times 0.59 \times TF$$

$$\Rightarrow TF = 15.7$$

For rural Sudan:

$$6.8 = 0.78 \times 1.0 \times 0.55 \times TF$$

$$\Rightarrow TF = 15.9$$

Bongaarts estimated a total fecundity rate of 15.3 live births by successive removal of the indices of the intermediate fertility variables. It is clear that the above values obtained for rural and urban Sudan do not differ greatly from the value obtained by Bongaarts.

The values obtained of total fecundity rates suggest that fertility levels in rural and urban Sudan are kept at the observed level due to: age entry into marriage, lactational practices and/or <sup>abstinence</sup>, and factors affecting the biological capacity of women to reproduce (i.e. infecundability). Urban females marry later than rural females, -- possibly due to the relative availability of higher education in the urban areas -- where a considerable period of reproduction is lost through education. Rural fertility, on the other hand, is affected more by the practice of

lactation where 45 percent of the marital natural fertility is lost due to prolonged lactation.

The very high values of lactation duration and amenorrhea obtained for the Southern region and the areas of the Western region, throw some doubt concerning the fecundability of women in these areas. An index (cx) of fecundability can be obtained using the total fecundity rate and assuming that women in these areas have the same birth intervals as the country's average. Then the index cf can be obtained from the equation:

$$\text{TFR} = \text{cm} \times (\text{C}_c \times \text{C}_a) \times \text{C}_i \times \text{cf} \times \text{TF}$$

$$\text{TFR} = \text{cm} \times \text{C}_i \times \text{cf} \times \text{TF}$$

For the urban areas of the Southern region:

$$5.1 = 0.73 \times 1.0 \times 0.59 \times 15.7 \times \text{cf}$$

$$\Rightarrow \text{cf} = 0.75$$

In effect this indicates that the urban woman in the Southern region is less fecund by 25 percent than the average woman in the urban Sudan. This is possibly related to the prevalence of malaria and venereal diseases. Likewise, the index cf for rural Western is:

$$6.7 = 0.83 \times 1.0 \times 0.55 \times 15.9 \times \text{cf}$$

$$\Rightarrow \text{cf} = 0.87$$

which also indicates that rural women in the Western region are 13 percent less fecund than the average woman in rural Sudan. Hence, the low fertility of rural women in the Western region, -- who are predominantly nomads, --  $\frac{1}{2}$  is greatly influenced by problems of infecundability,

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1/ 50% of the economically active females in the rural areas of the Western region are involved in agriculture and animal husbandry. (Table 5.1.4., p. 127).

2/ Pastoral nomadism as practiced in the Sudan is of three types:  
(i) pastoral nomads: on the constant move for pasture and water;  
(ii) semi-nomads: where part of the family is left in the "Dar"

rather than late age at marriage and mean age of fertility, etc., (in contrast to the settled population of the Gazera in the Central region); as reported by Henin. (Henin, 1968, 156, 157). Age at first marriage (Figure 3.3.A., p. 78) and mean age of fertility (Table 4.5.1, p. 115), are both lower for rural women in the Western region than for the settled population in the Central region. Although Henin succeeded in identifying some of the causes of the low fertility of the nomads in the Western region -- such as the prevalence of diseases and malnutrition, -- he did not explore the important mechanism through which this low fertility is achieved. Problems of infecundability are actually encountered, resulting in longer birth interval, amounting to 3.5 years in the rural areas of the Western region, which is 31.7% higher than that of the Central region.

It can be summarized that the effect of lactation and age at marriage in both the rural and urban areas of the Sudan tend partly to offset each other in urban and rural Sudan, with the effect that the difference in respective total fertility rates is small (only 5 percent in favour of rural areas). While lactation and/or abstinence tend to affect rural areas more than the urban areas, the effect of this on the overall fertility of the rural areas is compensated for by early age at marriage. The contrary is also true for the urban areas of the Sudan.

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engaged mainly in agriculture; and (iii) Transhumance: a highly developed form of pastoralism practised by sedentary cultures whose major economic activity is agriculture. The movement is generally undertaken from a permanent base. (M.S. Bayoumi, "Guide Lines Towards the Development of Nomadism in the Sudan", in Elhasan, M.A., editor, "Growth, Employment and Equity", CESR, K.U.P., 1977. However, in all these types, peasant rain cultivation is widely practised for subsistence.

6.2 The Effect of Migration  
On Rural Fertility:

It has been believed that separation of couples due to migration or prolonged separation has a depressing effect on fertility, especially in the rural areas. (op. cit., 1965, 22). This, however, seems not to be the case in the Sudan. Table 6.2.1 presents the rural-urban total fertility rates against the respective sex ratios of the Sudan as a whole and its regions.

TABLE 6.2.1 SEX RATIOS AND TOTAL FERTILITY RATES FOR RURAL-URBAN POPULATIONS, SUDAN AND ITS REGIONS, 1973

Region	S E X R A T I O S				Adjusted Total Fertility Rate	
	RURAL		URBAN		Rural	Urban
	For Total pop.	For 15-49	For Total pop.	For 15-49		
Sudan	98	87	113	122	6.8	6.5
Northern	94	63	105	106	8.1	7.1
Eastern	116	113	118	126	7.5	6.6
Western	90	74	97	95	6.3	6.6
Khartoum	108	106	126	149	8.1	6.4
Central	105	97	110	115	8.0	7.6
Southern	102	89	112	113	6.3	5.1

As can be seen from the table, although the rural areas of the Sudan as a whole, the Northern, Central and Southern regions, are affected by migration, especially adult males (as revealed by their sex ratios especially for the age group 15-49), their fertility remains higher than urban fertility. On the other hand, the Western region loses its adult males due to migration both in its urban and rural areas. So, there is some doubt that its lower rural than urban fertility has been caused by migration of rural males. The case in the Northern region



needs some explanation which is related to social factors : the rural males of the Northern region who reside at the urban centres leaving their wives or families at home, i.e. in the rural areas, but frequently visiting them, often at regular intervals. This, explains the shorter birth interval in the rural areas of the Northern region, where it seems that rural emigrants who come home always assure pregnancy before they go back to resume their work in the urban areas.

