Republic of Sierra Leone

2004 Population and Housing Census

Life Tables for Sierra Leone

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EXECUTIVE SUMMARY

This monograph comprises of three Life Tables for Sierra Leone. Section One describes the Mortality Life Tables which would give a summary of the mortality situation in the country. Section Two describes the Labour Force Life Tables which would give a summary of the net flows (i.e. taking mortality into account) within the Labour Force, and section three describes the School Attendance Life Tables which give a summary of the school accession and attrition rates.

With regard to the Mortality Life Tables, new age patterns of mortality have been constructed for Sierra Leone, which fit the hypothesis that over the years 1985 to 2006, the only change in mortality has been the mortality level parameter α (alpha) level estimates.

The examination of mortality patterns for Sierra Leone has shown a downward trend in infant, child and adult mortality over the years 1990 to 2006. The critical analysis of life tables constructed for Sierra Leone from the 2004 Census reveals some uncertainties about mortality patterns by age. Much remains to be done before we can obtain a reliable description of the age patterns of adult morality for Sierra Leone. In the interim, we must take full advantage of the current methods of analysis. Frequently at present, it seems that in Sierra Leone where good vital registration systems are lacking, an alternative source of more reliable estimates of childhood and adult mortality are reports at a census (or survey) of surviving relatives (of children ever born, mothers and fathers). Since reporting of both age and time at death of individuals (using direct methods) is still a very difficult problem, indirect estimates of mortality may be more reliable.

There will never be a single mathematical model of mortality, (i.e. a single representation of the age pattern of mortality, which will be sufficient for all populations and for all purposes. This analysis had explored the use of data on child survival and maternal orphanhood to derive complete life tables for Sierra Leone.

The indirect estimates for Sierra Leone seem fairly satisfactory. It is not possible to say, that one should always use the system which produces the model with the closest fit. The model that produces the closest fit is likely to be the more flexible, namely one with more degrees of freedom. Experience with African data seems to suggest that very flexible models must be used with caution, as they may not always give sensible results. In these circumstances, the advice is to use a system which is flexible enough to let real abnormal features appear, but which is sufficiently robust to errors in the data.

Conclusions vary and obviously have to be treated with particular caution. The fact that a model happens to yield fairly good results when applied to data of one developing country does not imply that it is generally useful.

It is encouraging, of course, that the two and three parameter logit system has produced favourable results with the 2004 Census data of Sierra Leone. Perhaps the principle of 'Serendipity' has worked in that case, that is, that many errors have compensated each other, and for this reason, the results are better than might be expected.

With regard to the Labour Force, the analysis of the census data shows that persons in the labour force who survive to ages 15 to 19 would expect to have about 20 years of working life remaining. Taking into consideration that these years could be disrupted by periods of unemployment arising from factors such as occupational injuries, redundancies, sickness etc. one would conclude that working life in Sierra Leone is short. When analyzed by sex, the results show that the average remaining years for males who survive to the next age is longer than that of females. Persons in the Western Area who enter the labour force at age 15 are expected to work longer (34.3 years) than persons in the same cohort in the Eastern (19.3 years), Southern (19.2 per cent), and Northern (16.7 years) provinces.

The average exit age for the Sierra Leone population according to the 2004 Housing and Population Census data was 55.5 years. The results show that males exit the labour force about 3 years later than females. Regional analysis of this indicator shows similar trends with males leaving the labour force later than females in all regions. The retirement age from the labour force is higher than the national average for all regions except in the Western Area where the exit age is lower than the national average.

Following the above analysis, it is apparent that there is a need for setting clear employment targets and policies aimed at increasing the average exit age at which people stop working and increase the employment rate of older workers especially women. The current effective average exit age of 55 years need to be raised by 10 years within a reasonable time period in order to meet the official target retirement age of 65 years. Learning from the experiences of developed economies that have effective social protection systems in place, considerable attention should be given to developing policies that boost labour force participation rates and delay the exit from the labour force for older workers. The policy focus should be to increase the social security contribution of the large number of persons in self employment in the informal sector.

Research on developing working life tables for Sierra Leone should be given high priority because of its usefulness to the social security system. One of such uses relates to the settlement of social security claims and benefit payments arising from occupational injury to social security contributors. By means of the working life table, lost earnings arising from the injury could be estimated which could serve as the basis for paying compensation to injured contributors.

With regard the School attendance Life Tables, Sierra Leone's School Life Tables have been constructed from the Population and Housing Census of 2004. A total of 15 tables were produced for three categories of the population (5 tables for males and females, 5 for males only and 5 for females exclusively) which are contained in appendices C, D and E. Prior to their construction, reference is made to *Regional Model Life Tables* for projections of Lx values for single ages from 6 – 29 years inclusive.

The tables constructed have been analyzed and the main findings are presented below:

FINDINGS

- At about the age of 11 years, Sierra Leone has the highest proportion of enrolment in 2004.

- The average number of years of school-life decrease steadily as the ages of scholars and their educational levels increase.

- The Eastern province has the least average number of school life

- School Life at the beginning of the primary level for boys and girls is below 16 years in the Eastern and Southern provinces.

- School Life at the beginning of the primary level for male population is below 16 years in the Eastern and Southern provinces.

- School Life at the beginning of the primary level for female population is below 16 years in the Eastern and Southern provinces.

- The Western Area has the highest average number of school life among the various regions in Sierra Leone

- Average school life for girls is higher than that for boys at all the educational levels (primary, secondary and tertiary).

- Even within regions, school life for girls is higher than that for boys

SECTION ONE

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1.0 MORTALITY LIFE TABLES

1.1 Abstract:

Mortality data from less developed countries are usually unreliable and inaccurate. As a result, the construction of a set of empirical life tables is not a straight forward procedure. It requires not only the gathering of data from a population distributed by age and sex collected from censuses, surveys and poor vital registration systems, but also careful analysis and evaluation of the collected information. In such circumstances where there are doubts about the quality of deaths reported on the population, the most reliable estimates of mortality are obtained by indirect methods, i.e. retrospective estimates of childhood and adult mortality made from reports at a survey or census of surviving relatives (of children ever born mothers and fathers). These indirect approaches depend heavily on Model Life Tables. The two principal methods of estimation (child survivorship and orphanhood) are investigated to discover how sensitive they are to assumptions about the age patterns of mortality.

In this Monograph, we recommend a procedure for examining a characteristic of the age pattern, apply the method to the Population and Housing Census data (2004) of Sierra Leone, and attempt to evaluate the extent to which the results are reasonable. Because the types of data obtained in less developed countries are usually unreliable and inaccurate for studying age patterns of mortality, the resulting estimates provide only a broad sketch of the patterns.

1.2 Introduction:

1.2.1 The Problem (The Choice Of The Model)

The construction of conventional life tables for less developed countries is not always a straight forward procedure. Most often, there are limitations in the mortality and fertility data. In such circumstances where there are doubts about the quality of reports on a population, it has been customary for analysts to use indirect methods. One common method has been to use the most reliable information (eg. q(5) = child mortality rate/level, at age 5) collected from the actual population and use it to locate a Model Life Table/Stable population with approximately the same value of q(5). The characteristics of this stable population are then taken as estimates of the corresponding parameters of the actual population. A major problem with this simple approach is that these Model

Life Tables have only one quantitative parameter ($\propto$ - alpha, which governs the level of mortality) and, therefore, cannot adequately describe the variety of shapes of observed survivorship curves. Another problem with the located Model Life Tables/Stable populations is their dependence upon the data base, that generated them, which may have causes of death, disease patterns and age patterns of mortality probably substantially different from those in the developing countries whose population is under investigation. It is probable, that any two populations with identical infant or child mortality levels may well have very different age patterns of mortality. Perhaps in one adult mortality is high relative to childhood mortality while in the other it is relatively low. Infact demographic research has repeatedly established that the relative levels of childhood and adult mortality vary markedly between populations (eg. Ledermann and Breas 1959). Such differences can extend to neighbouring populations and even to different ethnic groups living in the same area (Blacker et al 1985). For these reasons, it may be dangerous to use empirical model life tables for deriving estimates of the level of adult mortality by extrapolating from information on infant or child mortality.

There is the need for relational models which provide greater flexibility and degrees of freedom (by incorporating extra parameters, say, β - beta and δ - delta) in the indirect estimation of mortality based on more representative patterns. The parameter β governs the relationship between childhood and adult mortality, whilst the parameter δ allows the standard to be twisted so that deviations in infancy and old age are in the opposite directions.

The usefulness of relational Model Life Tables for indirect estimation of child and adult mortality, however, depends on whether the model standard can be chosen judiciously. If the model standard is chosen correctly, the derived estimates of childhood and adult mortality are less likely to be in error. If on the other hand, the true mortality experience in no way resembles that implied by the choice of the model standard, the estimates will be in error. Extensive illustrations of this idea has been done with child survival data from less developed countries, using Brass (General and African) standards on the one hand, and other model standards on the other hand. For example (in Kamara 1988, 1989), the 1972 census data of Kenya has been used to investigate the effects of variations from the standard pattern (β = 1.0) on indirect estimates of child and adult mortality. The illustrations show that if the wrong model standard is chosen, the derived estimates are very much in error. The estimates of trends in the infant mortality rate with standard notation q(1) obtained from the child survival data, are more sensitive to the assumed age pattern of mortality than the corresponding estimates of child mortality q(2), q(3) and q(5) at ages 2, 3 and 5 respectively. The examination of mortality trends for developing countries (Brass 1985, Kamara 1988, 1989) also show that in order to satisfy the assumption of a fixed age pattern of mortality over time, the patterns of childhood and adult mortality would have to differ markedly from the standard values found in most model life table systems. It is preferable to use sets of Model Life Tables which allow for variations in mortality pattern, making maximum use of whatever information is available about the age pattern of mortality for the study population.

2.0 METHODOLOGY

2.1 The New Model: Kamara's Three Parameter Logit System

We present an adaptive three parameter logit system (a reduced form of the Zaba four parameter logit system) which uses Brass's General (or African) standard and which can be collapsed into Brass's two parameter logit system when the data are not sufficiently adequate to support the use of three parameter.

The aim is to examine the effects of varying the standard pattern of mortality on indirect estimates by use of β and the extra two parameters γ and δ in the Zaba system (see for example Zaba 1979) as opposed to the one parameter system obtained by varying the level of mortality, α, only.

Preliminary investigations have been made by Brass and Kamara about the effects of adjusting Brass's General Standard $l_s(x)$, through the extra three parameters of Zaba's logit system.

Table 1: The Kamara's Standards $l_N(\beta, x)$ and $l_N(\gamma, x)$ obtained by modifying the General Standard, $l_s(x)$, with parameters β and γ respectively.

General Standard β = 1.0		**New Standards**			
		$l_N(\beta, x)$	$l_N(\gamma, x)$	$l_N(\beta, x)$	$l_N(\gamma, x)$
Age (x)	$l_s(x)$	β = 0.8	$\gamma = -0.6$	β = 0.9	$\gamma = -0.3$
1	0.8499	0.8001	0.7937	0.8264	0.8218
2	0.8070	0.7585	0.7541	0.7837	0.7806
3	0.7876	0.7405	0.7378	0.7649	0.7627
5	0.7691	0.7236	0.7228	0.7470	0.7460
10	0.7502	0.7068	0.7080	0.7290	0.7291
15	0.7363	0.6945	0.6972	0.7158	0.7167
20	0.7130	0.6744	0.6796	0.6940	0.6963
25	0.6826	0.6485	0.6566	0.6658	0.6696
30	0.6525	0.6234	0.6335	0.6381	0.6430
35	0.6223	0.5986	0.6096	0.6105	0.6159
40	0.5898	0.5721	0.5727	0.5810	0.5563
45	0.5535	0.5429	0.5506	0.5482	0.5521
50	0.5106	0.5085	0.5105	0.5095	0.5106
55	0.4585	0.4668	0.4570	0.4626	0.4578
60	0.3965	0.4168	0.3873	0.4066	0.3919
65	0.3210	0.3545	0.2959	0.3375	0.3084
70	0.2380	0.2827	0.1932	0.2597	0.2156
75	0.1516	0.2014	0.0954	0.1751	0.1235
80	0.0768	0.1203	0.0311	0.0964	0.0539

Source: Kamara 1989: (Unpublished Ph.D. Thesis)

The results of Table 1 above show that the effects of adjusting Brass's General Standards $l_s(x)$, through β<1.0 [for example, $\beta Y_s(x) = 0.8$ $Y_s(x)$] and negative values of Zaba's third parameter, γ [to give $l_N(\gamma, x)$ = $l_s(x)$ + $\gamma K(x)$], have rather similar effects at ages under 50 (the survivorship values of the new standards are quite close and are less than those of Brass's General Standard); and at ages over 50 their effects are in opposite directions but negligible in magnitude between ages 50 and 60.

Table 2 shows that the same effects (observed in Table 1) are true for positive values of γ and values of β>1.0 (the survivorship values of the new standards are again quite close but are greater than those of Brass's General Standard).

Table 2: The Kamara's New Standards $l_N(\beta, x)$ and $l_N(\gamma, x)$ obtained by modifying the General Standard, $l_s(x)$, with parameters β and γ respectively.

General Standard		New Standards			
		$l_N(\beta, x)$	$l_N(\gamma, x)$	$l_N(\beta, x)$	$l_N(\gamma, x)$
Age (x)	$l_s(x)$	β = 1.1	γ = − 0.3	β = 1.2	γ = − 0.6
1	0.8499	0.8707	0.8780	0.8890	0.9061
2	0.8070	0.8283	0.8334	0.8477	0.8599
3	0.7876	0.8087	0.8125	0.8282	0.8374
5	0.7691	0.7898	0.7922	0.8091	0.8154
10	0.7502	0.7702	0.7713	0.7891	0.7924
15	0.7363	0.7556	0.7557	0.7741	0.7752
20	0.7130	0.7313	0.7297	0.7488	0.7464
25	0.6826	0.6990	0.6956	0.7148	0.7086
30	0.6525	0.6666	0.6620	0.6805	0.6715
35	0.6223	0.6340	0.6287	0.6455	0.6350
40	0.5898	0.5986	0.6233	0.6072	0.6569
45	0.5535	0.5588	0.5549	0.5641	0.5564
50	0.5106	0.5117	0.5106	0.5127	0.5107
55	0.4585	0.4544	0.4593	0.4503	0.4600
60	0.3965	0.3865	0.4011	0.3766	0.4057
65	0.3210	0.3049	0.3336	0.2893	0.3461
70	0.2380	0.2175	0.2604	0.1984	0.2828
75	0.1516	0.1308	0.1797	0.1124	0.2078
80	0.0768	0.0609	0.0997	0.0482	0.1225

Source: Kamara 1989: (Unpublished Ph.D. Thesis)

It is only at late ages that the two parameters modify the standard in distinctly different ways (cf. Tables 1 and 2). Since we normally have little information on mortality at late ages, and whatever data there are remain suspect, it appears that there would be little gain by incorporating γ into a model for indirect estimation at ages under 60.

The results of Table 3 show that the adjustment of the General Standard through $t(x)$ to give a new standard $l_N(\delta, x) = l_s(x) + \delta t(x)$, however, has a quite different effect from variation of β.

Table 3: The Kamara's New Standards, $l_N(\delta, x)$ and $l_N(\gamma, x)$ obtained by modifying the General Standard, $l_s(x)$, with parameters δ.

General Standard		**New Standards**			
		$l_N(\delta, x)$	$l_N(\delta, x)$	$l_N(\delta, x)$	$l_N(\delta, x)$
Age (x)	$l_s(x)$	$\delta = -0.4$	$\delta = -0.1$	$\delta = 0.1$	$\delta = 0.4$
1	0.8499	0.8881	0.8594	0.8404	0.8117
2	0.8070	0.8350	0.8140	0.8000	0.7790
3	0.7876	0.8104	0.7933	0.7819	0.7648
5	0.7691	0.7871	0.7736	0.7646	0.7511
10	0.7502	0.7634	0.7535	0.7469	0.7370
15	0.7363	0.7461	0.7388	0.7338	0.7265
20	0.7130	0.7181	0.7143	0.7117	0.7079
25	0.6826	0.6825	0.6826	0.6826	0.6827
30	0.6525	0.6491	0.6517	0.6553	0.6559
35	0.6223	0.6173	0.6210	0.6236	0.6273
40	0.5898	0.5845	0.5885	0.5911	0.5951
45	0.5535	0.5496	0.5525	0.5450	0.5574
50	0.5106	0.5098	0.5104	0.5108	0.5114
55	0.4585	0.4616	0.4593	0.4577	0.4554
60	0.3965	0.4019	0.3978	0.3952	0.3911
65	0.3210	0.3215	0.3211	0.3209	0.3205
70	0.2380	0.2219	0.2340	0.2420	0.2541
75	0.1516	0.1137	0.1421	0.1611	0.1895
80	0.0768	0.0348	0.0663	0.0873	0.1188

Source: Kamara 1989: (Unpublished Ph.D. Thesis)

Adjustments through β >1.0 and the negative coefficients of $t(x)$ [i.e. negative values of δ] have rather similar effects on $l_s(x)$ both at ages 25 and over 65; between ages 25 and 60 their effects are in opposite directions. The same is true for positive values of δ and the values of $\beta < 1.0$.

In certain cases, the effect of δ on the gradient of the $l(x)$ function is much sharper up to age 25 than that of β (and vice versa), after this age, its effect is more or less, the opposite of β (cf. Tables 1, 2, and 3). In principle then the addition of the $t(x)$ modification to the standard $l_s(x)$, can provide a model for the examination of pattern effects which are apparent up to middle age mortality. Although the fourth parameter, γ, acts at the extreme ages we can ignore its effects on old age mortality, in so far as indirect methods cannot measure this accurately.

We can show that models produced by varying γ can be effectively described by setting γ equal to zero and adjusting β and δ (Kamara 1988, 1989). Thus, the Zaba four parameter logit system can be reduced to a three parameter logit system (with parameters α, β and δ) as long as the life table functions are computed to age 60.