### 6.3 Summary and Conclusion:

The preceding analysis has pointed to three important factors when considering rural and urban fertility differences. These are (i) traditional practices especially prolonged lactation, which affects rural areas more than urban areas, (ii) age entry into marriage, affecting urban areas more than rural areas, and (iii) factors affecting the biological capacity to reproduce which are more apparent in the urban areas of the Southern region and the rural areas of the Western region.

Age of marriage seems to work mainly through education especially higher education. With higher education more accessible to urban females, then a considerable proportion of the reproductive life is lost due to education. While rural females marry earlier about the age of 15 or 16, for those with primary education, those involved in higher education are likely to marry at age 20 or more. With a minimum difference of 5 years in age at marriage and a birth interval of 33.9 months in the rural areas, then rural females are already ahead by an average of 1.8 birth delivery than those in urban areas who are involved in higher education.

There is strong evidence that rural females in the Western region, and urban females in the Southern region, suffer unfavourable health

conditions that affect their biological capacity to reproduce. This is related to the prevalence of malaria and venereal diseases in the urban Southern and the absence of public health, poor nutritional standard, prevalence of diseases, as well as the hard work performed by the pastoral women in the rural areas of the Western region.

While age at marriage is positively related to fertility -- i.e. other things remaining the same, the earlier the age at marriage, the longer the time spent in reproductive union, and hence the higher the fertility, -- and prolonged lactation tend to reduce natural fertility, there is a tendency for the effect of each to be partly offset by the effect of the other, with the result that the net effect on the overall level of fertility of rural and urban areas is small, resulting in a difference of only 5 percent in the total fertility rate in favour of rural areas.



CHAPTER VII

SUMMARY AND CONCLUSION

7.0 Persistence of High Fertility  
in the Sudan

Most of the now underdeveloped countries, -- which are predominantly agricultural with little or no industry, -- are characterized by high fertility levels and the existence of fertility differentials. High fertility and fertility differentials are caused by environmental, economic, social and cultural factors. Only by explaining these factors within a historical context can a comprehensive picture be achieved.

In the context of fertility and underdevelopment, the Sudanese situation is quite typical. Fertility in Sudan is high. The first census of Sudan in 1955/56 reported a crude birth rate of 51.7 per 1000 population. Estimates from the latest census (1973) presented in Chapter IV suggest a crude birth rate of 51.5 per 1000 population. This indicates that fertility in the intercensal period might have remained constant. To explain this, we have to examine the factors responsible for that particular level of reproduction.

The cultural context -- reinforced by the poor and traditional socio-economic structure -- and the pro-natal religious prescriptions within which the Sudanese society exists, are conducive to high fertility.

During the pre-Colonial period, environmental, economic, social and political factors stressed the need for large individual families, and consequently for high fertility. However, variations in "natural" fertility, did exist at that time and can be attributed to variations in environmental and traditional practices, norms and social values prevailing in the different Sudanese communities. Such factors, e.g. prolonged

lactation and/or abstinence, tribal norms governing and regulating sexual and marriage habits, led to variations in the level of natural fertility.

In the next period, specific Colonial policies led to regional economic inequalities and income disparities as a result of the uneven distribution of agricultural schemes in the country. Such projects were located in Central Sudan. As a result, Khartoum, the capital city, acquired an increasing importance as an urbanized administrative centre. Subsequently, transportation, health and education services were concentrated in these areas as well. Western and Southern regions, on the other hand, continued to be neglected and as a result occupied inferior positions in all economic and social spheres. Furthermore, the Colonial period also witnessed the appearance of new diseases for the first time, e.g., cerebrospinal meningitis and relapsing fever, and the intensification of indigenous diseases like malaria and schistosomiasis as a result of canalization in the Gazera of the Central region.

Regional inequalities in socio-economic development resulted in differences of fertility and mortality rates, and migratory movements from the less developed regions to the more developed ones. The 1955/56 population census, which had been undertaken on the eve of independence, reported an infant mortality rate in the Southern region as high as almost twice that of the Central region. Henin (1969), on the other hand, showed that the fertility rates of the settled population, being now more nourished and healthy as a result of settlement, had increased. This indicates that the previous fertility rate of the now settled population, has been kept down involuntarily as a result of bad health and malnutrition. Hence the Colonial era has in fact resulted in differences in fertility and mortality rates and migration habits.

The period from independence up to 1973 is characterized by:

- (1) The absence of any significant structural changes, as the economy continues to rely heavily on agriculture, and
- (2) The continuation of regional socio-economic inequalities.

The Central, Eastern and Khartoum regions continue to attract almost all investments. These three regions account for more than 80 percent of the industrial (manufacturing) establishments and industrial production. Consequently, the same regions have been better off in terms of health and educational services. The Northern region, though less wealthy than the above mentioned regions, still stands as one of the best regions in terms of health and education facilities. Hence, the economic and the subsequent differences in social services continue to exist, with the Western and Southern regions continuing to occupy positions inferior to those of the other regions. This is also manifested in the migratory influx of the adult male population of the Western and Northern regions towards the Central, Eastern and Khartoum regions.

The result of the concentration of agricultural schemes in the Central region is not, however, negatively related to fertility. While it has resulted in a slight reduction in mortality rates, it does not significantly alter the values that keep fertility rates high. In the Western and Southern regions, on the other hand, the populations continue to be involved in their traditional way of life and pastoralism. There are strong evidences that the fertility rates in these two regions have been kept involuntarily at low levels due to poor health conditions and malnutrition.

## 7.1 Marital Conditions and Fertility

The cultural context within which the Sudanese society exists is conducive to high levels of fertility. The latter is achieved through: early age at marriage, low permanent celibacy and quick rates of re-marriage of the widowed and divorced women. These in turn are more apparent in rural than in urban areas, which implies higher rural than urban fertility. The rural-urban areas in the different regions of the Sudan revealed, however, slight differences in these characteristics. For example, high age at marriage is observed in Khartoum and the Northern regions. This in turn, can be attributed to the relative availability of higher education in these two regions and to the possible effect of migration in the Northern region.

While all marriage customs and patterns tend to support high fertility, fertility has also been kept down traditionally by some practices and norms. For example, the high rates of mortality in the Southern region, resulting in high incidences of widowhood, have been compensated for by quicker rates of remarriage of the widowed women. Polygamy, on the other hand, is widely practiced in all communities of the Sudan. The practice of polygamy would be likely to result in low fertility, owing to the fact that women associated with polygamous husbands are subject to low frequencies of intercourse, which results in low fertility. Polygamous marriages in the Sudan account for approximately 21 percent of all marriages.

## 7.2 Regional Fertility Estimates:

Reliable fertility estimates depend on accurate data on age and on fertility. The analysis of age data reported in the 1973 census revealed that data on age are highly inaccurate. The data are affected by age heaping and age misreporting, and can only be classified as highly

inaccurate. Secondly, there is a systematic pattern of age misreporting for the female population. This comes mainly from the erroneous age estimation put by the interviewers for women. We have identified this form of age misreporting as conforming to the pattern found in the "African-Asian" population. The identification of this form of age misreporting is useful for fertility estimates using the age distribution of the female population. Data on fertility have also shown some errors. The number of children under one year of age enumerated in the 1973 census is suspicious, and we believe that they have been underenumerated. Data on children ever born, though affected by those not stating their parity, show less fluctuations and irregularities and encourage the use of the Brass P/F ratio to obtain reasonable estimates of fertility.

Hence, suffering from inaccurate data on age and on fertility, the best estimates of fertility can only be obtained by combining the different available techniques to arrive at the most plausible fertility levels for Sudan as a whole and its regions.

The fertility estimates obtained for Sudan as a whole, its regions and rural-urban populations, by combining both the Brass P/F ratio method and the quasi-stable population method, are the most plausible that can be obtained.

With a gross reproduction rate of 3.3 (i.e., TFR = 6.7 live births) for Sudan as a whole, and gross reproduction rates varying between 3.3 and 3.9 for the Southern and Central regions, respectively, Sudan is clearly located among the African countries whose fertility is high or perhaps very high.

The regional fertility estimates have shown that there exist

differences in fertility levels within (rural-urban) and between the different regions of the Sudan. The difference between the highest (in the Central region) and the lowest (in the Southern region), total fertility rates amounts to 31.1 percent.

### 7.3 Rural-Urban Fertility Differentials

For the Sudan as a whole, rural fertility is slightly higher than urban fertility. This is also observed in Khartoum, Southern, Central, Eastern and Northern regions. The Western region, on the other hand, has shown slightly higher urban than rural fertility.

The analysis has shown that while female literacy is associated with high fertility levels, women involved in economic activity have lower fertility than those who are economically non-active. That is, women who are staying at home as full-housewives are associated with high fertility. Both the Western and Southern regions have shown the lowest levels of fertility and also the highest levels of illiteracy and economic activity, where most of the female active population is involved in agriculture and pastoral activities. The latter also implies unfavourable health conditions and hard work performed by the pastoral women, which would be likely to lead to higher incidences of miscarriages and pregnancy wastages.

Another factor that might generate differences in rural-urban fertility levels is the migration of rural adult males to the urban areas. Lower rural than urban fertility in this account, is thought to be a result of delaying ages of marriage and prolonged separation of the married couple. However, this is not the case in the Sudan. The Northern region, though affected by migration, exhibited the highest level of rural fertility in the country. The explanation of this is attributed to social factors. Rural emigrants who reside in the urban areas, leaving



their families at home (i.e., rural areas) but frequently visiting them, often at regular intervals. This explains the highest level of marital fertility in the rural areas of the Northern region.

However, socio-economic factors affect fertility through their effect on the intermediate fertility variables. The latter affect fertility directly. Chief among the intermediate fertility variables that generate the existing rural-urban fertility differences are: (i) Age entry into marriage, which affects urban areas more than rural areas; (ii) traditional practices, especially prolonged lactation, which affect rural areas more than urban areas; and (iii) factors affecting the biological capacity to reproduce, which are more apparent in the Southern and Western regions.

Age at marriage seems to work mainly through education, especially higher education. With higher education, more accessible to urban than rural females, a considerable proportion of the reproductive life of urban females is lost due to education.

There is strong evidence that rural females in the Western region, and urban females in the Southern region, suffer unfavourable health conditions that affect their biological capacity to reproduce. This is related to the prevalence of malaria and venereal diseases in the urban areas of the Southern region, where the average woman is approximately 25 percent less fecund than the average woman in urban Sudan. It is also related to the absence of public health facilities, poor nutritional standards, the prevalence of diseases as well as the hard work performed by the pastoral women in the rural areas of the Western region, where the average woman is approximately 13 percent less fecund than the average woman in rural Sudan.

However, while age at marriage is positively related to fertility --

i.e. other things remaining the same, the earlier the age at marriage, the higher the fertility, -- and prolonged lactation tends to reduce natural fertility; there is a tendency for the effect of each to be partly offset by the effect of the other with the result that the net effect on the overall fertility level of rural and urban fertility is small, resulting in a difference of only 5 percent in their total fertility rates in favour of rural areas.

#### 7.4 Further Implications of Socio-Economic Development for Fertility Levels and Trends

Sudan is a large country and sparsely populated. With a population of less than 15 million in 1973, average density was only 5.9 persons per square kilometre. This is one of the lowest densities in Africa and the world.

With a crude birth rate of 51.5 per 1000 population in 1973 and a crude death rate of approximately 20 deaths per 1000 population, Sudan might have been growing at a rate which is slightly higher than 3.0 percent annually. This is higher than the 2.7 and 2.8 percent growth rate frequently estimated and incorporated in the country's different development plans.