Extensive illustrations have been made of the effects of adjusting the General Standard by $Yk(x)$ as opposed to a combination of β and $\delta t(x)$ (Kamara 1989). For known values of β, δ and γ parameters, the logit (obtained by using γ alone) $Y(x,\gamma) = \log it\left(l_s(x) + \gamma k(x)\right)$ was compared with the logit (obtained by using β and δ combined); $\beta\, Y(x) = \log it(l_N(\delta, x)$, where $l_N(\delta, x) = l_s(x) + \delta t(x)$.

To show that β and the twist parameter δ given an optimum representation, it was illustrated that for a given value of γ, a combination of β and δ could be found such that the fits $\beta\, y(x,\delta)$ to $Y(x,\gamma)$ are close or fair (i.e most of the points lie on the straight line). Other illustrations showed that for a certain β and δ combination, a γ could not necessarily be found such that fits $Y(x,\gamma)$ to $\beta(x,\delta)$ are close or fair. In this case the fit is said to be poor as most of the points do not lie on the fitted line.

The parameter ranges considered are $(0.6 < \beta < 1.4)$ and $(-0.8 < \delta < 0.8)$.

Fair fits can be obtained when $(0.75 < \beta < 1.0)$ and $(-0.4 < \delta < 0.4)$. Outside of these range only poor fits are possible; when γ is the fitting parameter.

Relatively better fits are possible when low values of β are obtained with negative values of δ, than with combinations of low β and positive δ, or high β and negative δ.

2.2 Deriving an Expression for the Alpha Differences in the Adjusted Standard

This section gives an illustration of the use of the two and three parameter logit systems, to link estimates of life table measures based on child survival data and maternal orphanhood data to derive complete life tables for developing countries. We avoid estimating our model parameters by the direct fitting procedures outlined by Brass (1975) and Zaba (1979). Instead, we adopt a trial and error method to obtain values of β in the two parameter system, or combinations of β and δ in the three parameter system, which lead to the most consistent set of α estimates. In the first approach, it will be assumed that the age pattern of mortality in the population under study has been changing. We pick a value of the second parameter, β, of Brass's two parameter logit system which leads to the most consistent set of mortality level estimates α over time from both child and adult survival estimates.

In the alternative approach, it is assumed that the age pattern of mortality in the population under study has been fixed. In this case we pick a combination of the second and third parameters β and δ respectively (in Kamara's three parameter logit system) which leads to the most consistent set of α -estimates over time.

It is convenient to express the adjustment of the standard in terms of α rather than the survivorship $l_s(x)$, since the magnitude of the difference in alpha does not depend on age.

Assuming that $\delta t(x)$ is small compared with $l_s(x)$, logit $\left(l_N(x)\right) = Y_N(x),$ can be expressed as the first two terms of a Taylor's series expansion about $l_s(x)$ giving:

$$\log it\left(l_N(x)\right) = \tfrac{1}{2}\log\left\{\frac{\left(1.0 - l_s(x) - \delta t(t)\right)}{l_s(x) - \delta t(t)}\right\}$$

$$= \log it\left(l_s(x)\right) - \left[\frac{\delta t(x)}{2l_s(x)(1.0 - l_s(x)}\right] \quad \text{………(1)}$$

i.e

$$Y_N(x) = Y_s(x) - \left[\frac{\delta t(x)}{2l_s(x)(1.0 - l_s(x)}\right] \quad \text{……….(2)}$$

where $Y_s(x)$ is obtained with the original standard $l_s(x)$ and $Y_N(x)$ with the modified standard, $l_N(x) = l_s(x) + \delta t(x).$

Then for the child mortality estimates, expressing a model logit in terms of the new standard logits $Y(x) = \alpha + \beta Y_N(x)$ so that

$$Y_N(x) = \alpha + Y_s(x) + (\beta - 1)Y_s(x) - \left[\frac{\beta\delta t(t)}{2l_s(x)\left(1.0 - l_s(x)\right)}\right] \quad \text{……..(3)}$$

and $Y(x) = a + Y_s(x)$ ………(4)

where a is obtained with the original standard and α with the modified one.

The difference in the $\alpha -$ estimate is then

$$(\alpha - a) = -(\beta - 1)Y_s(x) - \left[\frac{\beta\delta t(t)}{2l_s(x)\left(1.0 - l_s(x)\right)} \right] \quad \text{.......(5)}$$

The charge in α caused by the modified standard can then be calculated. However, the estimates of adult mortality α's are made from rates of the form $l(b+n)/l(b)$ the probability of surviving from age b to $(b+n)$, and the effects of changing the standard are more complicated.* However, it is possible to obtain approximate algebraic expressions for small adjustments. Technical details are given elsewhere in the Mathematical Parts A and B.

The final expression obtained for adults is summarized in equation 6 below:

$$(\alpha - a)\mathrm{E}(b,n) = F(b)G(b+n) - F(b+n)G(b) \quad \text{......(6)}$$

where $\mathrm{E}(b,n) = l_s(b) - l_s(b+n),$ .....(7)

$$F(b) = \left(1.0 - l_s(b)\right)\left((\beta - 1)Y_s(b) - \left[\frac{\beta\delta t(x)}{2l_s(b)\left(1.0 - l_s(b)\right)} \right]\right. \quad \text{.....(8)}$$

and $G(b) = \left(e^{2a} + l_s(b)\left\lfloor 1.0 - e^{2a} \right\rfloor\right)$ ......(9)

Each category of child and adult mortality has a time location (Brass and Bamgboye 1981). The mortality levels can, therefore, be plotted against the calendar time points in a graph. Most frequently, the mortality levels of children and adults at the same time points will fail to agree. A small disagreement is of no importance but often the gap is large. The question in these circumstances is whether an age pattern of mortality to achieve consistency can be found. Because of the shape of the $t(x)$ vector the adjustments through δ, do not affect significantly the estimates of α at the upper ends of the range of values (20 – 25) years for children and (50 – 60) years for adults. However, at younger ages which correspond to the more recent time location points the effects of the δ adjustments are in opposite directions for child and adult α. Thus the δ parameter can be used to modify underlying mortality patterns to bring children and adult estimates more closely into line. If the discrepancy is fairly small β and δ adjustments to bring the α for children and adults together can be found easily by trial and error. Kamara has explored this idea for several African Populations (Kamara 1988, 1989). The best consistency is often obtained with unlikely or implausible life-table models. It is possible that as data quality improves, this approach will yield more plausible returns. At present, it seems practicable to use it to derive measures of the broad level of mortality at different stages of life, but no refinement by age.

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* The maternal orphanhood estimate *l(b+n)/l(b)* are not sensitive to variations in the β (Beta) parameter [except at central ages 40,45 and 50]. Brass and Hill 1973, Brass 1975, K.Hill 1973, Kamara 1988, 1989].

3.0 RESULTS

3.1 Application of Kamara's Model To the 2004 Sierra Leone Population and Housing Census

The Sierra Leone 2004 Household and Census Data turns out to be an interesting illustration. The data quality is of a more improved nature than that of the previous censuses conducted in 1961, 1975 and 1985 respectively. The techniques introduced in this Monograph are new in their applications to Sierra Leone retrospective data.

The child and adult mortality measures from the reports on surviving children (children ever born) and mothers (maternal orphanhood) are used to examine a method for arriving at a consistent mortality pattern. Three procedures for representing age patterns of mortality are examined. In the first approach, it will be assumed that the age patterns of mortality in the population under study, has been changing. In this case we pick a value of the second parameter β, of Brass's two parameter logit system which leads to the most consistent set of mortality level estimates $(\propto)$ from both child and adult survival estimates.

In the second approach, the age pattern of mortality will be assumed fixed (i.e. the second parameter β of Brass's two parameter logit system in fixed). A similar assumption is made for the third approach where the mortality is fixed. We pick a combination of the second and third parameters β and δ respectively (in the three parameter logit system developed by Kamara 1988 which leads to the most consistent set of $\propto$ estimates for both child and adult survival estimates. The evidence for mortality trends in Sierra Leone is then interpreted in terms of a general improvement on the mortality level parameter, $\propto$, which is allowed to vary (whilst all other parameters are kept fixed).

The three methods have been explored extensively, and without any loss of generality, the estimates obtained from the assumption of a fixed pattern of mortality has been observed to be more consistent with other results both within and outside Sierra Leone.

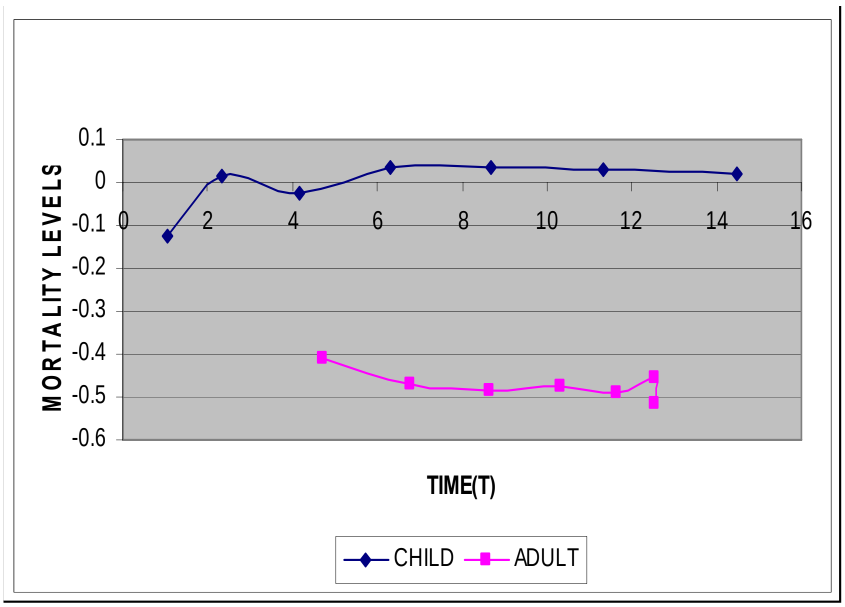
The estimates obtained from this study are from the method which allows the mortality level parameter, $\propto$, to vary, whilst all other parameters are kept fixed.

For Sierra Leone, the $\propto$ - measures of mortality level with the General Standard $(\beta = 1.0)$ is given in table 4 and plotted in graph 1 below.

Table 4: Sierra Leone Mortality Levels and Time Locations

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α (β= 1.0)	Age (x)	Time (T)	α (β= 1.0)
1	1.06	-0.126	35	4.702	-0.412
2	2.34	0.013	40	6.785	-0.470
3	4.17	-0.027	45	8.661	-0.485
5	6.32	0.036	50	10.303	-0.474
10	8.69	0.036	55	11.621	-0.491
15	11.31	0.031	60	12.554	-0.455
20	14.47	0.022	65	12.524	-0.517

Graph 1: Child and Adult Mortality Levels – Sierra Leone

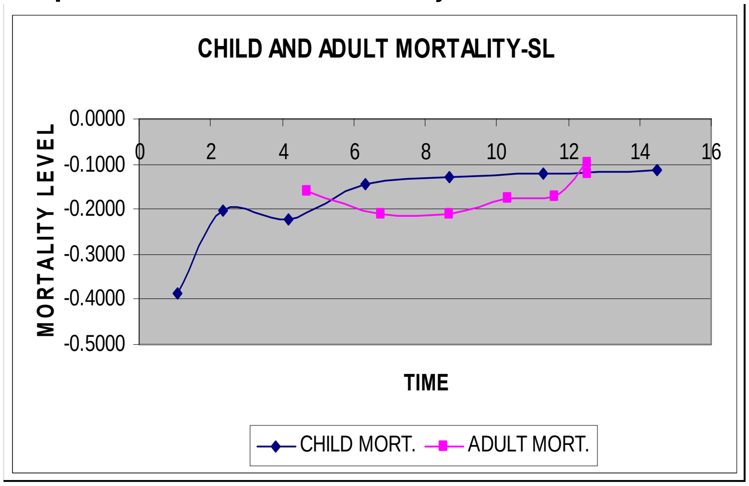


Obviously, graph 1 shows that the standard (β=1.0) gives incompatible results for adults and children. Changes in the β coefficient to 0.7 gives the results in table 5 and plotted in graph 2 below.

Table 5: Sierra Leone Mortality Levels and Time Locations

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α=Y(X)-0.7*Ys(X)	Age (x)	T=(N/6)*d for β=1.0	α(β=0.7)
1	1.06	-0.3857	35	4.7016	-0.1605
2	2.34	-0.2015	40	6.7846	-0.2097
3	4.17	-0.2238	45	8.6611	-0.2102
5	6.32	-0.1448	50	10.3029	-0.1772
10	8.69	-0.1286	55	11.6209	-0.1711
15	11.31	-0.1228	60	12.5543	-0.0961
20	14.47	-0.1149	65	12.5236	-0.1230

Graph 2: Child and Adult Mortality Levels – Sierra Leone



The $\propto$ - measures for adults and children (β=0.7) are closer together than for the standard pattern (β=1.0). The introduction of the third parameter δ only slightly reduces the disagreement in the adult and child mortality trends but the final estimates are more or less the same as with β=0.7 alone. Thus, the child and adult measures for Sierra Leone can best be brought into coincidence by using β=0.70 and δ=0 to fix the pattern, of mortality. Similarly, the child and adult measures are best brought together by β=0.7, δ=0 for the Eastern Province, β=0.75, δ=0 for the Northern Province, β=0.6, δ=0 for the Southern Province, β=0.8, δ=0 for the Western Province (See Tables A1 to A8 and Graphs A1 to A8 of Appendix A).

For the districts (not shown in Appendix), the child and adult mortality measures are best brought together by β=0.8, δ=0 for Kailahun District, β=0.6, δ=0 for Kenema District, β=0.7, δ=0 for Kono District, β=0.75, δ=0 for Bombali District, β=0.7, δ=0 for Kambia District, β=0.75, δ=0 for Koinadugu District, β=0.87, δ=0 for Port Loko District, β=0.8, δ=0 for Tonkolili District, β=0.6, δ=0 for Bo District, β=0.6, δ=0 for Bonthe District, β=0.6, δ=0 for Moyamba District, β=0.65, δ=0 for Pujehun District, β=0.75, δ=0 for the Western Rural District and β=0.9, and δ=0 for the Western Urban District.

The above illustrations seem to be fairly satisfactory. New age patterns of mortality have thus been constructed which fit the hypothesis that over the years the only change has been in the mortality level parameter $\propto$ (alpha) of the Brass logit system.

The Life Tables for any of the years under construction can be derived by combining the new age pattern with the $\propto$ - level estimates. These level estimates can be made from graph 2 for Sierra Leone, and graphs A2, A4, A6 and A8 respectively for the regions (see Appendix A.)

$$l_N(x) = l_s(s) \; + \; \delta t(x)$$

and logit $(l(x) \; = \; \propto + \beta \; \log it \; (l_N(x))$

and the values of β and δ are given for each region above.

Freehand curves have been fitted approximately to the time series of $\propto$ (alpha) jointly for children and adults in graphs 2, A2, A4, A6 and A8 respectively. Values of $\propto$ (alpha) for different years have been read off. The resulting Life Tables are shown in Tables B1 to B4 for Sierra Leone and B5 to B20 for the Regions, (see Life Tables in Appendix B).

Values for ages over 70 (seventy) are not shown since extrapolation to late ages without knowledge of the effects captured by the neglected fourth parameter, the coefficient of $l(x)$ is not justified.

4.0 CONCLUSION:

The above results for Sierra Leone show that life tables constructed using β alone, (or a combination of β and δ) and linearly changing $\propto$ can fit observed orphanhood and child survival data fairly well. In some circumstances, even closer fits to the observation can be obtained using the two parameter system with β fixed, but allowing $\propto$ to vary.

The examination of Mortality patterns for Sierra Leone has shown a downward trend in infant, child and adult mortality over the years 1985 to 2006.

Life Tables have been constructed for the Nation and for the regions, by combining the new age patterns with the α (alpha) level estimates.

Great caution must be taken, however, in using these models and, above all, in interpreting the results, particularly in an uncertain field of mortality in developing countries. The Sierra Leone 2004 census data are by no means representative of all developing countries. A model that may work well for one country may not necessarily translate to another. It is encouraging of course, that the two and three parameter logit systems have produced favourable results with the 2004 census data of Sierra Leone.

5.0 POLICY IMPLICATION

The Life Tables for Sierra Leone and the regions (B1 to B20 of Appendix B), show a decline in mortality levels over the years 1985 to 2006.

The life expectancy at birth for the country as a whole, has risen from 38.5 years in 1985 to 48.4 years in 2006. Life expectancies for the regions are 46.6 years (East), 49.8 years (North), 48.7 years (South) and 53.5 years (Western Area). These figures are still below those noted for other African Countries. There is need for improvement in this area, perhaps by improving the living conditions of the population.

The lower levels of mortality rates in the Western Area may be as a result of better social services like Health, Education, Water and Sanitation, Housing in this region. It is encouraging to note that there is the political will to improve social services, and provide better Health facilities, Education, Water and Sanitation, Housing etc. which may lead to further reduction in mortality levels and improve longeivity by the year 2014, the next round of census.

6.0 MATHEMATICAL PART A

6.1 Use of Brass Two Parameter Logit System to Link Child and Adult Mortality Estimates

If $l_s(x)$ are the survivorship values for age x of the General Standard, life table, survivorship values $l(x),$ can be derived from the standard values $l_s(x)$ by choosing α and β such that

$$Y(x) = \log it\left[l(x)\right] = 0.5\ln\left\{(1.0 - l(x))/l(x)\right\} = \alpha + \beta\log it\left[l_s(x)\right]$$

……A(1)

6.2 Child Ages: (X=1, 2, 3, 5, 10, 15, 20)

From the child mortality estimates, the logit, Y(x), is obtained as

$$Y(x) = \alpha + \beta \;\; Y_s(x)$$

……A(2)

and

$$Y(x) = \alpha + Y_s(x)$$

……A(3)

Where a is obtained with the original standard and α with the modified one.