A growth rate of 3.0 percent annually indicates that the population will double every 23 years. That is, by the year 2000, the population of Sudan might be higher than 33 million if the growth rate is kept constant for the coming two decades. This in turn will raise the average density to 13.5 persons per square kilometre, which is still very low. The density would be higher than that if the growth rate is accelerated. This might be possible if more emphasis is put in developing the poor and less developed regions which constitute almost 50

percent of the country's population. By so doing, regional inequalities are likely to be narrowed, and fertility and mortality differentials are likely to disappear in the long run. In a market oriented economy, investments tend to concentrate in the urban areas and in particular areas, where maximum profits can be generated. This has its implications on population dynamics. As a result, large differences in fertility, mortality and migration would also be generated. Rural-urban migration will be aggravated, resulting in unemployment and other problems in the urban areas, and depopulation of the rural areas. The latter is a real obstacle to the development of the rural areas and the country in general. This is the kind of population "problem" that Sudan is likely to face more in the near future.

Despite the low density, however, a high growth rate results in a broad-based population pyramid, i.e. greater proportions of young people, in particular those aged less than 15 years of age. This has been thought by many demographers and economists to be an obstacle to economic growth,<sup>1/</sup> as the increasing number of children need to be fed, educated and looked after medically, and hence most of the funds needed for investments will be directed to expenditure on non-productive aspects.

At the same time, a youthful population offers a large potential

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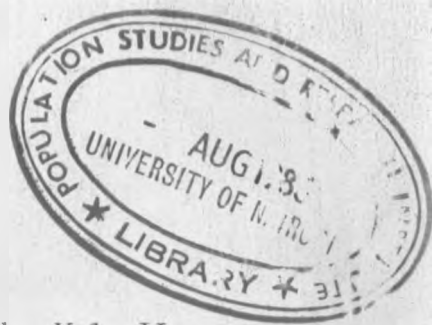
<sup>1/</sup> "First, contrary to what is stressed in the neo-Malthusian Models, we generally find a positive correlation between population growth and economic growth, i.e. the more people the bigger the total labour force and the market and more is produced. (Kenya, for instance, is "more developed" than Ethiopia but produces less, simply because the population of Kenya is smaller than that of Ethiopia). Thus, a higher population growth in fact encourages a faster increase in total production. A comparison of 67 underdeveloped countries (each with more than one million inhabitants) shows that, contrary to

labour force for a society. The higher the growth rate, the larger will be the potential labour force. The increasing potential numbers of labour force should not be perceived as a burden to the economy, but as primary producers and thus an asset. Hence, Sudan can be said to be lucky in having such a potential labour force (46 percent are under 15 years of age). Yet, the full and gainful exploitation of this labour force depends not only on the proper education and training it gets, but also on the increasing capacity of the economy to absorb this labour force gainfully. Therefore expenditure on education (as well as on health) should be seen not as a social cost, but as an investment in the training of the future labour force. After all, it is the people, their quality, skills and the productive values they have, that account for the largest part of the process of socio-economic development.

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what Neo-Malthusians claim, during the period 1960-1970, there was no connection between population growth and growth in the GNP per capita (all data from "World Bank" Atlas, 1972). Actually, the coefficient of correlation was slightly positive, which is in agreement with a statement by Colin Clark who has insisted that countries with a higher population growth also show a faster growth in GNP per capita. Although it casts doubt upon the Malthusian argument, it is not definitely refuted by such ambiguous statistics. With the very heterogeneous economic structure of the underdeveloped countries, cross-national statistical analysis, is notoriously deceptive, but it can at least be used to demask simplistic reasoning". (Lars Bondestam, 1980, 26).

B I B L I O G R A P H Y



- Abbas, I. "Chapter on Fertility" in the Unpublished. Vol. II. - Analysis of the 1973 Population Census of Sudan. Khartoum: Department of Statistics, Ministry of National Planning, 1978.
- Abd-el-Salam, M.M. "Agriculture in Sudan", In, Elhasan, M.A. ed. Introduction to Sudan Economy, Khartoum University Press (K.U.P.), 1976.
- Adegbola, O. and Page, H. "Nuptiality and Fertility in Metropolitan Lagos: Components and Compensating Mechanism". In: IUSSP Seminar on Nuptiality and Fertility, Liege : IUSSP, 1979
- Barclay, W.G. Techniques of Population Analysis : New York : Wiley & Sons, Inc., 1958.
- Bashir, O.M. - Educational Policy and the Employment Problem in the Sudan. (Monograph Series No. 3). Khartoum : DSRC, 1979.
- Bayomi, A. - The History of Sudan Health Services. Nairobi : Kenya Literature Bureau, 1979.
- Berent, J. - "Fertility and Social Mobility." In : Population Studies, Vol. 5: No. 3. London, March 1952, pp. 244-260.
- Bogue, J.D. - Principles of Demography. New York : Wiley & Sons, Inc., 1969.
- Bondestan, Lars and Bergstrom, S. eds. - Poverty and Population Control. London : Academic Press, 1981.
- Bongaarts, J. - "A Framework for Analysing the Proximate Determinants of Fertility." In : Population and Development Review, Vol. 4, March 1979. The Population Council.
- Brass, W. - "Methods of Estimating Fertility and Mortality from Limited and Defective Data." In : Labs. for Population Statistics : An Occasional Publication. Oct, 1975 - University of North Carolina at Chappel Hill, U.S.A., 1975.
- Brass, W. et. al., - The Demography of Tropical Africa. Princeton, New Jersey : University Press, 1968.
- Caldwell, J. - "Towards a Restatement of the Demographic Transition theory." In : Caldwell, J., ed., The Persistence of High Fertility. (Family and Fertility Change Series). Canberra, Australian National University, 1977.
- \_\_\_\_\_ General Theory of Fertility. Canberra : ANU, 1977.
- Coale, A.J. - "The Involuntary Control of Human Fertility." In : Proceedings of the American Philosophical Society, Vol. III:3 (June, 1967).

- Coale, A.J. and Hoover, E. - Population Growth and Economic Development in Low Income Countries. Princeton, New Jersey : University Press, 1968.
- Corsini, Carlo, A. - Is the Fertility-Reducing Effect on Lactation Really Substantial? In : Leridon, H. and Menken, J. eds. 'Natural Fertility. International Union for the Scientific Study of Population. Liege:IUSSP, 1977.
- Davis, K. - The Theory of Change and Response in Modern Demographic History. In: Population Index, Vol. XXIX : No. 4. (October, 1963). Princeton, Office of Population Reserach.
- Demeny, P. - The Demography of the Sudan : An Analysis of the 1955/56 Census". In : Brass, W. et. al. - Demography of Tropical Africa. Princeton : University Press, 1968.
- Deng, M.F. - The Dinka of Sudan, Khartoum : Khartoum University Press, 1971.
- Dorjahn, V.R. : "Polygamy in African Demography", in Continuity and Change. Bascon, F.W. and Kerckhove, M.H., eds. Chicago : University of Chicago Press, 1959.
- Dow, E.T. - Breast-feeding and Abstinence Among the Yoruba. In : Studies in Family Planning. Vol. 8 : 8 (1977), pp. 208-214.
- El Hasan, M.A. ed. - Introduction to Sudan Economy. Khartoum : University Press, 1976.
- Evans-Pritchard, E.E. - Some Aspects of Marriage and the Family Among the Nur, (The Rhodes-Livingstone Papers, No. 11).
- Freedman, R. - The Sociology of Human Fertility, 1961/62. In: Current Sociology, Vol. X/XI, No. 2 (1961/62).
- Statement by the Moderator. In : Proceedings of the World Population Conference, 1965, Vol. I. Summary Report. U.N. Publications, Sales No. 66, X III.5 (1965).
- Gaisie, S. and Aryee, F. - Fertility Implications of Contemporary Patterns of Nuptiality in Ghana. In : IUSSP Seminar on Nuptiality and Fertility 31(3) (1979), pp. 585-597. Liege:IUSSP.
- Galal-El-Din, El. M. - Population and Labour Force in the Sudan." In: Elhasan, M.A. ed. "Introduction to Sudan Economy. Khartoum University Press, 1976.
- "The Economic Value of Children in Rural Sudan", In : Caldwell, C.J. , editor, The Persistence of High Fertility. Family and Fertility Change Series. Australian National University, Canberra, 1977.

- Gruenbaum, E. - Patterns of Family Living : A Case Study of Two Villages on the Rahad River. (Monograph Series No. 12). Khartoum : DSRC, 1979.
- Henin, R.A. - The Applicability of the Theory of Demographic Transition in African Countries. In : Proceedings of an Experp Group Meeting, Paris, November, 1970.
- \_\_\_\_\_ et. al. - The Demography of Tanzania : An Analysis of the 1973 National Demographic Survey of Tanzania, Vol. 6, Dar-es-Salaam : BRALUP, 1976.
- \_\_\_\_\_ Fertility Differentials in the Sudan : With Reference to Nomadic and Settled Populations. In : Population Studies, Vol. 22 (1968), pp. 147-164.
- \_\_\_\_\_ The Patterns and Causes of Fertility Differentials in Sudan with Reference to Nomadic and Settled Populations. In : Population Studies, Vol. 23, 1969.
- \_\_\_\_\_ and Egero, B. - The Population of Tanzania : An Analysis of the 1967 Population Census. Dar-es-Salaam : BRALUP, 1973.
- Khalifa, A.M. - Fertility Differentials in Urban Khartoum. (Bulletin No. 31). Khartoum : National Council for Research, 1.
- Lesthaeghe, R., Page, H.J. and Adegbola, O. eds. - Child Spacing and Fertility in Lagos. In : Child-Spacing in Tropical Africa; Tradition and Change. London : Academic Press, 1981.
- Morgan, W.R. - Fertility Levels and Fertility Change. In : Caldwell, J. ed. Population Growth and Socio-Economic Change in Western Africa. London : Columbia University Press, 1976, pp. 187-235.
- \_\_\_\_\_ 'Modernization and Fertility in Nigeria', Monograph 4, Washington D.C., Interdisciplinary Communications Program, Smithsonian Institute, 1976.
- Mosley, H.W., et. al. - The Dynamics of Birth Spacing and Marital Fertility in Kenya. Population Studies and Research Institute, University of Nairobi, 1981.
- Mott, F.L. - The Dynamics of Demographic Change in a Nigerian Village. Monograph 2, Human Resources Research Unit, Lagos University.
- Nuer, J.V. - Population Growth and Educational Development in the Sudan. (An Unpublished M.A. thesis, Presented at the University of Ghana). 1978.
- Numeri, S. - Industry in the Sudan. In : S/hasan, M.A., ed., Introduction to Sudan Economy, K.U.P., 1976.