6.3 Adult Ages

Fix a radix age $x = b,$ and for some $n > 0,$ the information for adults are normally in the form $\frac{1(b+n)}{1(b)} = {}_n p_b,$ where ${}_n p_b$ is the conditional probability of surviving from exact age b to exact age $b+n.$ It follows from equation A(1) above that

$$Y(b) = 0.5 * l\,\text{n}\left\{(1.0 - l^*(b))/l^*(b)\right\} = \alpha + \beta Y_s \text{ (b)}$$

….A(4)

and

$$Y(b+n) = 0.5 * \left\{(1.0 - l^*(b+n))/l^*(b+n)\right\} = \alpha + \beta Y_s(b+n)$$ ….A(5)

where

$$l^*(b) = 1.0/\left\{1.0 + e^{2\alpha+2\beta Ys(b)}\right\}$$ ….A(6)

is an estimate of $l(b)$ and

$$l^*(b+n) = \frac{l(b+n)}{l(b)}.l^*(b) = {}_n\ p_b.l^*(b)$$ …A(7)

is an estimate of $l(b+n)$.

substituting the expression for $l^*(b)$ in equation (A6) above into equation A(7) we obtain,

$$l^*(b+n) = {}_n\,p_b.\left\{1.0/\left[1.0 + e^{2\alpha+2\beta Ys(b)}\right]\right\}$$ …A(8)

as an estimate of $l^*(b+n)$.

Next, substituting the above expression for $l^*(b+n)$ in equation A(8), into equation A(5), we obtain

$$2\alpha = \ln\left[\frac{\left\{\left[1.0 + e^{2\alpha+2\beta Ys(b)}\right] - {}_n\,p_b\right\}}{{}_n\,p_b}\right] - 2\beta Y_s(b+n)$$

…..A(9)

A slight rearrangement of A(9) results in

$$\left(1.0 - {}_n\,p_b\right) = e^{2\alpha}\left\{\left({}_n\,p_b.e^{2\beta Ys(b+n)}\right) - \left(e^{2\beta Ys(b)}\right)\right\}$$

which finally gives

$$2\alpha = \ln\left(1.0 - {}_n\,p_b\right) - \ln\left\{\left[{}_n\,p_b.e^{2\beta Ys(b+n)}\right] - \left[e^{2\beta Ys(b)}\right]\right\}$$

…...A(10)

7.0 MATHEMATICAL PART B

7.1 Use of the Three Parameter Logit System to Link Child and Adult Mortality Levels

If $l_s(x)$ are the survivorship values for age x of the general standard, and $t(x)$ are schedules for deviations from this general standard, a 'new' standard $l_N(x)$ may be chosen by specifying the constant δ such that

$$l_N(x) = l_s(x) + \delta t(x) \qquad \text{.... B(1)}$$

and

$$Y_N(x) = 0.5\ln\{(1.0 - l_N(x))/l_N(x)\}$$

$$= 0.5\ln\left[\frac{[1.0 - ls(x) - \delta t(x)]}{l_s(x) + \delta t(x)}\right] \qquad \text{.... B(2)}$$

Using the Taylor's series expansion in (B2), about $l_s(x)$
We obtain,

$$Y_s(x) = (1/2)\ln\left[\frac{[1.0 - l_s(x)]}{l_s(x)}\right] - \frac{\delta t(x)}{2l_n(x)[1.0 - l_s(x)]} \qquad \text{.... B(3)}$$

approximating for small $\delta t(x)$ where δ is a constant multiplier of t(x).

7.2 Child Ages (1, 2, 3, 5, 10, 15, 20)

From the child mortality estimates, the logit Y(x) is obtained as,

$$Y(x) = a + Y_s(x) \qquad \text{.... B(4a)}$$

and

$$Y(x) = a + \beta Y_s(x) \qquad \text{.... B(4b)}$$

Where Y(x) refers to observed data (i.e estimates made from indirect methods e.t.c.), $Y_s(x)$ refers to the standard data and a is the mortality level obtained with the original standard, and α is the mortality level obtained with the modified standard. Substituting the expression obtained for $Y_s(x)$ in equation B(3) into equation B(4b), gives

$$Y(x) = \alpha + (\beta/2)\ln\left[\frac{[1.0 - l_s(x)]}{l_s(x)}\right] - \frac{\beta\delta t(x)}{2l_s(x)[1.0 - l_s(x)]}$$

$$= \alpha + \beta Y_s(x) - \frac{\beta\delta t(x)}{2l_s(x)[1.0 - l_s(x)]}$$

$$= \alpha + Y_s(x) + (\beta - 1)Y_s(x) - \frac{\beta\delta t(x)}{2l_s(x)[1.0 - l_s(x)]}$$

…. B(5)

Subtracting equation (B5) from equation B(4a), gives

$$(\alpha - \alpha) = -(\beta - 1)Y_s(x) + \frac{\beta\delta t(x)}{2l_s(x)[1.0 - l_s(x)]}$$

…. B(6)

as the change in the alpha-values from the original to the modified standard, respectively for the above mentioned child ages.

7.3 Adult Ages

From the definition of $l(x) = \frac{1.0}{1.0 + e^{[2Y(x)]}}$

we obtain,

$${}_n p_b = \frac{l(b+n)}{l(b)} = \frac{1.0 + e^{[2a + Ys(b)]}}{1.0 + e^{[2a + Ys(b+n)]}}$$

…. B(7)

where

$Y(x) = a + Y_s(x)$ in the one-parameter representation.

The equivalent expression for ${}_n p_b$ in the three parameter representation can be written as

$${}_n p_b = \frac{l(b+n)}{l(b)} = \frac{1.0 + e^{[2Y(\mathrm{B})]}}{1.0 + e^{[2Y(b+n)]}}$$

…. B(8)

where

$$2Y(b) = 2\alpha + 2Y_s(b) + 2(\beta - 1)Y_s(b) - \frac{\beta\delta t(b)}{l_s(b)[1.0 - l_s(b)]}$$

…. B(9)

and

$$2Y(b+n) = 2\alpha + 2Y_s(b+n) + 2(\beta - 1)Y_s(b+n) - \frac{\beta\delta t(b+n)}{l_s(b+n)[1.0 - l_s(b+n)]}$$

…. B(10)

are obtained respectively from the expression for Y(x) derived in equation B(5) above. Equating B(7) and (B8), the two representations of ${}_n p_b$, yield

$$\left[1.0 + e^{[2Y(b+n)]}\right]\left[1.0 + e^{[2a+2Y(b)]}\right]$$

=

$$\left[1.0 + e^{[2Y(b)]}\right]\left[1.0 + e^{[2a+2Ys(b+n)]}\right]$$

…. B(11)

The next stage is to expand the expressions in the brackets on either side of equation (B11) above.

Define $S(x,\alpha,\beta,\delta),$ the difference between the observed and the standard logits, in terms of the basic variables x,α,β,δ as

$$2Y(x) - 2Y_s(x) = S(x,\alpha,\beta,\delta)$$

$$= 2\alpha + 2(\beta - 1)Y_s(x) - \frac{\beta\delta t(x)}{l_s(x)[1.0 - l_s(x)]}$$

…. B(12)

Substituting the above expressions for $S(x,\alpha,\beta,\delta)$ in equations B(9) and B(10), into equation B(11) would give a new representation for equation B(11) as

$$[U\{(b+n),\alpha,\beta,\delta\}][T\{(b),a\}] = [U\{(b),\alpha,\beta,\delta\}][T\{b+n,a\}]$$

…. B(13)

Where

$$[U(b),\alpha,\beta,\delta] = 1.0 + e^{[2Y(b)]}$$

$$= \frac{l_s(b) + [1.0 - l_s(b)][e^{s\{b,\alpha,\beta,\delta\}}]}{l_s(b)}$$

…. B(14)

and

$$T(b,a) = 1.0 + e^{[2a+2Ys(b)]} = \frac{l_s(b) + [1.0 - l_s(b)]e^{2a}}{l_s(b)}$$

…. B(15)

Substituting the definitions of $U(b,\alpha,\beta,\delta)$ and $T(b,a)$ given in equations B(14) and B(15) into equation B(13), and then evaluating the products we obtain

$$[U\{(b+n),\alpha,\beta,\delta\}][T(b,a)]$$

$$= l_s(b).l_s(b+n) + l_s(b+n)[1.0 - l_s(b)]e^{2a}$$

$$+[\{1.0 - l_s(b+n)\}\{e^{2a} + l_s(b)[1.0 - e^{2a}]\}]e^{s\{(b+n),\alpha,\beta,\delta\}}$$

…. B(16)

and

$$[U(b,\alpha,\beta,\delta][T\{(b+n),a\}]$$

$$= l_s(b+n)[l_s(b) + l_s(b)[1.0 - l_s(b+n)]]e^{2a}$$

$$+[\{1.0 - l_s(b)\}\{e^{2a} + l_s(b+n)[1.0 - e^{2a}]\}]e^{s(b,\alpha,\beta,\delta)}$$

…. B(17)

We can rearrange equation B(12) above, to give $S(x,\alpha,\beta,\delta) = 2\alpha + R(x,\beta,\delta)$ where we define $R(x,\beta,\delta)$ in terms of the basic variables x,β,δ such that

$$R(x,\beta,\delta) = 2(\beta-1)Y_s(x) - \frac{2\beta\delta t(x)}{2l_s(x)[1.0-l_s(x)]}$$

…. B(18)

Substituting the expression for $R(x,\beta,\delta)$ in equation B(18), into equations B(16) and B(17) respectively, we obtain

$$[U\{(b+n),\alpha,\beta,\delta\}][T(b,a)]$$

$$= l_s(b).l_s(b+n) + l_s(b+n)[1.0-l_s(b)]e^{2a}$$

$$+[\{1.0-l\ (b+n)\}\{e^{2a}+l(b)[1.0-e^{2a}]\}]e^{2a}.\ e^{R\{(b+n),\beta,\delta\}}$$

…. B(19)

and

$$[U(b,\alpha,\beta,\delta)]\ [T(b+n),a]$$

$$= l_s(b)[l_s(b+n)] + l_s(b)\ [1.0-l_s(b+n)]e^{2a}$$

$$+[\{1.0-l_s(b)\}\{e^{2a}+l_s(b+n)[1.0-e^{2a}]\}]e^{2a}.\ e^{R(b,\beta,\delta)}$$

…. B(20)

Subtracting equation B(20) from equation B(19), we obtain

$$[l_s(b+n)-l_s(b)]\ [e^{2(a-\alpha)}$$

$$= [\{1.0-l_s(b)\}\{e^{2a}+l_s(b+n)[1.0-e^{2a}]\}].e^{R(b,\beta,\delta)}$$

$$-[\{1.0-l_s(b+n)\}\{e^{2a}+l_s(b)[1.0-e^{2a}]\}].\ e^{R\{(b+n),\beta,\delta\}}$$

…. B(21)

Assuming that the change in alpha-values $(a - \alpha)$ is small, the exponential function, $e^{2(a-\alpha),}$ of equation B(21) can be expanded to give the following approximate results:-

$$e^{2(a-\alpha),} = 1.0 + 2(a-\alpha)$$

…. B(22)

Similarly, the expression for $R(x,\beta,\delta)$ in B(18) can be substituted into equation B(21) so that for β close to 1.0 and for small δ values, we obtain

$$e^{R(b,\beta,\delta)} = 1.0 + 2(\beta - 1)Y_s(b) - \frac{2\beta\delta t(b)}{2l_s(b)[1.0 - l_s(b)]}$$

…. B(23)

and

$$e^{R(b+n,\beta,\delta)} = 1.0 + 2(\beta - 1)Y_s(b+n) - \frac{2\beta\delta t(b+n)}{2l_s(b+n)[1.0 - l_s(b+n)]}$$

…. B(24)

Substituting the expressions for $e^{2(a-\alpha),}$ $e^{R(b,\beta,\delta)}$ and $e^{R(b+n,\beta,\delta)}$ in equations B(22), B(23) and B(24) respectively, into equation B(21) and simplifying the algebra, we obtain the final expression for the change in adult mortality levels i.e. $(a - \alpha)$ for the different age groups. The expression can be written in the form below:-

$$(a-\alpha)\{l_s(b) - l_s(b+n)\} = F(b,b+n,a).G(b,\beta,\delta)$$

$$-F(b+n,b,a).G(b+n,\beta,\delta)$$

…. B(25)

where

$$F(b,b+n,a) = \{1.0 - l_s(b)\}\{e^{2a} + [l_s(b+n)][1.0 - e^{2a}]\}$$

and

$$G(b,\beta,\delta)=(\beta-1)Y_s(b)-\left[\frac{\beta\delta t(b)}{2l_s(b)[1.0-l_s(b)]}\right] \text{ and}$$

$$F(b+n,b,a)=\{1.0-l_s(b+n)\}\{e^{2a}+[l_s(b)][1.0-e^{2a}]\}$$

and

$$G(b+n,\beta,\delta)=(\beta-1)Y_s(b+n)-\left[\frac{\beta\delta t(b+n)}{2l_s(b+n)[1.0-l_s(b+n)]}\right]$$

7.4 Addendum

The approximations given in B(6) and B(25) respectively above, for the change in alpha i.e.

$$(\alpha-a)=\delta\alpha \qquad \text{….B(26)}$$

for small changes in β and δ from their central values is not very good for the extreme $(\beta-1)$ and δ. However, a big improvement is obtained by writing $(1/2)\{e^{2\delta\alpha}-1\}=(1/2)\{e^{2(\alpha-a)}-1\}$ in those expressions.

The result is that $\alpha_2=\alpha_1+(1/2)\{e^{2\delta\alpha}-1\}$ ….B(27)

where α_1 is the original alpha-value obtained with the modified standard, α_2 is the new alpha-value obtained by adjusting α_1 and a is the alpha-value obtained with the standard $(\beta=1.0)$.

the new change in alpha-value is then given as

$$\delta\alpha_2=(\alpha_2-a) \qquad \text{….B(28)}$$

and the original change in alpha-value i.e, $\delta\alpha=(\alpha-a)$ given in equation B(26) above, is now replaced by the expression

$$\delta\alpha_1 = (\alpha_1 - a) \quad \text{….B(29)}$$

The new α_2 values can be plotted against the calendar time points. There are no changes in the broad conclusions about the displacement effects of altering the β and the tilting effects of altering δ. The theory seems to work surprisingly well with the retrospective data of the 2004 Population and Housing Census of Sierra Leone, that is, the child and adult mortality trends have been brought into coincidence by altering β and δ.

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APPENDICES A:

Table A1: Mortality Levels and Time Locations - Eastern Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α (β= 1.0)	Age (x)	Time (β= 1.0)	α (β= 1.0)
1	1.06	-0.088	35	4.704	-0.392
2	2.34	0.070	40	6.791	-0.443
3	4.17	0.030	45	8.699	-0.425
5	6.32	0.102	50	10.394	-0.390
10	8.69	0.100	55	11.761	-0.411
15	11.31	0.095	60	12.752	-0.387
20	14.47	0.074	65	12.805	-0.449

Graph A1: Mortality Levels and Time Locations - Eastern Region

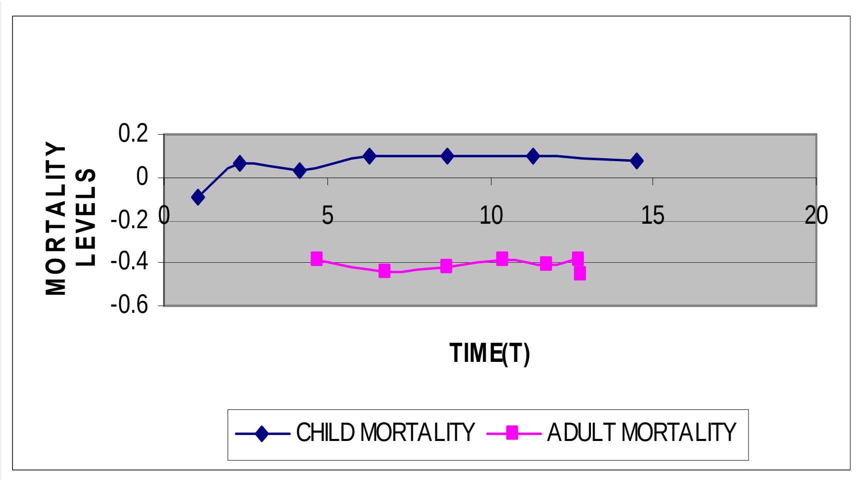


Table A2: Mortality Levels and Time Locations - Eastern Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α=Y(X)-0.7*ls(X)	Age (x)	T=(N/6)*d for β=1.0	α(β=0.7)
1	1.06	-0.3477	35	4.7016	-0.1376
2	2.34	-0.1442	40	6.7846	-0.1805
3	4.17	-0.1665	45	8.6611	-0.1427
5	6.32	-0.0782	50	10.3029	-0.0828
10	8.69	-0.0645	55	11.6209	-0.0797
15	11.31	-0.0592	60	12.5543	-0.0161
20	14.47	-0.0630	65	12.5236	-0.0424

Graph A2: Mortality Levels and Time Locations - Eastern Region

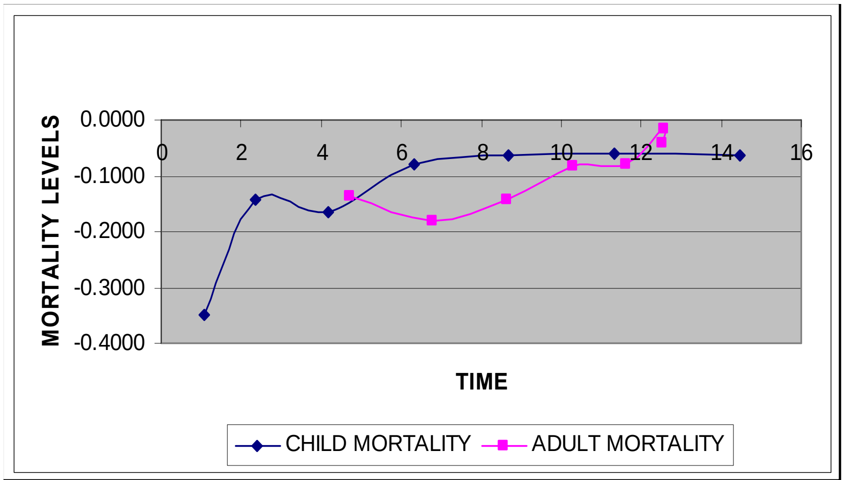


Table A3: Mortality Levels and Time Locations - Northern Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α (β= 1.0)	Age (x)	Time (β= 1.0)	α (β= 1.0)
1	1	-0.1927	35	4.7087	-0.3331
2	2.17	-0.0137	40	6.7971	-0.4039
3	3.97	-0.0399	45	8.6612	-0.4558
5	6.09	0.0191	50	10.3105	-0.4352
10	8.44	0.0203	55	11.6254	-0.4645
15	11.03	0.0211	60	12.6175	-0.3881
20	14.12	0.0240	65	12.4921	-0.4807

Graph A3: Mortality Levels and Time Locations - Northern Region

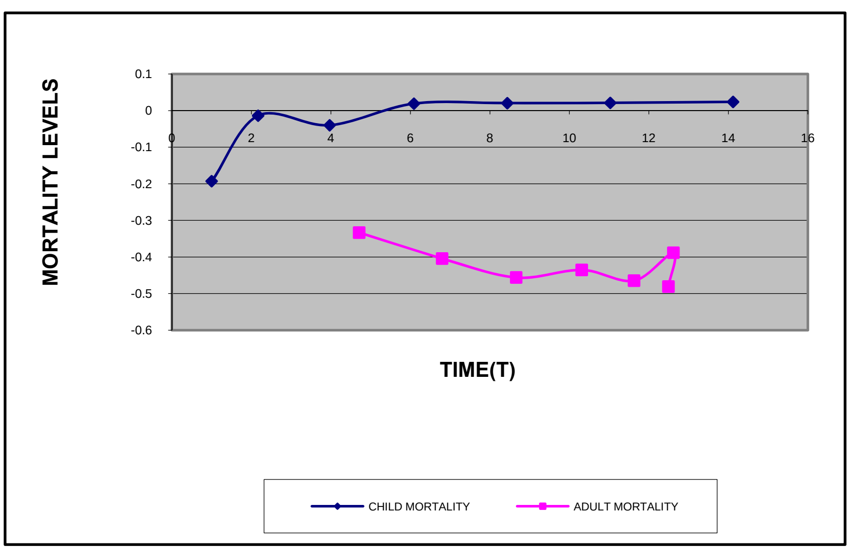


Table A4: Mortality Levels and Time Locations - Northern Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α=Y(X)-0.75*Ys(X)	Age (x)	T=(N/6)*d for β=1.0	α(β=0.75)
1	1.06	-0.4095	35	4.7016	-0.1243
2	2.34	-0.1925	40	6.7846	-0.1895
3	4.17	-0.2037	45	8.6611	-0.2322
5	6.32	-0.1313	50	10.3029	-0.1930
10	8.69	-0.1172	55	11.6209	-0.2042
15	11.31	-0.1072	60	12.5543	-0.0906
20	14.47	-0.0898	65	12.5236	-0.1576

Graph A4: Mortality Levels and Time Locations - Northern Region

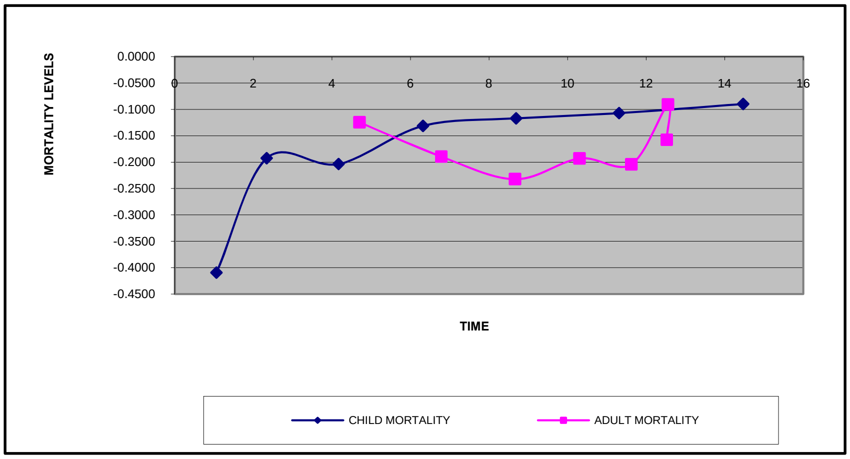


Table A5: Mortality Levels and Time Locations - Southern Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α (β= 1.0)	Age (x)	Time (β= 1.0)	α (β= 1.0)
1	1.06	-0.021	35	4.687	-0.521
2	2.34	0.104	40	6.753	-0.565
3	4.17	0.045	45	8.625	-0.539
5	6.32	0.120	50	10.273	-0.481
10	8.69	0.108	55	11.540	-0.529
15	11.31	0.111	60	12.478	-0.458
20	14.47	0.085	65	12.349	-0.545

Graph A5: Mortality Levels and Time Locations - Southern Region

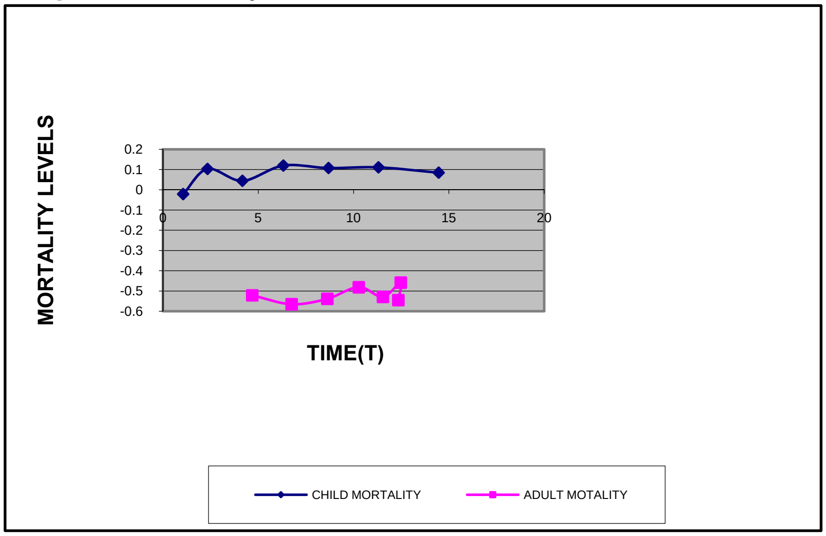


Table A6: Mortality Levels and Time Locations - Southern Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α=Y(X)-0.6*Ys(X)	Age (x)	T=(N/6)*d for β=1.0	α(β=0.6)
1	1.06	-0.368	35	4.702	-0.172
2	2.34	-0.182	40	6.785	-0.202
3	4.17	-0.218	45	8.661	-0.149
5	6.32	-0.120	50	10.303	-0.054
10	8.69	-0.112	55	11.621	-0.075
15	11.31	-0.094	60	12.554	0.060
20	14.47	-0.097	65	12.524	0.015

Graph A6: Mortality Levels and Time Locations - Southern Region

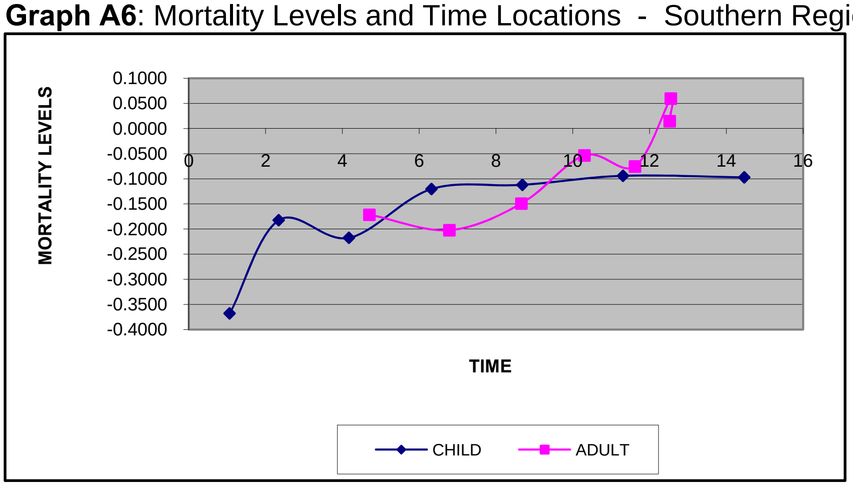


Table A7: Mortality Levels and Time Locations - Western Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α (β= 1.0)	Age (x)	Time (β= 1.0)	α (β= 1.0)
1	1.67	-0.286	35	4.692	-0.511
2	3.4	-0.185	40	6.773	-0.535
3	5.42	-0.233	45	8.644	-0.535
5	7.72	-0.229	50	10.245	-0.551
10	10.22	-0.206	55	11.525	-0.558
15	13.13	-0.206	60	12.346	-0.567
20	16.64	-0.206	65	12.374	-0.579

Graph A7: Mortality Levels and Time Locations - Western Region

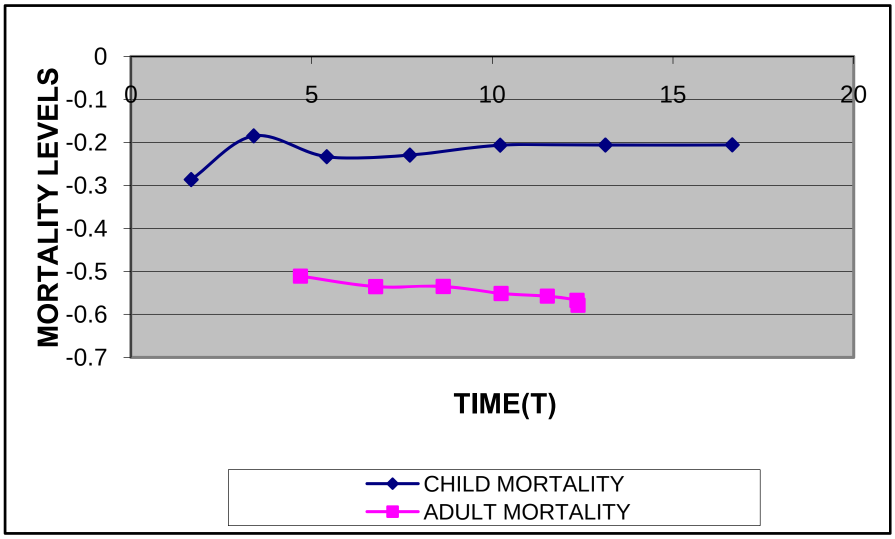
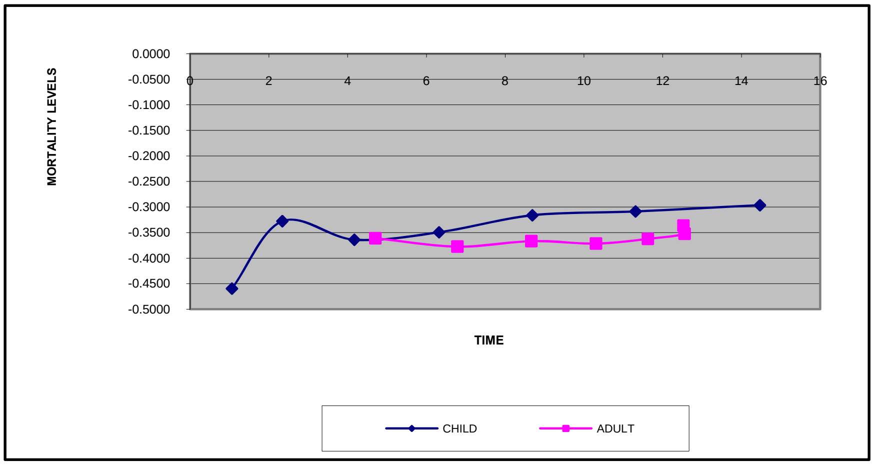


Table A8: Mortality Levels and Time Locations - Western Region

Child Mortality			Adult Mortality		
Age (x)	Time (T)	α=Y(X)-0.8*Ys(X)	Age (x)	T=(N/6)*d for β=1.0	α(β=0.8)
1	1.06	-0.460	35	4.702	-0.361
2	2.34	-0.328	40	6.785	-0.378
3	4.17	-0.364	45	8.661	-0.367
5	6.32	-0.350	50	10.303	-0.372
10	8.69	-0.316	55	11.621	-0.362
15	11.31	-0.309	60	12.554	-0.352
20	14.47	-0.297	65	12.524	-0.336

Graph A8: Mortality Levels and Time Locations - Western Region



APPENDICES B

Table B1: Life Tables for Sierra Leone (1990) (α= - 0.10 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.804	0.196
2	0.769	0.231
3	0.754	0.246
5	0.739	0.261
10	0.725	0.275
15	0.715	0.285
20	0.698	0.302
30	0.655	0.345
35	0.634	0.366
40	0.612	0.388
45	0.587	0.413
50	0.557	0.443
55	0.521	0.479
60	0.477	0.523
65	0.420	0.580
70	0.351	0.649

Table B2: Life Tables for Sierra Leone (1995) (α= - 0.15 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.820	0.180
2	0.786	0.214
3	0.772	0.228
5	0.758	0.242
10	0.745	0.255
15	0.735	0.265
20	0.719	0.281
25	0.698	0.302
30	0.677	0.323
35	0.657	0.343
40	0.635	0.365
45	0.611	0.389
50	0.582	0.418
55	0.546	0.454
60	0.501	0.499
65	0.444	0.556
70	0.374	0.626

Table B3: Life Tables for Sierra Leone (2000) (α= - 0.20 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.834	0.166
2	0.802	0.198
3	0.789	0.211
5	0.776	0.224
10	0.763	0.237
15	0.754	0.246
20	0.738	0.262
25	0.718	0.282
30	0.699	0.301
35	0.679	0.321
40	0.658	0.342
45	0.634	0.366
50	0.606	0.394
55	0.570	0.430
60	0.526	0.474
65	0.469	0.531
70	0.398	0.602

Table B4: Life Tables for Sierra Leone (2006) (α= - 0.25 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.847	0.153
2	0.818	0.182
3	0.805	0.195
5	0.793	0.207
10	0.781	0.219
15	0.772	0.228
20	0.757	0.243
25	0.738	0.262
30	0.719	0.281
35	0.700	0.300
40	0.680	0.320
45	0.657	0.343
50	0.629	0.371
55	0.595	0.405
60	0.551	0.449
65	0.494	0.506
70	0.422	0.578

Table B5: Life Tables for Eastern Region (1990)
(α= - 0.06 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.749	0.251
2	0.707	0.293
3	0.689	0.311
5	0.673	0.327
10	0.657	0.343
15	0.645	0.355
20	0.626	0.374
25	0.603	0.397
30	0.580	0.420
35	0.557	0.443
40	0.534	0.466
45	0.508	0.492
50	0.477	0.523
55	0.441	0.559
60	0.398	0.602
65	0.344	0.656
70	0.282	0.718

Table B6: Life Tables for Eastern Region (1995)
(α= - 0.10 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.804	0.196
2	0.769	0.231
3	0.754	0.246
5	0.739	0.261
10	0.725	0.275
15	0.715	0.285
20	0.698	0.302
25	0.676	0.324
30	0.655	0.345
35	0.634	0.366
40	0.612	0.388
45	0.587	0.413
50	0.557	0.443
55	0.521	0.479
60	0.477	0.523
65	0.420	0.580
70	0.351	0.649

Table B7: Life Tables for Eastern Region (2000) (α= - 0.13 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.814	0.186
2	0.779	0.221
3	0.764	0.236
5	0.751	0.249
10	0.737	0.263
15	0.727	0.273
20	0.710	0.290
25	0.689	0.311
30	0.668	0.332
35	0.648	0.352
40	0.626	0.374
45	0.601	0.399
50	0.572	0.428
55	0.536	0.464
60	0.492	0.508
65	0.434	0.566
70	0.365	0.635

Table B8: Life Tables for Eastern Region (2006) (α= - 0.18 & β=0.7)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.828	0.172
2	0.796	0.204
3	0.782	0.218
5	0.769	0.231
10	0.756	0.244
15	0.746	0.254
20	0.730	0.270
25	0.710	0.290
30	0.690	0.310
35	0.670	0.330
40	0.649	0.351
45	0.625	0.375
50	0.596	0.404
55	0.561	0.439
60	0.516	0.484
65	0.459	0.541
70	0.388	0.612

Table B9: Life Tables for Northern Region (1990)
(α= - 0.10 & β=0.75)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.818	0.182
2	0.781	0.219
3	0.765	0.235
5	0.751	0.249
10	0.736	0.264
15	0.725	0.275
20	0.707	0.293
25	0.684	0.316
30	0.662	0.338
35	0.640	0.360
40	0.616	0.384
45	0.589	0.411
50	0.558	0.442
55	0.519	0.481
60	0.471	0.529
65	0.410	0.590
70	0.338	0.662

Table B10: Life Tables for Northern Region (1995)
(α= - 0.12 & β=0.75)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.824	0.176
2	0.788	0.212
3	0.773	0.227
5	0.758	0.242
10	0.744	0.256
15	0.733	0.267
20	0.716	0.284
25	0.693	0.307
30	0.671	0.329
35	0.649	0.351
40	0.625	0.375
45	0.599	0.401
50	0.568	0.432
55	0.529	0.471
60	0.481	0.519
65	0.420	0.580
70	0.347	0.653

Table B11: Life Tables for Northern Region (2000) (α= - 0.17 & β=0.75)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.838	0.162
2	0.804	0.196
3	0.790	0.210
5	0.776	0.224
10	0.762	0.238
15	0.752	0.248
20	0.735	0.265
25	0.714	0.286
30	0.693	0.307
35	0.671	0.329
40	0.649	0.351
45	0.623	0.377
50	0.592	0.408
55	0.554	0.446
60	0.506	0.494
65	0.445	0.555
70	0.370	0.630

Table B12: Life Tables for Northern Region (2006) (α= - 0.20 & β=0.75)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.846	0.154
2	0.814	0.186
3	0.799	0.201
5	0.786	0.214
10	0.773	0.227
15	0.763	0.237
20	0.747	0.253
25	0.726	0.274
30	0.705	0.295
35	0.684	0.316
40	0.662	0.338
45	0.637	0.363
50	0.606	0.394
55	0.568	0.432
60	0.521	0.479
65	0.460	0.540
70	0.384	0.616

Table B13: Life Tables for Southern Region (1990) (α= - 0.05 & β=0.60)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.758	0.242
2	0.723	0.277
3	0.708	0.292
5	0.695	0.305
10	0.681	0.319
15	0.672	0.328
20	0.656	0.344
25	0.636	0.364
30	0.617	0.383
35	0.599	0.401
40	0.579	0.421
45	0.557	0.443
50	0.531	0.469
55	0.500	0.500
60	0.462	0.538
65	0.413	0.587
70	0.355	0.645