- Okediji, F. - Some Social and Physiological Aspects of Fertility. In : Nigerian Journal of Economic and Social Studies, 9 (1). 1967. p. 67-80.
- Olusanya, P. - The Educational Factor in Human Fertility : A Case Study of the Residents of Suburban Area in Ibadan, Western Nigeria. In : Nigerian Journal of Economic and Social Studies. 9 (3), 1967., pp. 351-374
- \_\_\_\_\_ Modernization and the Level of Fertility in Western Nigeria. In : International Population Conference. Liege : IUSSP, 1971.
- Podyachikh, P.G. - Impact of Demographic Policy on the Growth of Population. In : World Views of Population Growth. Szabady, E. ed. Budapest, 1968.
- Pool, D.I. - Urbanization and Fertility in Africa. In : African Urban Notes 6 (1), 1971, pp. 25-32.
- Romaniuk, A. - The Demography of the Democratic Republic of the Congo. In : Brass, W., et. al. - The Demography of Tropical Africa. Princeton : University Press, 1968.
- Ruzicka, L. ed. - The Economic and Social Support of High Fertility. In : Proceedings of the Conference Held in Canberra, November 1970. Australian National University.
- Seligman, C.G. and Seligman, Z.B. - Pagan Tribes of the Nilotic Sudan. London : Routledge and Kegan Paul, 1965.
- Sembajwe, I. - Fertility and Child Mortality Levels and Differentials Among the Yoruba of Western Nigeria. Ph.D. Dissertation, Demographic Department. Canberra : Australian National University, 1977.
- Shryock and Siegel - The Methods and Materials of Demography. Academic Press, 1976.
- Sudan, Ministry of National Planning - The 1955/56 Final Report. Vol. 1. Khartoum : Department of Statistics, 1956.
- \_\_\_\_\_ The 1973 Census Volumes : Sudan and its Provinces. Khartoum. Department of Statistics, 1973.
- Swarts, M. - Some Cultural Influences on Family Size in the Three Eastern African Societies. In : Anthropological Quarterly 42 (2), 1969, pp. 73-88.
- United Nations - Population Bulletin of U.N. No. 7, ST/SOA/Ser. N/7, New York, 1963.
- \_\_\_\_\_ Manual IV, Methods of Estimating Basic Demographic Measures from Incomplete Data. ST/SOA/Ser. A/42, New York, 1967.
- \_\_\_\_\_ The Determinants and Consequences of Population Trends. U.N., Sales No. 53, XIII.3. New York, 1973.



Van de Walle, E. - Appendix B, Note on the Effect of Age Mis-Reporting.  
In : Brass, W., et. al., The Demography of Tropical Africa. Princeton  
University Press, 1968.

\_\_\_\_\_ et. al. - Marriage in African Censuses and Inquiries. In :  
Brass, W. et. al. "The Demography of Tropical Africa. Princeton :  
University Press, 1968.

Ware, H. - The Motivations for Use of Birth Control : Evidence from  
Western Africa. In : Demography 13 (1976). p. 479-493.

Zacariah, C.K. and Soliman, H.S. - The Use of Population and Housing  
Survey Data of the Sudan for Estimating its Current Demographic  
Measures. in : Demographic Measures and Population Growth in Arab  
Countries. Research Monograph Series No. 1. Cairo : Demographic  
Unit, 1970, pp. 171-193.

OTHER RELEVANT LITERATURE ABOUT SUDAN FOR CHAPTERS I AND III.

- Abd-al-Rahim, M. (1969): Imperialism and Nationalism in the Sudan. Oxford at the Clarendon Press, 1969.
- Abdel-Ghaffar, M.A. (1977): "The Extended Family and Development in the Sudan", In ESRC Bulletin No. 53, 13.2.77. Economic and social Research Council, Khartoum, Sudan.
- \_\_\_\_\_ (1979): Urbanization and Exploitation: The Role of Small Centres. Monograph Series No. 11, DSRC, Khartoum, Sudan.
- ASAD, Talal (1970): The Kababish Arabs: Power, Authority and Consent in a Nomadic Tribe. C. Hurst and Company, London, 1970.
- Barbour, M.K. (1961): The Republic of the Sudan: A Regional Geography, University of London Press Ltd., 1961.
- Bashir, O.M. (1974): Revolution and Nationalism in the Sudan. Rex Collings, London, 1974.
- Baxter, P.T.W. (1953): The Azande, and Related Peoples, International African Studies Institute, 1953.
- Cunnison, I. (1966): "Baggara Arabs" Power and Lineage in a Sudanese Nomad Tribe. Clarendon Press of Oxford, 1966.
- Daffalla, H. (1975): The Nubian Exodus. C. Hurst and Company, London, 1975.
- Deng, M.F. (1978): Africans of Two Worlds: The Dinka in Afro-Arab Sudan, New Haven and Condon, Yale University Press, (1978).
- Evans-Pritchard. E.E. (1971): The Azande: History and Political Institutions, Oxford at the Clarendon Press, 1971.
- Galal-el-Din, El. M., Population Problems and Development in the Sudan and the Third World. 1/ Development Book Series, DSRC, Khartoum, Sudan.
- \_\_\_\_\_ (1977): "The Rationality of High Fertility in the Sudan" in Caldwell, J. Editor, Changing African Family Monograph 2, Canberra: Australian National University.
- Holt, M.P. (1963): A Modern History of the Sudan, Second Edition, Weidenfeld and Nicolson, London, 1963.
- \_\_\_\_\_ (1977): The Mahadist State in the Sudan: 1881-1898. Second Edition, Oxford University Press, 1977.

- MacMichael, A.H. (1967): The Tribes of Northern and Central Kordofan. Franck Cass and Co. Ltd., London, 1967.
- Nadel, F.S. (1947): The Nuba, Oxford University press, London, New York, Toronto, 1947.
- O'Fahey, S.D. (1980): State and Society in Darfur, London, C. Hurst and Company Ltd., (1980).
- Paul, A. (1971): A History of the Beja Tribes of the Sudan. Frank Cass and Co. Ltd., New Impression, London, 1971.
- Said, M.B. (1965): The Sudan: Crossroads to Africa. The Bodley Head, London, 1965.

APPENDIX I

An application of the calculation of  $\bar{m}$  from the reported proportions married and from the standard age pattern of marital fertility rates, Sudan urban female population, 1973 (For Table 3.4.1., p. 82).