Table B14: Life Tables for Southern Region (1995) (α= - 0.10 & β=0.60)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.776	0.224
2	0.742	0.258
3	0.728	0.272
5	0.715	0.285
10	0.703	0.297
15	0.693	0.307
20	0.678	0.322
25	0.659	0.341
30	0.641	0.359
35	0.622	0.378
40	0.603	0.397
45	0.581	0.419
50	0.556	0.444
55	0.525	0.475
60	0.487	0.513
65	0.438	0.562
70	0.378	0.622

Table B15: Life Tables for Southern Region (2000)
(α= - 0.18 & β=0.60)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.802	0.198
2	0.772	0.228
3	0.759	0.241
5	0.747	0.253
10	0.735	0.265
15	0.726	0.274
20	0.712	0.288
25	0.694	0.306
30	0.677	0.323
35	0.659	0.341
40	0.641	0.359
45	0.620	0.380
50	0.595	0.405
55	0.565	0.435
60	0.527	0.473
65	0.478	0.522
70	0.416	0.584

Table B16: Life Tables for Southern Region (2006)
(α= - 0.23 & β=0.60)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.818	0.182
2	0.789	0.211
3	0.777	0.223
5	0.765	0.235
10	0.754	0.246
15	0.746	0.254
20	0.732	0.268
25	0.715	0.285
30	0.698	0.302
35	0.681	0.319
40	0.663	0.337
45	0.643	0.357
50	0.619	0.381
55	0.589	0.411
60	0.552	0.448
65	0.503	0.497
70	0.441	0.559

Table B17: Life Tables for Western Region (1990)
(α= - 0.29 & β=0.8)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.877	0.123
2	0.849	0.151
3	0.836	0.164
5	0.824	0.176
10	0.811	0.189
15	0.802	0.198
20	0.787	0.213
25	0.767	0.233
30	0.747	0.253
35	0.727	0.273
40	0.705	0.295
45	0.680	0.320
50	0.649	0.351
55	0.610	0.390
60	0.561	0.439
65	0.495	0.505
70	0.413	0.587

Table B18: Life Tables for Southern Region (1995)
(α= - 0.31 & β=0.8)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.882	0.118
2	0.854	0.146
3	0.841	0.159
5	0.830	0.170
10	0.818	0.182
15	0.809	0.191
20	0.794	0.206
25	0.774	0.226
30	0.755	0.245
35	0.735	0.265
40	0.713	0.287
45	0.688	0.312
50	0.658	0.342
55	0.619	0.381
60	0.571	0.429
65	0.505	0.495
70	0.423	0.577

Table B19: Life Tables for Western Region (2000) (α= - 0.34 & β=0.8)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.888	0.112
2	0.861	0.139
3	0.849	0.151
5	0.838	0.162
10	0.826	0.174
15	0.818	0.182
20	0.803	0.197
25	0.785	0.215
30	0.766	0.234
35	0.746	0.254
40	0.725	0.275
45	0.701	0.299
50	0.671	0.329
55	0.633	0.367
60	0.585	0.415
65	0.520	0.480
70	0.438	0.562

Table B20: Life Tables for Southern Region (2006) (α= - 0.38 & β=0.8)

Age (x)	Probability of Surviving to Exact Age $l(x)$	Probability of Dying at Exact Age (x) $q(x)$
1	0.895	0.105
2	0.870	0.130
3	0.859	0.141
5	0.848	0.152
10	0.837	0.163
15	0.829	0.171
20	0.816	0.184
25	0.798	0.202
30	0.780	0.220
35	0.761	0.239
40	0.741	0.259
45	0.717	0.283
50	0.689	0.311
55	0.652	0.348
60	0.604	0.396
65	0.540	0.460
70	0.457	0.543

SECTION TWO

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1.0 WORKING LIFE TABLES

1.1 Introduction

1.2 An Overview of the Employment Situation in Sierra Leone

Sierra Leone is mainly an agrarian economy as evident by the large proportion of the labour engaged in Agriculture. The results of the 2004 population and housing census reveals that 64. 9% of the total Sierra Leone labour force was in the agriculture, hunting and forestry industry (i.e. crop farming, livestock, poultry, hunting, and forestry) with crop farming alone accounting for 64.0 % of the total labour force

The other sector that has the second highest share of the labour force was the Trade and Repairs industry (14.3 %), which include wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods. A very small share of the labour force was engaged in manufacturing (0.50), financial Intermediation (0.4 %), hotels and restaurants (0.3 %), transport, storage and communication (0.9%), education (1.8%) health and social work (1.1 %), and public administration (1.8 %).

The ten-year rebel war (1991-2001) battered the economy and created massive unemployment and underemployment. The civil war and the general insecurity associated with it resulted in capital flight out of the economy, loss of investor confidence, and a sustained contraction in output and substantial increase in poverty. The overall effect was wide spread poverty, social dissatisfaction, a decline in standard of living and life expectancy. The lack of employment opportunities in the formal sector brought about a substantial increase in informal sector activities as people struggled to make a living. Informal employment with little or no prospects for retirement benefits accounted for about 70 percent of total labour force participation in economic activities.

To promote the decent work agenda, the National Social Security and trust Fund (NASSIT) was set up. NASSIT like any social security scheme will succeed if it can clearly define a method for measuring peoples working life and set effective employment policies and strategies in this area. For a social security system to succeed, people must be able to work for a longer life. Decreases in birth rates and increases in life expectancy puts a lot of strain on a social security system especially on its ability to sustain the retired population. Thus, there is need for policy on the length of people’s careers especially on occupational injuries which hasten exit from the labour force.

1.3 Objective of the Study

The main objective of the study is to compute working life tables for Sierra Leone in order to estimate the working life expectancy for the general Sierra Leone Population. Specifically the study is intended to;

(i) Compute working life expectancies for the Sierra Leone working population.

(ii) Compute the average exit age from the labour force

(iii) Discuss the policy implications of the results.

1.4 Methodology

1.4.1 Data Requirements

To compute an abridged working life table three types of data are required;

(i) Population in five year age bands

(ii) Deaths in five year age bands

(iii) Age specific labour force participation rates

1.4.2 Assumptions

In the analysis of the census data discussed below the following assumptions were made:

(i) The age specific activity rate rises to a single maximum age and then decline. This implies that there is one specific age when the total number of the labour force employed is the highest.

(ii) The Labor force participation rates represent the prevalence of employment opportunities for the labour forcer

(iii) Before the age at which the age specific participation rate is maximum, there are no withdraws from the labour force (except for deaths) and after that age, there are no new entrants into the labour force but there are separations due to both death and retirement.

1.4.3 Detailed Calculations and Columns Definitions

The computation of working life tables follow similar concepts of the life table technique for mortality. The working life table follows the experience of a (hypothetical) closed group of persons from birth to death, as the group is subject to age-specific labour force participation rates. The working life table enables us to follow the working life of a population of a cohort born alive from the start of their active working life to retirement. The Number of Persons alive at the Start of the Interval is derived from the stationery or model life table. In the computation of a life table, the first step is to agree on a suitable model life table (e.g. Coale and Demeny or United Nations Models; North, South, East or West Life tables) with a stable population whose mortality experience fits the Sierra Leone data. It has been established by many researchers that the North Models life tables best fit the African populations because of their similar characteristics of infant and child mortality to these populations. Thus the North Model was assumed to best fit the Sierra Leone mortality experience. The overall life expectancy for Sierra Leone calculated using the 2004 population and housing census data was 48.4 years. This life expectancy corresponds to a level between levels 11 with life expectancy of 45 years and levels 13 with life expectancy of 50.6 years on the North Model life table. Hence, the mortality level corresponding to a life expectancy of 48.4 for Sierra Leone was calculated by interpolation. This mortality level was used to locate a stationary population (i.e. the L(x) column of appropriate regional model life tables) that was used as number of persons alive at start of interval (Lx in the hypothetical population in table 1.1 below). This standard table shows how many persons would be alive at each age group of the total of 100,000 persons born alive. It illustrates the mortality experience of a stable population.

By multiplying the age specific labour force participation rates(column 1 in table 1.1) with the total standard(hypothetical) population alive at each age group one derives the total standard(hypothetical) labour force per age group(column 3 on table 1.1). This hypothetical labour force becomes the model population which is used in the analysis

The next step is to determine the number living and in the labor force at beginning of year of age (lwx* in column 4 in Table 1.1). Of the hypothetical 100,000 born alive, the number living and in the labour force at beginning of each age group is computed by adding the number living and in labour force during the previous age group and the number living and in labour force in the reference age group and diving the total by 2. For example; to derived the number living and in labour force at beginning of the age group15-19 on column 5; we add the number living and in labour force in the age group 10-14 and 15-19 in column 3 and divide by 2. Once the number of the stable population still living and in the labour force at various ages is computed, the total number of person years in the labour force remaining and in the year of age and in later years could be computed by summing from the bottom the ‘number of the stable population still living and in the labour force through the interval.

The working life or the average remaining years of active life for survivors in the labour force at beginning of age is computed by dividing the number of man years in the labour force remaining at year of age and later years by the standard population still living and in labour at beginning of year of age.

2.0 RESULTS

The table below shows the working life table for the Sierra Leone population obtained using the methodology of section 1.4 above.

Table 1.1: Working Life Tables for Total Sierra Leone Population(Males and Females)

Age (Years)	Percent of population in the Labour Force	Of 100,000 born alive, number living in year of age			Of 100, 000 born alive number living and in labor at beginning of year of age	Number of man years in the labour force remaining in the year of age and later years	Average remaining years of active life for survivors in the labour force at beginning of year of age	Complete expectation of life at beginning of year of age
		In the population	In the Labour Force					
x	W(x)	L(x)	Lw(x)	Lw(x*1)	Lw(x)*	Tw*x	eow*x	eox
	1	2	3	4	5	6	7	8
10-14 . . .	21.97256	371319.6	8158843	30462342	11031202	231044337	20.94	51.18
15-19 . . .	38.3764	362294.6	13903561	29721953	11031202	220013135	19.94	47.37
20-24 . . .	58.68016	351616.8	20632930	28845967	17268246	208981933	12.10	43.61
25-29 . . .	72.79672	339334.8	24702458	27838371	22667694	191713688	8.46	39.93
30-34 . . .	77.83675	326271.2	25395885	26766658	25049171	169045994	6.75	36.33
35-39 . . .	79.89036	312169.2	24939307	25609757	25167596	143996823	5.72	32.79
40-44 . . .	80.91278	296683.3	24005467	24339324	24472387	118829227	4.86	29.27
45-49 . . .	82.03808	279679.4	22944356				4.02	27.39
50-54 . . .	79.49688	260295.1	20692643				4.56	24.14
55-59 . . .	78.22485	237107.5	18547694				3.82	21.26
60-64 . . .	71.58091	208362.3	14914763				3.29	19.01
65+	60.97276	172360.6	10509299				2.80	17.73

Table 1.1 above reveals that working life declines gradually with increasing age, which is the expected pattern. Thus as persons in the labour force become older, there chances of leaving the labour force increases. This means the number of years they can be expected to continue working decreases. However, the results shown above reveal very short careers for the Sierra Leone working population. As shown in table 1.1 above, persons in the labour force who survive to ages 15 to 19 would expect to have about 20 years of working life remaining. Taking into consideration that these years could be disrupted by periods of unemployment arising from factors such as occupational injuries, redundancies, sickness etc.one would conclude that working life in Sierra Leone is short. This underscores the lack of employment opportunities particularly in the formal sector of the economy. Figure 1 below illustrates the differences in the working life expectancies of the male and female population. It shows that the average remaining years for males who survive to the next age is longer than that of

females. Caution needs to be exercised in making direct comparison in working life expectancies between males and females because of the peculiar nature of female employment . Females are more likely to have their working life interrupted for various reasons than males. For example female labour force participation might be interrupted by marriage, pregnancy, etc.

Figure 1.1: Working Life Expectancy for Total Sierra Leone Population by Age and Sex

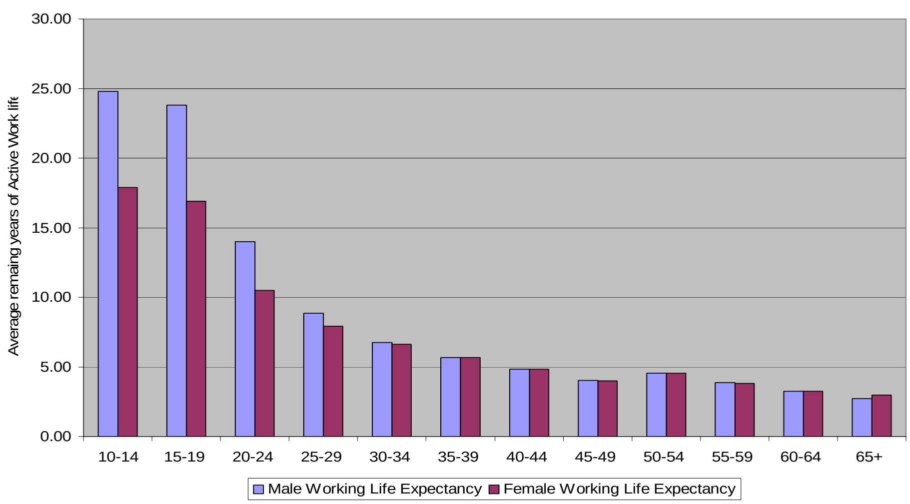


Figure 1.1 above depicts a familiar pattern with working life declining gradually with age. The differences between males and females are more noticeable at early ages, but the expected working lives are more or less equal. Working life expectancies in various provinces for males and females are shown on Table 1.2 below.

Table 1.2: Distribution of average remaining years of active life for survivors in the labour force at beginning of year of age by province for both sexes

Age	Eastern	Southern	Northern	Western
15-19	19.33	19.19	16.71	34.34
20-24	11.80	11.71	10.91	14.99
25-29	8.41	8.41	8.09	8.89
30-34	6.85	6.80	6.67	6.57
35-39	5.84	5.79	5.72	5.42
40-44	4.96	4.92	4.88	4.53
45-49	4.11	4.07	4.06	3.71
50-54	4.60	4.55	4.61	4.36
55-59	3.81	3.81	3.81	3.79
60-64	3.27	3.27	3.26	3.51
65+	2.67	2.83	2.76	3.46

As shown in table 1.2 above, working life expectancy is higher at younger ages for the Western Area labour force than the labour force in the other regions. However, at older ages, there are no significant differences in the working life expectancies of the labour force in the regions and that in the Western Area.

Table 1.3: Distribution of average remaining years of active life for survivors in the labour force at beginning of year of age number of years of age by province and by sex

Age	Eastern Province		Southern		Northern		Western	
	Males	Females	Males	Females	Males	Females	Males	Females
15-19	22.77	15.99	19.19	16.80	20.87	14.16	43.01	28.04
20-24	13.14	10.20	11.71	10.24	13.23	9.49	17.35	12.97
25-29	8.53	7.99	8.41	7.97	8.81	7.58	9.57	8.19
30-34	6.69	6.80	6.80	6.75	6.84	6.50	6.83	6.29
35-39	5.69	5.85	5.79	5.81	5.78	5.64	5.57	5.23
40-44	4.86	4.97	4.92	4.94	4.93	4.84	4.68	4.37
45-49	4.09	4.12	4.07	4.10	4.14	4.03	3.87	3.58
50-54	4.59	4.58	4.55	4.51	4.64	4.59	4.38	4.40
55-59	3.90	3.85	3.81	3.82	3.86	3.78	3.80	3.84
60-64	3.22	3.20	3.27	3.21	3.19	3.24	3.40	3.53
65+	2.63	2.78	2.83	2.95	2.66	2.94	3.19	3.55

The data of table 1.3 above, giving the distribution of average working life by province and sex shows similar patterns. The data shows that females tend to have similar or slightly longer years of active working life at older ages than males.

3.0 THE AVERAGE EXIT AGE

The average exit age is an important indicator for policy formulation relating to the length of working life. It enables policy makers to set employment rate targets for the ageing that will ensure that the public pension system is able to meet the demands of the retired population. The methodology used in the computation of this indicator follows from the original method developed by the International Labour Organization (ILO). This indicator is calculated by using the changes occurring in the activity rates of the presently active population. To compute the average exit age from the labour force, it is assumed that no one has left the labour market before the age of 50 which implies that the active population at age 49 is 100% and that at age 70, every one who survived to this age would have left the labour force. To compute the average exit age, the first step was to compute the probability that a person who is in the active labour force will remain or exit the labour force based on the changes in the activity rates for the cohorts, 50-54; 55-59; 60-64 and 65-69. This probability was computed by comparing the age specific activity rates for two consecutive age groups. Table 1.4 below shows the results obtained.

Table 1.4. Average Exit age from the Sierra Leone Labour Force (both Sexes)

Age	Labour Force Participation rates	Probability of Remaining in Labour Force	Probability of exiting the labour force	Average Exit Age
50-54 . . .	79.50	0.9690	0.0310	50.87
55-59 . . .	78.22	0. 9840	0.0160	56.58
60-64 . . .	71.58	0.9151	0.0849	57.19
65-69	60.97	0.8518	0.1482	57.50
Total				55.54

Table 1.4 shows the probability of remaining in the labour force for each age group. To compute the probability of remaining in the labour force for the cohort 60-64 year olds, the activity rate for the age group 60-64 was divided by the activity rate for the age group 55-59(71.58/78.22). Similarly, the probability of remaining in the labour force up to the 55-59 year age group was obtained by dividing the activity rate for the 55-59 year old age group by that for the 50-54 year old group. To compute the probability of exiting the labour force at each age we subtract the probability of remaining in the labour force for each cohort from the value 1.0

The average exit age from the labour force could then be computed by multiplying the probability of remaining in the labour force by the mid-year of the age interval for each cohort. The overall average exit age for the Sierra Leone Labour Force was computed as the simple average of the average exit ages of all age groups 50 to 69 years old.

Figure 1.2: Average Exit age from the Labour Force by sex

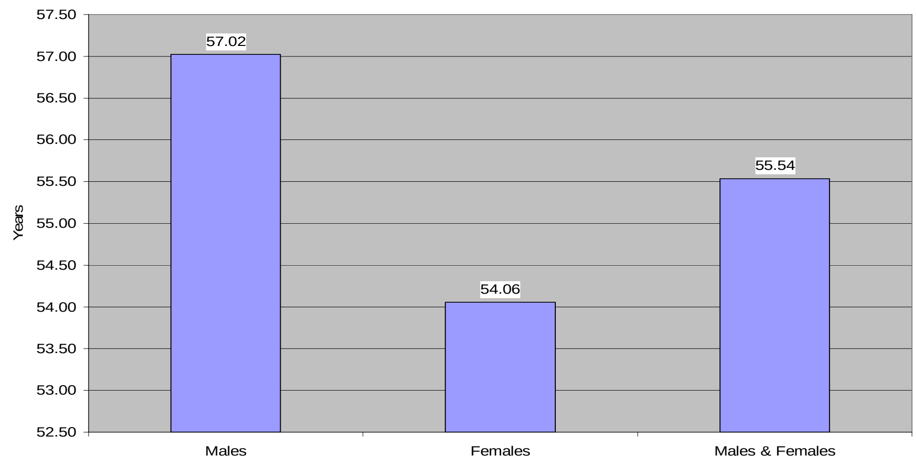


Figure 1.2 above shows that the average exit age for the Sierra Leone population according to the 2004 Housing and Population Census data was 55.5 years. The results illustrated above show that males exit the labour force about 3 years later than females.

Regional analysis of this indicator shows similar trends with males leaving the labour force later than females in all regions. As shown in table 1.5 below, the exit age from the labour force is higher than the national average for all regions except in the Western Area where the exit age is lower than the national average. This may be as a result of the unavailability of formal employment opportunities. Formal employment offer the opportunity to retire with benefits and regular pension paid to the individual. In the absence of such opportunities, people will have to continue working to support themselves and their families even when they are old. For most rural people, retirement is forced by injury, sickness or severe old age which limits the individual's capacity to work.

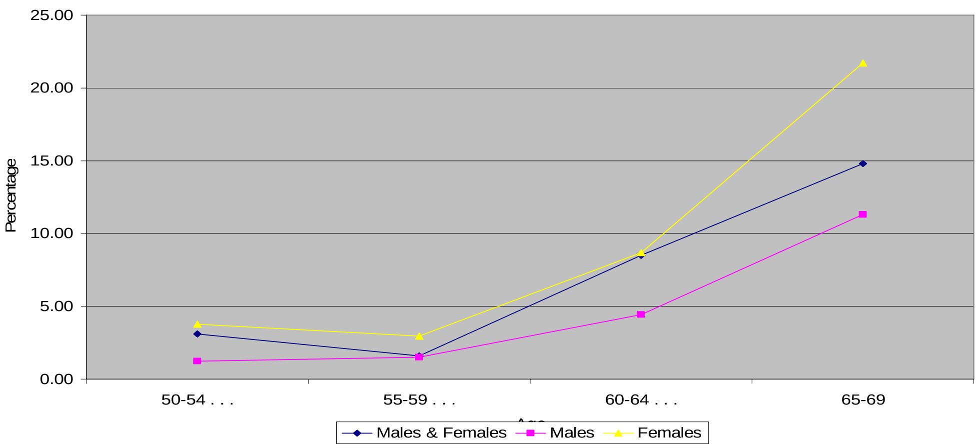
Table 1.5: Average exit age by Province and sex

Province	Males	Females	Males & Females
Eastern	58.02	55.71	56.86
Northern	57.46	54.43	56.11
Southern	57.00	54.69	55.67
Western	52.42	48.38	50.14

4.0 PROBABILITY OF EXITING THE LABOUR FORCE

The probability of leaving the labour force provides a measure of the likelihood that persons who are in the labour force until they are 49 will leave at various ages up to 70 years. This indicator is useful for estimating social security contributions of persons at various ages and in cases of injury the lost earnings arising as a result of such injury.

Figure 1.3: Probability of Exiting the Labour Force by Sex



The indicator is computed using the same assumptions on which the average exit age was estimated. Thus the probability of leaving the labour force at age 49 is zero and the probability of exiting the labour force at 70 is one. This means that the probability of leaving the labour force increases gradually from age 50 so that at age 70 all persons who were in the labour force at age 49 would have retired. Figure 1.3 above illustrates this pattern. As shown on the graph, the probability of leaving the labour force is lower at ages 55-59 than at other age groups but rises sharply there after. Assuming that activity rates fall in a linear fashion after age 64 until they are zero at age 70, the probability of leaving the labour force reaches 100 at age 70. The 2004 census data illustrated on figure 1.3 above shows that females who survive in the labour force up to age 49 are more likely to leave earlier than their male counterparts at all ages. Generally, the probabilities of leaving the labour force are low due to the high labour force participation rates at various age groups.

5.0 OTHER WORKING LIFE AND SOCIAL PROTECTION INDICATORS

In order to further investigate the working life of the Sierra Leone population and to advise policy on social protection, three social protection indicators; old age dependency ratio, participation rate of older workers, and the proportion of older workers in the total labour force were computed. Each of these indicators can be used to throw light on the working life of the Sierra Leone population

5.1 The Participation rate of old age workers

This indicator was constructed as the number of older workers (55-64) in the labour force expressed as a percentage of the total population in this age group (i.e. 55-64). The results are depicted in table 1.6 below. This indicator is very important for projecting the future supply of labour. To improve working life expectancy and average exit age from the labour force, it is necessary as a matter of policy to increase labour force participation rate of old age workers. As shown in table 1.6, the participation rate of old age workers for the country as a whole was about 75 percent, which is quite high. The interpretation of this indicator must be placed in proper perspective. It should be noted that 75.8 percent of the old age workers (55-64) were self employed mainly in the informal sector. This means that the bulk of the old age workers are not likely to be covered by any social insurance scheme that guarantees some measure of protection at old age. The type of labour force participation that could be considered beneficial to the social security system of a welfare state is one which can guarantee a flow of part of the individual's earnings as contributions to the system.

Table 1.6 Participation rate of older workers by Province and sex

Province	Males & Females	Males	Females
Eastern	75.97	88.72	61.34
Northern	77.25	89.23	67.47
Southern	76.77	89.30	66.02
Western	65.05	77.76	51.49
Sierra Leone	**74.85**	**87.10**	**63.43**

The implication is that although the current participation rates of older workers as revealed by the 2004 census data appears to be high, there is need for policies aimed at raising or sustaining the participation rate of older workers in decent employment opportunities.

5.2 Old Age Dependency

The old age dependency ratio was computed as the ratio of the population aged 65 and older to the working population (15-64).

Table 1.7 Old age Dependency Ratio by Province and Sex

Province	Males & Females	Males	Females
Eastern	8.36	8.67	8.04
Northern	9.99	11.32	8.98
Southern	10.82	10.80	10.84
Western	5.13	4.39	5.89
Sierra Leone	**8.73**	**8.93**	**8.55**

This indicator can point to the level of burden that those working are likely to bear in catering for the retired, assuming that the effective retirement age is 65.The Old Age Dependency ratio is a very crude estimate of the relationship between the active population and the “dependent” population. To be very precise, one would have to estimate the “worker to retiree ratio” to clearly discern this relationship. The Census data on which the analysis is based does not lend it itself to such detailed analysis.

5.3 Proportion of Older Workers in the Total Labour Force

The proportion of older workers in the total labour force is defined as the number of older workers (55-64) in the labour force expressed as a percentage of the total labour force. This indicator can be used as a tool to determine the share of older workers in the total labour force. When comparable data exist, this kind of information can help us asses the progress being made on the implementation of policies aimed at increasing the working life of the aged population. The aim of social protection policy is to increase the length of working life of the older population by increasing their employment rate.

Table 1.8 Proportion of older workers in the total labour force

Province	Males & Females	Males	Females
Eastern	6.05	6.63	5.28
Northern	6.99	7.72	6.34
Southern	7.19	7.51	6.85
Western	5.28	6.01	4.40
Sierra Leone	**7.03**	**7.07**	**5.90**

As shown in table 1.8, the share of older workers in the total labour force is very small. When the data on table 1.8 is compared with that in table 1.6, an interesting pattern emerges. It shows that although the participation rate of old age workers mainly in the informal sector was high, the number of such workers in the total labour force was small. Combining these two observations will help us to advocate for a policy shift towards the provision of decent work opportunities for older, mature workers particularly in the formal sector where they are likely to be of more benefit to the social security system. The current emphasis tends to be more focused on the provision of jobs for the youths. For a welfare state that uses the social security system as a means to provide social protection for the vulnerable especially the aged, extending the working life of the old aged population by raising their participation rates in employment that guarantee the contribution of their earnings to the system should be a major policy objective.

The important point to take note of is that in a welfare state, prolonged retirement ages are necessary to ensure a continuous flow of funds needed to sustain the social protection system. As the employment rate decreases especially of the older population the income flow to the social security system declines and the outflows to sustain the contributor increases.

6.0 CONCLUSIONS AND POLICY RECOMMENDATIONS

Working life expectancy can be regarded as a measure of the retirement age because work-life expectancy represents the expected length of life spent in the labour force. If we regard this as the valid measure of the age of retirement, expected life time earnings of persons in the labour force could be computed. The working life reflects the labour force participation rates and withdrawals from the labour force. By means of a working life table we can estimate the average expected number of years every body in Sierra Leone will work including employed persons who survive to specific ages by calculating from 100,000 births the number of employed people who survive to each specific age. By means of the life table we can compute the number of person-years lived in each age group, and the cumulative future person-years lived of employed people. This information can be used to calculate the mean expected working years, the mean age and median age at entry into and withdrawal from employment, the replacement rate and replacement ratio of labor force to reflect changes in the labor force, the expected total consumption, and output of different ages.

Research on developing working life tables for Sierra Leone should be given high priority because of its usefulness to the social security system. One of such uses relates to the settlement of social security claims and benefit payments arising from occupational injury to social security contributors. By means of the working life table, lost earnings arising from the injury could be estimated which could serve as the basis for paying compensation to injured contributors. In the absence of such scientific means of computing benefits, lawyers may rely on guess work to arrive at compensation claims.

Following the above analysis, it is apparent that there is a need for setting clear policies and employment targets. Employment policies and targets should be aimed at increasing the average exit age at which people stop working and increase the employment rate of older workers especially women. The current effective average exit age of 55 years need to be raised by 10 years within a reasonable time period in order to meet the official target retirement age of 65 years. Learning from the experiences of developed economies that have effective social protection systems in place, considerable attention should be given to developing policies that boost labour force participation rates especially for women and older workers. There is need for setting clear targets for increasing the employment rate and delaying the exit from the labour force for older workers especially women.

The policy focus should be to increase the social security contribution of the large number of persons in self employment especially old age workers in the informal sector while at the same time planning for a progressive increase in the effective retirement age and employability of these workers.

Some of the policy responses that could encourage increasing labour force participation and delayed retirement from the labour force include; removing incentives encouraging early retirement and providing financial rewards for longer service, continuous training of the work force to update their skills, increase adult education and training, providing safe and attractive work environments etc. All of these would require collaboration from employers in both the public and private sector. A coordinated system of collaboration among the various employment agencies needs to be put in place.

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SECTION THREE

Ibrahim G. Kargbo - Statistics Sierra Leone

1.0 SCHOOL LIFE TABLES

1.1 Introduction

1.1.1 The Nature of School Life Tables

School Life tables are examples of current or period life tables that combine mortality rates and educational characteristics in schools within an educational system. More specifically they explain the average number of years learners have in school at a particular age due to a combination of mortality rates and one or more educational indicator(s). Such a combination usually produces a statistical model that can be used to evaluate mortality, survivorship and life expectancy within an educational system.

1.2 Methodology

1.2.1 The Composition of School Life Tables

In an attempt to provide a snap shot of mortality and education throughout Sierra Leone from the census data, school life tables have been constructed not only for the country, but also for the four regions. The disparities which exist will form the basis for exploring avenues to improve education nationwide.

In the context of Sierra Leone, school life tables consist of the proportion of enrolment for the individual ages of learners within the 6-3-3-4 educational system. Basically, six components/functions have been used in the design of school-life tables for our country and her regions.

The components of the life tables in the appendices are as follows:

1. The total stationary population at each age (L_x)
2. The total number of persons reaching a specific age (l_x)
3. The proportion/percentage enrolled in school (s_x)
4. The product of the total stationary population and the proportion enrolled (L_{sx})
5. The total number of person-years spent in school (T_{sx})
6. The average number of years of school-life (eo_{sx})

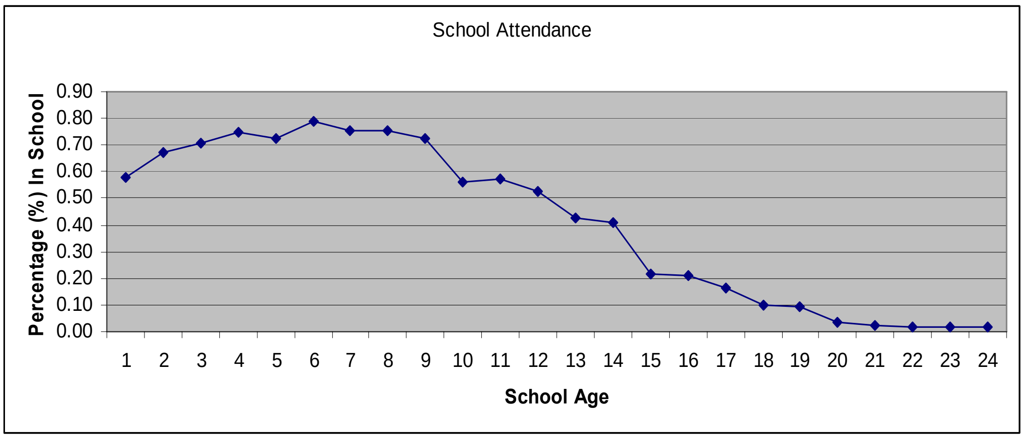
With the foregoing, it is important to mention that life expectancy is a key determinant of the stationary population used in the construction of any life table. Starting with the national life expectancy of 48.4(calculated from the census data), stationary populations for each region were selected from the *Regional Model Life Tables and Stable Populations* using an indirect method, and thereafter interpolating between appropriate North Model Life Tables of Coale and Demeng and the United Nations (1966) to produce the 2004 school life tables for Sierra Leone.

2.0 RESULTS

2.1 School Attendance

A fascinating picture painted by the 2004 School Life Tables is the trend in the proportion of school attendance between ages 6 – 29 years. At the beginning of the primary level (age 6), the proportion enrolled increases steadily from about 58% to 79% (age 11) and then diminishes to the minimum at the age of 29 years. Alternatively, it has been shown that more than 42% of 6 year old are out of school although this proportion tend to reduce over the last five or six years as indicated in Chart 1 below:

Chart 1: Proportion of School Attendance By Age



Impact on the length of school life for learners in Sierra Leone due to high proportions of over-aged children in school cannot be overemphasised.

2.2 School Life at beginning of Educational Levels

Appendices C, D and E provide three sets of School Life Tables for both sexes (male and female combined), male and female populations respectively, obtained from the 2004 census in Sierra Leone. In all cases, the tables suggest that the average number of years of school-life decrease steadily as the ages of scholars and their educational levels increase.

Chart 2: National School Life for Both sexes at the Beginning of Educational Levels

Chart 2 above explains that boys and girls at age six (official age for commencing primary school) have an average school life of 16.34 years. The corresponding years at the onset of Junior Secondary School (JSS), Senior Secondary School (SSS) and Tertiary levels are 7.29 years, 5.9 years and 4 years respectively. Charts 3 and 4 below show similar figures exclusively for males and females respectively:

Chart 3: National School Life for Combine Males By Educational Level

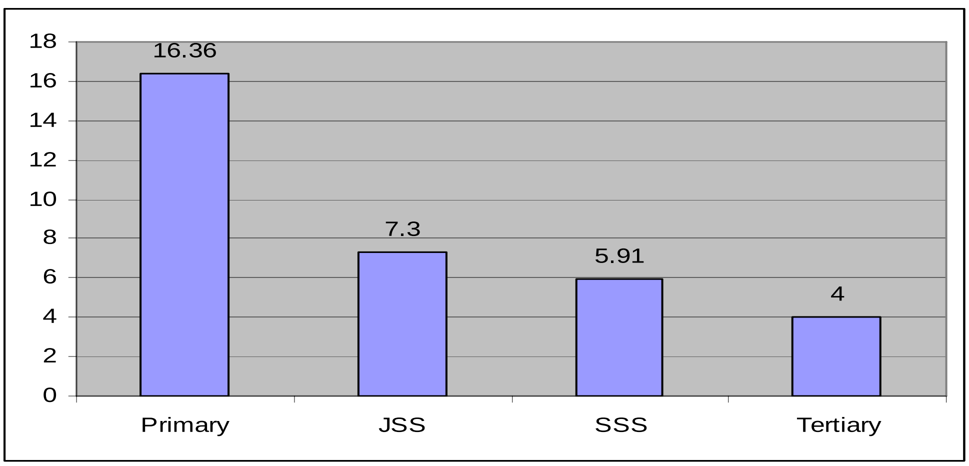
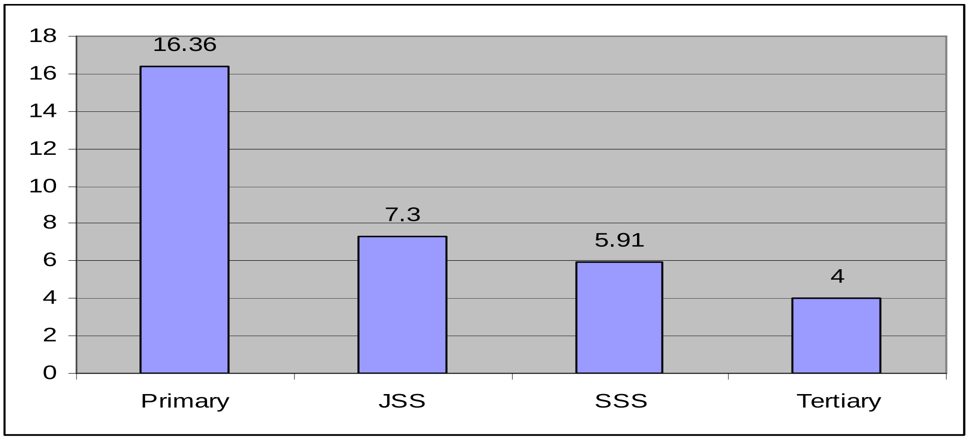


Chart 4: National School Life for Combined Females By Educational Level



The two charts shown above indicate that as a nation, school life is the same at the beginning of all educational levels within the 6-3-3-4 system of education, irrespective of sex. It must be noted that the 6-3-3-4 system requires a minimum of 16 years at the onset of the primary, 10 years at JSS, 7 years at SSS and 4 years in the tertiary for completion of schooling. Notwithstanding this, only children in the primary level are at an advantage since the results of the 2004 census fall far below the minimum number of years required particularly in the JSS and SSS levels.