Age Interval (1)	Proportion of Married Females (2)	Standard M Fertility Rates (3)	Hypothetical Fertility Rates Col.2 X Col.3 (4)	Median Age (5)	Col. 4 X Col. 5 (6)
15-19	0.3281	0.9703 <sup>a</sup>	0.3184	17.5	5.572
20-24	0.7224	1.000	0.7224	22.5	16.525
25-29	0.8474	0.935	0.7923	27.5	21.788
30-34	0.8487	0.853	0.7239	32.5	23.527
35-39	0.8268	0.685	0.5664	37.5	21.240
40-44	0.7419	0.349	0.2589	42.5	11.003
45-49	0.6574	0.051	0.0335 3.4158	47.5	1.591 101.246

$$\text{Hence, } \bar{m} = \frac{101.246}{3.4158} = 29.6 \text{ years}$$

$$^a 1.2 - .7(0.3281) = 0.9703$$

APPENDIX II

(1) Rank correlation between early parity (20-24) and completed family size (CFS), Sudan regions, 1973 "For Table 4.2.1, p. 90".

Region	Rank of Parity (20-24)	Rank of CFS	di	di <sup>2</sup>
Central	1	1	0	0
Eastern	2	3	-1	1
Western	3.5	5	-1.5	2.25
Southern	3.5	6	-2.5	6.25
Khartoum	5	4	1	1
Northern	6	2	4	16
			$\Sigma di=0$	$\Sigma di^2=26.5$

$$r = \frac{1-6\Sigma di^2}{N(N^2-1)} = \frac{1-6(26.5)}{6(35)} = 1 - \frac{159}{210} = 1 - 0.7571 = + 0.24$$

(2) Rank correlation between reported total fertility rate and women not stating their parity, sudan regions, 1973 "For Table 4.2.2., p. 93"

Region	Rank of TFR	% of Rank of women not stating their parity	di	di <sup>2</sup>
Central	1	6	=5	25
Northern	2	5	-3	9
Eastern	3	3	0	0
Khartoum	4	4	0	0
Western	5	2	3	9
Southern	6	1	5	25
			$\Sigma di=0$	$\Sigma di^2=68$

$$r = \frac{1 - 6\Sigma di^2}{N(N^2 - 1)} = 1 - \frac{6(68)}{210} = 1 - \frac{408}{210} = -0.94$$

$$r^2 = 0.883$$

APPENDIX III

For Table 5.3.1, Chapter V, P. 138.

- (1) Correlation: Fertility and primary education (urban females, Sudan, 1973).

Y = TFR

X = Index for primary education (%)

Region	Y	X	y=Y- $\bar{Y}$	x= X- $\bar{X}$	$\bar{y}^2$	$\bar{x}^2$	xy
Central	7.6	38.4	1.0	5.0	1.0	25.0	5.0
Northern	7.1	42.4	0.5	9.0	0.25	81.0	4.5
Eastern	6.6	32.6	0	-0.8	0	0.64	0
Western	6.6	0	0	-5.7	0	32.49	0
Khartoum	6.4	40.0	-0.2	6.6	0.04	43.56	-1.32
Southern	5.1	19.2	-1.5	-14.2	2.25	201.64	21.3
$\bar{Y} = 6.6$ $\bar{X} = 33.4$					3.54	384.33	29.48

$$r = \frac{29.48}{\sqrt{(3.54)(384.33)}} = + 0.80$$

- (2) Fertility and Higher secondary education (urban females, Sudan, 1973)

Y = TFR

X = Index for higher secondary education (%)

Region	Y	X	y=Y- $\bar{Y}$	x= X- $\bar{X}$	$\bar{y}^2$	$\bar{x}^2$	xy
Central	7.6	3.6	1.0	-0.6	1	0.36	-0.6
Northern	7.1	5.8	0.5	1.6	0.25	2.56	+0.9
Eastern	6.6	2.4	0	-1.8	0	3.24	0
Western	6.6	2.3	0	-1.9	0	3.61	0
Khartoum	6.4	10.0	-0.21	5.8	.04	33.64	-1.16
Southern	5.1	0.80	-1.5	-3.4	2.25	11.56	+5.1
$\bar{Y} = 6.6$ $\bar{X} = 4.2$					3.54	54.97	3.34

$$r = \frac{3.34}{\sqrt{(3.54)(54.97)}} = + 0.24$$

(3) Correlation: Fertility and Literacy (urban females, Sudan, 1973)

Y = TFR

X = Index for literacy (% literate)

Region	Y	X	y=Y- $\bar{Y}$	x=X- $\bar{X}$	y <sup>2</sup>	x <sup>2</sup>	yx
Central	7.6	42.0	1.0	4.5	1.0	20.25	4.5
Northern	7.1	48.0	0.5	10.5	0.25	110.25	51.25
Eastern	6.6	35.0	0	-2.5	0	6.25	0
Western	6.6	30.0	0	-7.5	0	56.25	0
Khartoum	6.4	50.0	-0.2	12.5	+0.04	156.25	-2.5
Southern	5.1	20.0	-1.5	-17.5	+2.25	306.25	26.25
$\bar{Y} = 6.6$ $\bar{X} = 37.5$					3.54	655.5	33.375

$$r = \frac{33.375}{\sqrt{(3.54)(655.5)}} = + 0.69$$

(4) Correlation: Fertility and economic activity (urban females, Sudan, 1973).

Region	Y	X	y=Y- $\bar{Y}$	x=X- $\bar{X}$	y <sup>2</sup>	x <sup>2</sup>	xy
Central	7.6	6.3	1.0	-3.8	1.0	14.44	-3.8
Northern	7.1	5.1	0.5	-5.0	0.25	25.0	-2.5
Eastern	6.6	10.2	0	+0.1	0	.01	0
Western	6.6	17.4	0	+7.3	0	53.29	0
Khartoum	6.4	9.9	-0.2	-0.2	0.04	.04	+ .04
Southern	5.1	11.9	-1.5	+1.8	2.25	3.24	-2.7
$\bar{Y} = 6.6$ $\bar{X} = 10.1$					3.54	96.02	-8.96

$$r = \frac{- 8.96}{\sqrt{(3.54)(96.02)}} = - 0.49$$

(5) Correlation: Fertility and primary education (Rural females, Sudan, 1973).