2.3 Average School Life for Both Sexes By Regions

Table 1 below gives a fascinating and complete picture of average school life for both sexes throughout Sierra Leone. Judging from the fact that the 6-3-3-4 educational system requires a minimum of 16 years of average school life at the beginning of primary school, any region below this minimum will be at a disadvantaged position.

With this background, it is clear from table 1 that much attention is needed for both sexes in the Eastern Province and the Southern Province where average school life at the onset of the primary level is below 16 years. Similarly at the beginning of Junior Secondary School (where a minimum of 10 years is required), attention is needed not only at the national level, but in all the regions of Sierra Leone. The situation is rather more appalling at the beginning of Senior Secondary Schools where school life is less than the 7 years minimum particularly at the national level. For the tertiary level however, attention is needed in all the regions apart from the Western Area and the nation as a whole.

Table 1: School Life for Both Sexes by Educational Levels and Regions

Region	Primary	JSS	SSS	Tertiary
Eastern Province	15.08	6.84	5.18	3.36
Northern Province	16.66	6.83	5.59	3.65
Southern Province	15.46	6.99	5.57	3.8
Western Area	16.28	8.16	6.28	4.53
Sierra Leone	**16.34**	**7.29**	**5.9**	**4**

2.4 Average School Life for Males By Region

Table 2 below shows the average school life for males in the various regions. Again at the beginning of the primary level, focus should be given to the Eastern province and Southern province where the average year of school life is least. At the JSS level of the males, attention should be given to all the regions and the country as a whole since school life is far below the 10 years minimum. The SSS and Tertiary levels require the same attention from educational stakeholders to maximise school life to 7 and 4 years respectively (see table 2 below).

Table 2: Males School Life by Educational Levels and Regions

Region/District	Primary	JSS	SSS	Tertiary
Eastern Province	15.07	6.84	5.18	3.36
Northern Province	16.65	6.82	5.58	3.64
Southern Province	15.45	6.98	5.56	3.8
Western Area	16.26	8.15	6.27	4.53
Sierra Leone	**16.36**	**7.3**	**5.91**	**4**

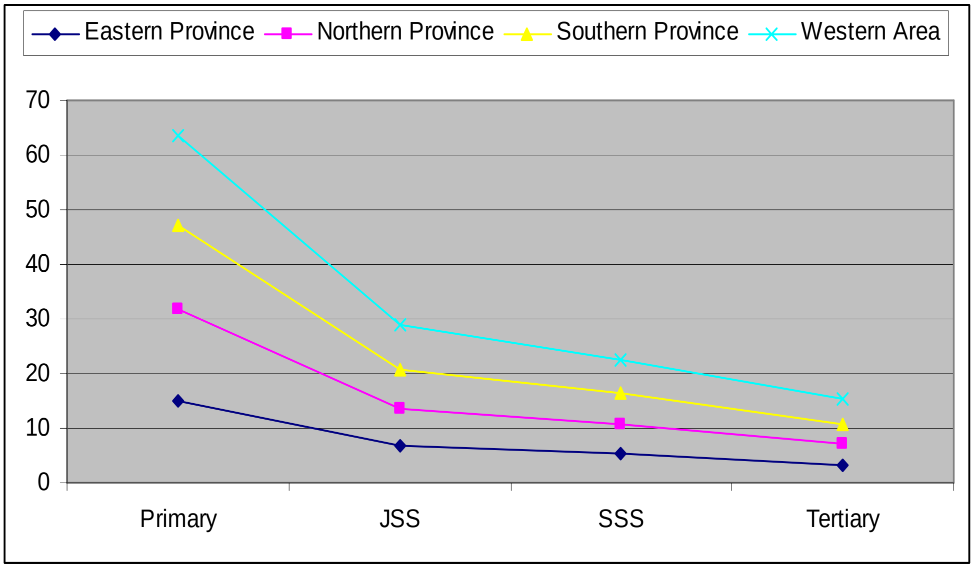
2.5 Average School Life for Female By Regions

Table 3 below and chart 5 which follow show the female school life by educational levels and regions. The Eastern and Southern provinces also need attention for the maximisation of average school life (to 16 years) for the females at the beginning of primary school. Trends for JSS, SSS and Tertiary levels are similar to those of males throughout the country.

Table 3: Female School Life by Educational Levels and Regions

Region/District	Primary	JSS	SSS	Tertiary
Eastern Province	15.1	6.85	5.19	3.37
Northern Province	16.68	6.84	5.6	3.65
Southern Province	15.48	7	5.58	3.81
Western Area	16.3	8.18	6.3	4.54
Sierra Leone	**16.36**	**7.3**	**5.91**	**4**

Chart 5: School Life by Educational Level and Region



2.6 Male and Female Average Primary School Life By Region

The 6-3-3-4 system of education aims at making quality education accessible to as many as possible throughout Sierra Leone. The 2004 regional school life tables however show disparities in the average school life for boys and girls at all levels of education in the various regions. Charts 6, 7, 8 and 9 confirm differences in school life by sex across regions throughout Sierra Leone:

Chart 6: Primary School Life by Sex across Regions

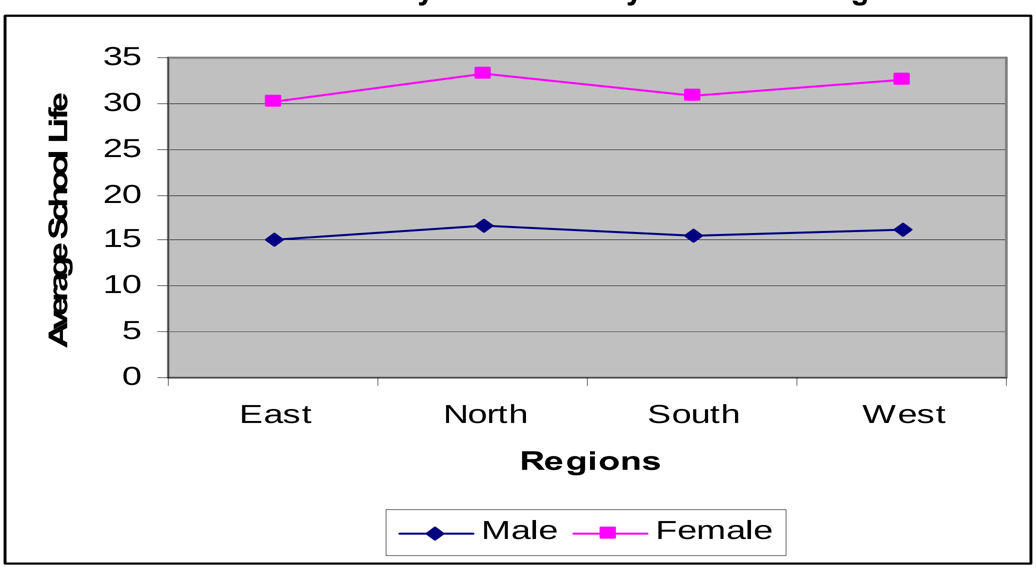


Chart 7: JSS School Life by Sex across Regions

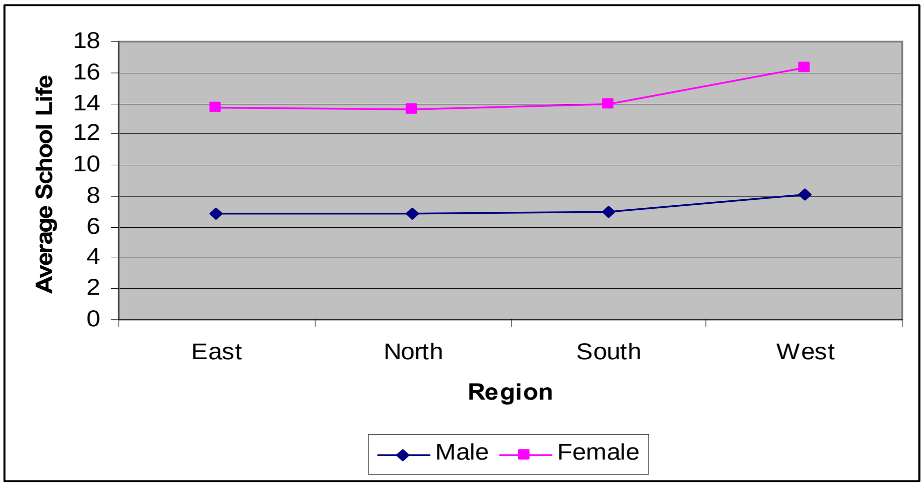


Chart 8: SSS School Life by Sex across Regions

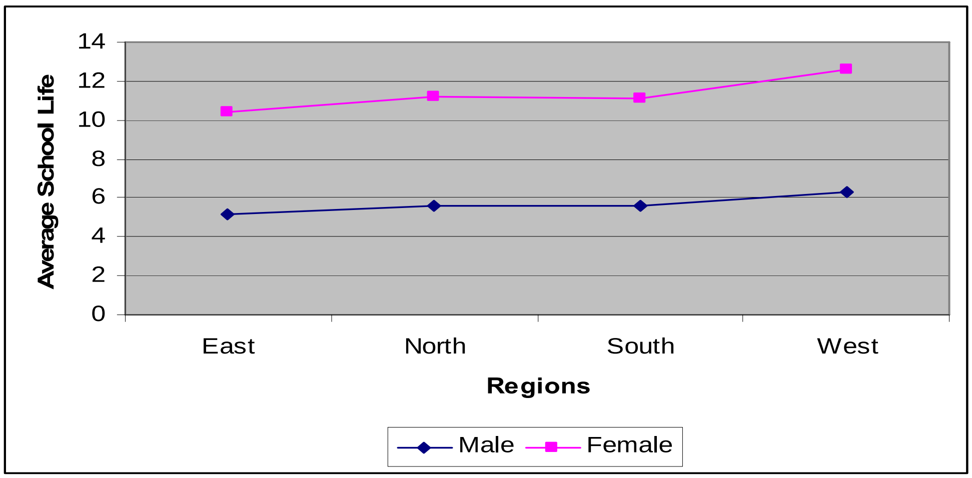
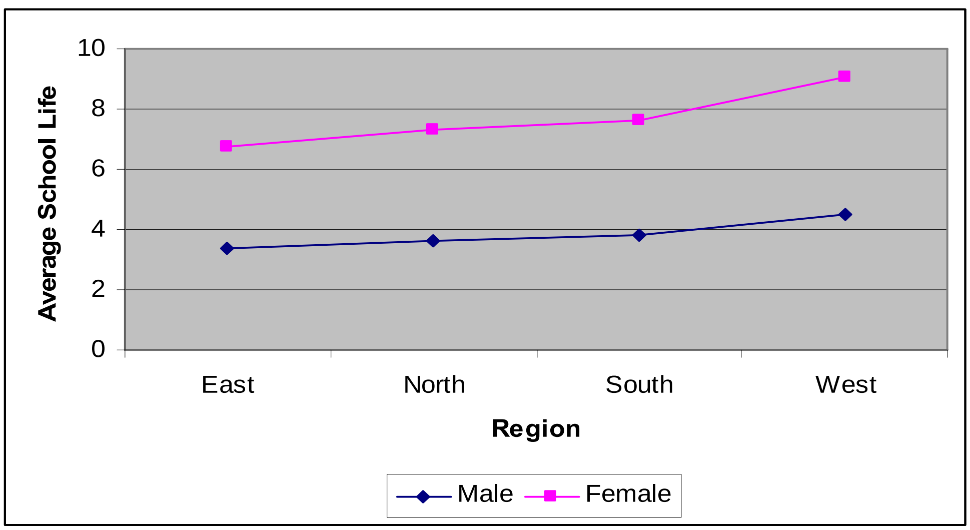


Chart 9: Tertiary School Life By Sex Across Regions



2.7 Differential School Life Within Regions

Analysis of the census data also indicate marked differences in average school life among the combined male and female populations within regions. Charts10, 11, 12 and 13 below illustrate such disparities.

Chart 10: Differential School Life in the Western Area by Educational Levels

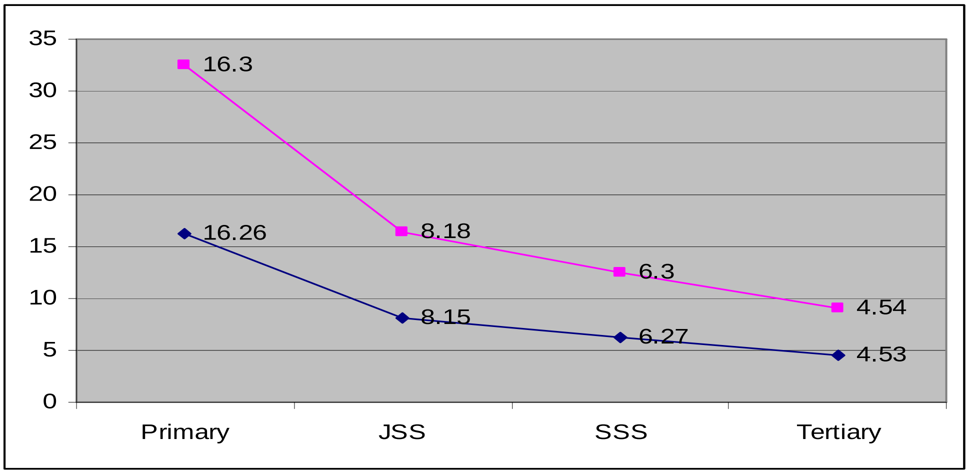


Chart 11: Differential School Life in the Southern Province by Sex and Educational Levels

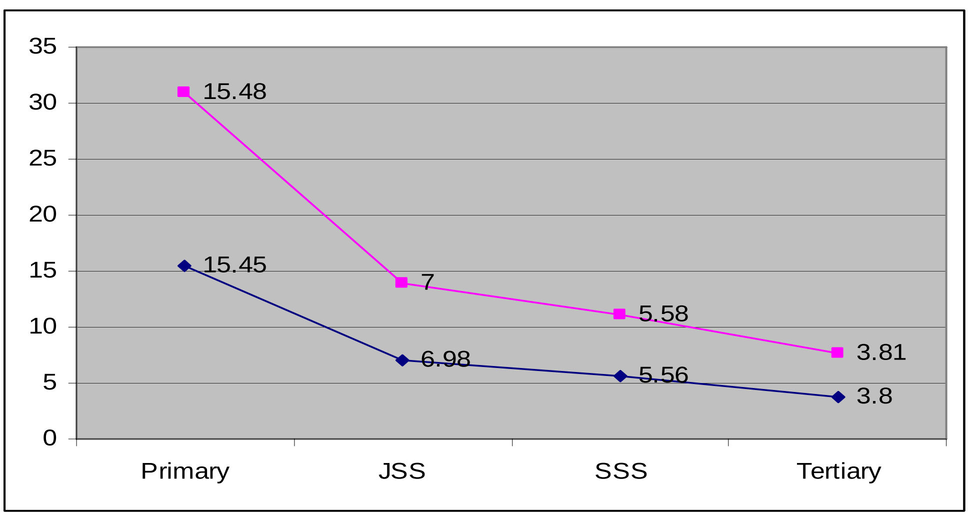


Chart 12: Differential School Life in the Northern Province by Sex and Educational Levels

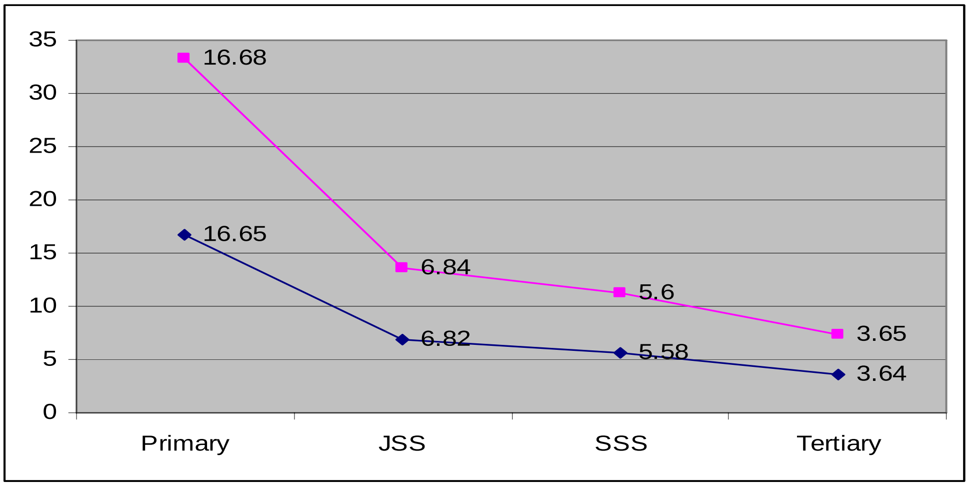
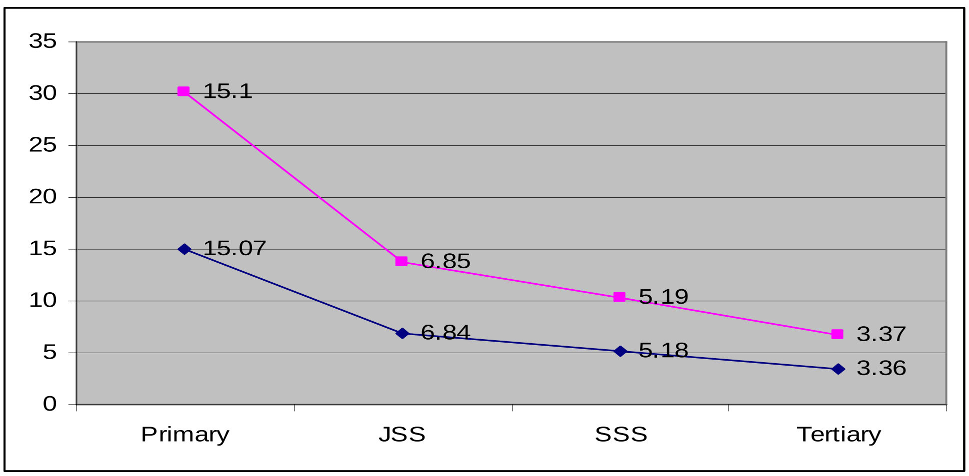


Chart 13: Differential School Life in the Eastern Province by Sex and Educational Levels



2.8 Conclusion

In the preceding sections, an attempt has been made to analyse Sierra Leone's School Life Tables constructed from the 2004 census data on education. An attempt has been made to carry out an analysis as comprehensive as possible, given the nature of the education data collected. Analysis has been done on a national and regional level with a gender focus at the various educational levels. The fact that the data was not smoothed before generating the tables caused a little concern but this did not in anyway hinder the analysis of the raw/original data. There were obvious data errors but these were only of concern where the numbers were significant or totally ridiculous.