Y = Total Fertility Rate  
X = Index for primary education (%)

Region	Y	X	y=Y- $\bar{Y}$	x=X- $\bar{X}$	y <sup>2</sup>	x <sup>2</sup>	xy
Northern	8.1	25.9	0.7	8.3	0.49	68.98	5.81
Khartoum	8.1	27.6	0.7	10.0	0.49	100.00	7.0
Central	8.0	19.3	0.6	1.7	0.36	2.89	1.02
Eastern	7.5	20.8	0.1	3.2	0.01	10.24	0.32
Western	6.3	5.8	-1.1	-11.8	1.21	139.24	12.98
Southern	6.3	5.9	-1.1	-11.7	1.21	136.89	12.87
$\bar{Y} = 7.4$ $\bar{X} = 17.6$					3.77	458.24	40.0

$$r = \frac{40}{\sqrt{(3.77)(458.24)}} = +0.96$$

(6) Correlation: Fertility and Higher Secondary (rural females, Sudan, 1973)

Y = Total Fertility Rate  
X = Index for Higher secondary school (%)

Region	Y	X	y=Y- $\bar{Y}$	x=X- $\bar{X}$	y <sup>2</sup>	x <sup>2</sup>	xy
Northern	8.1	1.1	0.7	0.5	0.49	0.25	+0.35
Khartoum	8.1	1.4	0.7	0.8	0.49	0.64	+0.56
Central	8.0	0.7	0.6	0.1	0.36	0.01	+0.06
Eastern	7.5	0.2	0.1	-0.4	0.01	0.16	-0.04
Western	6.3	0.2	-1.1	-0.4	1.21	0.16	+0.44
Southern	6.3	0.1	-1.1	-0.5	1.21	0.25	+0.55
$\bar{Y} = 7.4$ $\bar{X} = 0.6$					3.77	1.47	1.92

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}} = \frac{1.92}{\sqrt{(3.77)(1.47)}} = +0.82$$



(7) Correlation: Literacy and fertility (rural females, Sudan, 1973)

X = Index of literacy  
Y = Total fertility rate

Region	Y	X	y=Y- $\bar{Y}$	x=X- $\bar{X}$	y <sup>2</sup>	x <sup>2</sup>	xy
Northern	8.1	27.0	0.7	8.8	0.49	77.44	6.16
Khartoum	8.1	29.0	0.7	10.8	0.49	116.64	7.56
Central	8.0	20.0	0.6	1.8	0.36	3.24	1.08
Eastern	7.5	21.0	0.1	2.8	0.01	7.84	0.28
Western	6.3	6.0	-1.1	-12.2	1.21	148.84	13.42
Southern	6.3	6.0	-1.1	-12.2	1.21	148.84	13.42
$\bar{X} = 18.2$ $\bar{Y} = 7.4$					3.77	502.84	41.92

$$r = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}} = \frac{41.92}{\sqrt{(3.77)(502.84)}} = + 0.96$$

(8) Correlation: Fertility and economic activity (rural females, Sudan, 1973).

Y = Total fertility rate  
X = Index for economic activity

Region	Y	X	y=Y- $\bar{Y}$	x = X- $\bar{X}$	y <sup>2</sup>	x <sup>2</sup>	xy
Northern	8.1	2.7	0.7	-12.4	0.49	153.76	-8.68
Khartoum	8.1	2.6	0.7	-12.5	0.49	156.25	-8.75
Central	8.0	10.1	0.6	- 5.0	0.36	25.0	-0.3
Eastern	7.5	7.9	0.1	- 7.2	0.01	51.84	-0.72
Western	6.3	49.8	-1.1	+34.7	1.21	1204.09	-38.17
Southern	6.3	17.3	-1.1	+2.2	1.21	4.84	- 2.42
$\bar{Y} = 7.4$ $\bar{X} = 15.1$					3.77	1595.78	-59.04

$$r = \frac{-59.04}{\sqrt{(3.77)(1595.78)}} = - 0.77$$

- (9) Correlation between the economic activity and literacy (urban Sudan): Female population.

X = Index for economic activity  
Y = Index for literacy

Region	X	Y	$x=X-\bar{X}$	$y=Y-\bar{Y}$	$x^2$	$y^2$	xy
Central	6.3	42.0	-3.8	+4.5	14.44	20.25	-17.1
Northern	5.1	48.0	-5.0	+10.5	25.0	110.25	-52.5
Eastern	10.2	35.0	+0.1	-2.5	0.01	6.25	-0.25
Western	17.4	30.0	+7.3	-7.5	53.29	56.25	-54.75
Khartoum	9.9	50.0	-0.2	+12.5	0.04	156.25	-2.5
Southern	11.9	20.0	+1.8	-17.5	3.24	306.25	31.5
$\bar{X} = 10.1$ $\bar{Y} = 37.5$					96.02	655.5	-158.6

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}} = \frac{-158.6}{\sqrt{96.02 \times 655.5}} = -0.63$$

- (10) Correlation between the economic activity and literacy (rural Sudan: female population)

Y = Index for economic activity  
X = Index for literacy

Region	X	Y	$x=X-\bar{X}$	$y=Y-\bar{Y}$	$x^2$	$y^2$	xy
Northern	27.0	2.7	8.8	-12.4	77.44	153.76	-109.12
Khartoum	29.0	2.6	10.8	-12.5	116.64	156.25	-135.0
Central	20.0	10.1	1.8	-5.0	3.24	25.0	-9.0
Eastern	21.0	7.9	2.8	-7.2	7.84	51.84	-20.16
Western	6.0	49.8	-12.2	34.7	148.84	1204.09	423.34
Southern	6.0	17.3	-12.2	2.2	148.84	4.84	-26.84
$\bar{X} = 18.2$ $\bar{Y} = 15.1$					502.84	1595.78	-723.46

$$r = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}} = \frac{-723.46}{\sqrt{(502.84)(1595.78)}} = -0.81$$