The overall picture of education presented by the 2004 School Life Tables indicates of ongoing progress and improvement but with a tremendous amount of work still to be done to maximise school life, reduce gender inequality, improve net enrolment and completion rates at all levels for the hundreds of thousands whose education may otherwise end at the junior secondary level. The challenges are huge but invigorating. The writer of this report is however certain that with a dynamic and willing government, education will be the key that unlocks the door to a bright and prosperous Sierra Leone.

2.9 Policy Implications

2.9.1 School Life at the Beginning of Each Educational Level

1. National School Life is below the minimum of 10 and 7 years at the beginning of JSS and SSS respectively.

2. School Life at the beginning of the primary level is below the minimum of 16 years in the Eastern and Southern provinces for the combined male and female populations.

2.9.2 School Life by Sex across Regions

Female School Life is higher across regions and within regions.

2.9.3 School Attendance

1. Over 42% of 6 year olds are out of school. To be able to achieve our Universal Primary Education and Completion and Universal Basic Education goals, Sierra Leone needs to get all pupils of basic education age into schools. Action must be taken immediately if the 2015 target for the achievement of Universal Primary Education is to be achieved.

2. The analysis shows that school attendance peaks at approximately 11 years. The suggestion is that many start school late. Local Governments in the regions should be encouraged to ensure that children start school at the right age as over-aged pupils appear to encounter more completion problems than their younger counterparts.

3. The difference between males and females in terms of school attendance increases with age. Programmes which focus on getting the girl-child into school on time and retaining her there until completion are recommended.

3.0 REFERENCES

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4.0 APPENDICES

APPENDICES C

School Life Table for the Total and Enrolled Male and Female Populations of Sierra Leone

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	381505	220,270	0.57737	220270	3600239	16.34
7	378959	253,935	0.67008	253934	3379970	13.31
8	376412	265,382	0.70503	265381	3126035	11.78
9	373866	279,140	0.74663	279139	2860654	10.25
10	371320	268,091	0.72199	268090	2581516	9.63
11	369515	292,570	0.79177	292570	2313426	7.91
12	367710	277,199	0.75385	277199	2020856	7.29
13	365905	275,882	0.75397	275881	1743657	6.32
14	364100	263,096	0.72259	263095	1467776	5.58
15	362295	204,165	0.56353	204165	1204681	5.90
16	360159	206,923	0.57453	206922	1000516	4.84
17	358023	189,240	0.52857	189240	793594	4.19
18	355888	151,139	0.42468	151138	604354	4.00
19	353752	144,437	0.40830	144437	453216	3.14
20	351617	76,508	0.21759	76507	308779	0.40
21	349160	73,027	0.20915	73027	232272	0.32
22	346704	56,799	0.16382	56798	159245	0.28
23	344248	35,143	0.10209	35143	102446	0.29
24	341791	31,759	0.09292	31759	67303	0.21
25	339335	12,570	0.03704	12570	35545	0.28
26	336722	6,921	0.02056	6921	22974	0.33
27	334109	6,169	0.01846	6169	16053	0.26
28	331497	4,931	0.01487	4931	9884	0.20
29	328884	4,953	0.01506	4953	4953	0.10
School Life Table for the Total and Enrolled Male and Female Populations In The Eastern Province						
Age	**L_x**	**l_x**	**s_x**	**L_{sx}**	**T_{sx}**	**eo_{sx}**
6	381505	236,599	0.62017	236598	3568305	15.08
7	378959	269,083	0.71006	269082	3331707	12.38
8	376412	275,711	0.73247	275710	3062625	11.11
9	373866	288,124	0.77066	288123	2786915	9.67
10	371320	275,592	0.74219	275591	2498792	9.07
11	369515	293,333	0.79383	293332	2223200	7.58
12	367710	281,988	0.76687	281987	1929869	6.84
13	365905	278,883	0.76217	278883	1647881	5.91
14	364100	268,345	0.73701	268344	1368999	5.10
15	362295	212,304	0.58600	212304	1100655	5.18
16	360159	210,046	0.58320	210045	888351	4.23
17	358023	181,873	0.50799	181872	678306	3.73
18	355888	147,686	0.41498	147686	496433	3.36
19	353752	133,234	0.37663	133234	348748	2.62
20	351617	71,188	0.20246	71188	215514	3.03
21	349160	51,012	0.14610	51012	144326	2.83
22	346704	41,255	0.11899	41255	93314	2.26
23	344248	17,912	0.05203	17912	52060	2.91
24	341791	16,656	0.04873	16656	34148	2.05

School Life Table for the Total and Enrolled Male and Female Populations In The Eastern Province (cont'…)

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
25	339335	7,502	0.02211	7502	17491	2.33
26	336722	2,808	0.00834	2808	9989	3.56
27	334109	2,835	0.00848	2835	7181	2.53
28	331497	2,356	0.00711	2356	4346	1.84
29	328884	2,038	0.00620	2038	1990	0.98

School Life Table for the Total and Enrolled Male and Female Populations In The Northern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	381505.19	185,184	0.48540	185183	3086047	16.66
7	378958.78	220,321	0.58138	220321	2900864	13.17
8	376412.37	236,606	0.62858	236606	2680543	11.33
9	373865.96	249,891	0.66840	249891	2443937	9.78
10	371319.55	240,123	0.64667	240122	2194046	9.14
11	369514.56	264,264	0.71516	264264	1953924	7.39
12	367709.57	247,434	0.67290	247433	1689661	6.83
13	365904.58	247,730	0.67703	247729	1442227	5.82
14	364099.59	229,498	0.63031	229497	1194498	5.20
15	362294.6	172,569	0.47632	172569	965001	5.59
16	360159.04	171,711	0.47676	171711	792432	4.61
17	358023.48	153,851	0.42972	153851	620721	4.03
18	355887.92	128,014	0.35970	128014	466870	3.65
19	353752.36	123,115	0.34802	123115	338856	2.75
20	351616.8	59,139	0.16819	59139	215742	3.65
21	349160.39	51,298	0.14692	51298	156603	3.05
22	346703.98	40,925	0.11804	40925	105305	2.57
23	344247.57	21,202	0.06159	21202	64380	3.04
24	341791.16	18,463	0.05402	18463	43179	2.34
25	339334.8	8,598	0.02534	8598	24716	2.87
26	336722.03	4,292	0.01275	4292	16118	3.76
27	334109.31	4,706	0.01408	4706	11826	2.51
28	331496.59	3,629	0.01095	3629	7120	1.96
29	328883.87	3,491	0.01061	3491	3491	1.00

School Life Table for the Total and Enrolled Male and Female Populations In The Southern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	381505.19	227,519	0.59637	227519	3518560	15.46
7	378958.78	259,329	0.68432	259328	3291042	12.69
8	376412.37	265,191	0.70452	265190	3031713	11.43
9	373865.96	278,439	0.74475	278438	2766523	9.94
10	371319.55	267,083	0.71928	267082	2488085	9.32
11	369514.56	292,952	0.79280	292952	2221003	7.58
12	367709.57	275,820	0.75010	275820	1928051	6.99
13	365904.58	272,997	0.74609	272996	1652232	6.05
14	364099.59	265,982	0.73052	265981	1379236	5.19
15	362294.6	199,695	0.55119	199694	1113254	5.57
16	360159.04	197,343	0.54793	197342	913560	4.63
17	358023.48	182,676	0.51023	182676	716218	3.92
18	355887.92	140,307	0.39424	140307	533542	3.80

School Life Table for the Total and Enrolled Male & Female Populations In The Southern Province (cont'…)

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
19	353752.36	131,762	0.37247	131762	393236	2.98
20	351616.8	67,686	0.19250	67686	261474	3.86
21	349160.39	63,896	0.18300	63896	193788	3.03
22	346703.98	49,776	0.14357	49776	129892	2.61
23	344247.57	28,322	0.08227	28322	80115	2.83
24	341791.16	26,539	0.07765	26539	51794	1.95
25	339334.8	9,708	0.02861	9708	25254	2.60
26	336722.03	4,760	0.01414	4760	15546	3.27
27	334109.31	4,281	0.01281	4281	10786	2.52
28	331496.59	3,261	0.00984	3261	6505	1.99
29	328883.87	3,244	0.00986	3244	3244	1.00

School Life Table for the Total and Enrolled Male and Female Populations In The Western Area

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	381505.19	278,694	0.73051	278693	4536113	16.28
7	378958.78	307,043	0.81022	307042	4257420	13.87
8	376412.37	321,106	0.85307	321106	3950378	12.30
9	373865.96	327,761	0.87668	327760	3629272	11.07
10	371319.55	324,240	0.87321	324240	3301512	10.18
11	369514.56	331,840	0.89804	331839	2977273	8.97
12	367709.57	324,066	0.88131	324065	2645434	8.16
13	365904.58	316,038	0.86371	316037	2321368	7.35
14	364099.59	303,790	0.83436	303790	2005331	6.60
15	362294.6	270,810	0.74748	270809	1701542	6.28
16	360159.04	262,800	0.72968	262799	1430733	5.44
17	358023.48	244,246	0.68220	244245	1167934	4.78
18	355887.92	203,766	0.57255	203765	923689	4.53
19	353752.36	186,638	0.52759	186637	719924	3.86
20	351616.8	127,740	0.36329	127740	533287	4.17
21	349160.39	117,157	0.33554	117157	405547	3.46
22	346703.98	90,454	0.26090	90453	288390	3.19
23	344247.57	62,133	0.18049	62133	197936	3.19
24	341791.16	54,810	0.16036	54809	135803	2.48
25	339334.8	34,052	0.10035	34052	80994	2.38
26	336722.03	14,648	0.04350	14648	46942	3.20
27	334109.31	11,748	0.03516	11748	32293	2.75
28	331496.59	10,613	0.03202	10613	20545	1.94
29	328883.87	9,932	0.03020	9932	9932.000	1.00

APPENDICES D

School Life Table for the Total and Enrolled Male Populations of Sierra Leone

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	375852	217,006	0.57737	217006	3543135	16.33
7	373320	250,156	0.67008	250156	3326129	13.30
8	370788	261,416	0.70503	261415	3075973	11.77
9	368255	274,951	0.74663	274950	2814558	10.24
10	365723	264,050	0.72199	264050	2539608	9.62
11	363910	288,133	0.79177	288132	2275559	7.90
12	362096	272,968	0.75385	272967	1987427	7.28
13	360283	271,644	0.75397	271643	1714460	6.31
14	358470	259,028	0.72259	259027	1442817	5.57
15	356656	200,988	0.56353	200987	1183790	5.89
16	354356	203,589	0.57453	203588	982802	4.83
17	352056	186,086	0.52857	186086	779214	4.19
18	349756	148,534	0.42468	148534	593129	3.99
19	347456	141,866	0.40830	141866	444594	3.99
20	345156	75,102	0.21759	75102	302729	0.40
21	342474	71,629	0.20915	71629	227627	0.32
22	339793	55,666	0.16382	55666	155998	0.28
23	337111	34,414	0.10209	34414	100332	0.29
24	334429	31,075	0.09292	31075	65918	0.21
25	331747	12,289	0.03704	12289	34843	0.28
26	329021	6,763	0.02056	6763	22554	0.33
27	326294	6,025	0.01846	6025	15791	0.26
28	323568	4,813	0.01487	4813	9766	0.20
29	320842	4,832	0.01506	4832	4953	0.10

School Life Table for the Total and Enrolled Male Populations In The Eastern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	375852	233,093	0.62017	233092	3512182	15.07
7	373320	265,079	0.71006	265078	3279090	12.37
8	370788	271,591	0.73247	271590	3014012	11.10
9	368255	283,800	0.77066	283799	2742422	9.66
10	365723	271,438	0.74219	271438	2458623	9.06
11	363910	288,883	0.79383	288883	2187185	7.57
12	362096	277,683	0.76687	277683	1898302	6.84
13	360283	274,599	0.76217	274598	1620620	5.90
14	358470	264,195	0.73701	264195	1346022	5.09
15	356656	209,000	0.58600	209000	1081827	5.18
16	354356	206,662	0.58320	206661	872827	4.22
17	352056	178,842	0.50799	178841	666166	3.72
18	349756	145,141	0.41498	145141	487325	3.36
19	347456	130,863	0.37663	130862	342184	2.61
20	345156	69,880	0.20246	69880	211322	3.02
21	342474	50,035	0.14610	50035	141442	2.83
22	339793	40,432	0.11899	40432	91407	2.26
23	337111	17,541	0.05203	17541	50975	2.91
24	334429	16,297	0.04873	16297	33434	2.05

School Life Table for the Total and Enrolled Male Populations In The Eastern Province (cont'…)

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
25	331747	7,335	0.02211	7334	17137	2.34
26	329021	2,744	0.00834	2744	9802	3.57
27	326294	2,769	0.00848	2769	7058	2.55
28	323568	2,300	0.00711	2300	4290	1.87
29	320842	1,988	0.00620	1988	1990	1.00

School Life Table for the Total and Enrolled Male Populations In The Northern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	375852	182,440	0.48540	182439	3037357	16.65
7	373319.8	217,043	0.58138	217042	2854917	13.15
8	370787.6	233,071	0.62858	233070	2637875	11.32
9	368255.4	246,141	0.66840	246141	2404805	9.77
10	365723.2	236,504	0.64667	236503	2158664	9.13
11	363909.78	260,256	0.71516	260255	1922161	7.39
12	362096.36	243,657	0.67290	243656	1661906	6.82
13	360282.94	243,924	0.67703	243923	1418250	5.81
14	358469.52	225,949	0.63031	225949	1174327	5.20
15	356656.1	169,883	0.47632	169883	948378	5.58
16	354356.1	168,945	0.47676	168944	778495	4.61
17	352056.1	151,287	0.42972	151286	609550	4.03
18	349756.1	125,809	0.35970	125808	458264	3.64
19	347456.1	120,924	0.34802	120923	332456	2.75
20	345156.1	58,053	0.16819	58053	211533	3.64
21	342474.36	50,316	0.14692	50315	153480	3.05
22	339792.62	40,109	0.11804	40109	103165	2.57
23	337110.88	20,762	0.06159	20762	63056	3.04
24	334429.14	18,065	0.05402	18065	42294	2.34
25	331747.4	8,406	0.02534	8406	24229	2.88
26	329020.94	4,194	0.01275	4194	15823	3.77
27	326294.48	4,596	0.01408	4596	11629	2.53
28	323568.02	3,542	0.01095	3542	7033	1.99
29	320841.56	3,405	0.01061	3405	3491	1.03

School Life Table for the Total and Enrolled Male Populations In The Southern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	375852	224,148	0.59637	224147	3462906	15.45
7	373319.8	255,470	0.68432	255470	3238759	12.68
8	370787.6	261,228	0.70452	261228	2983289	11.42
9	368255.4	274,260	0.74475	274259	2722061	9.93
10	365723.2	263,058	0.71928	263057	2447802	9.31
11	363909.78	288,509	0.79280	288508	2184745	7.57
12	362096.36	271,610	0.75010	271609	1896237	6.98
13	360282.94	268,803	0.74609	268802	1624628	6.04
14	358469.52	261,869	0.73052	261868	1355826	5.18
15	356656.1	196,587	0.55119	196586	1093958	5.56
16	354356.1	194,163	0.54793	194162	897372	4.62
17	352056.1	179,632	0.51023	179631	703209	3.91
18	349756.1	137,890	0.39424	137889	523578	3.80

School Life Table for the Total and Enrolled Male Populations In The Southern Province (cont'…)

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
19	347456.1	129,417	0.37247	129417	385689	2.98
20	345156.1	66,443	0.19250	66443	256272	3.86
21	342474.36	62,673	0.18300	62672	189830	3.03
22	339792.62	48,784	0.14357	48784	127157	2.61
23	337110.88	27,735	0.08227	27735	78373	2.83
24	334429.14	25,968	0.07765	25968	50639	1.95
25	331747.4	9,491	0.02861	9491	24671	2.60
26	329020.94	4,651	0.01414	4651	15180	3.26
27	326294.48	4,181	0.01281	4181	10529	2.52
28	323568.02	3,183	0.00984	3183	6348	1.99
29	320841.56	3,165	0.00986	3165	3165	1.00

School Life Table for the Total and Enrolled Male Populations In The Western Area

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	375852	274,564	0.73051	274563	4463437	16.26
7	373319.8	302,474	0.81022	302473	4188874	13.85
8	370787.6	316,308	0.85307	316307	3886401	12.29
9	368255.4	322,843	0.87668	322842	3570094	11.06
10	365723.2	319,354	0.87321	319353	3247252	10.17
11	363909.78	326,807	0.89804	326806	2927899	8.96
12	362096.36	319,119	0.88131	319118	2601094	8.15
13	360282.94	311,182	0.86371	311181	2281975	7.33
14	358469.52	299,093	0.83436	299092	1970794	6.59
15	356656.1	266,595	0.74748	266594	1671702	6.27
16	354356.1	258,566	0.72968	258565	1405108	5.43
17	352056.1	240,175	0.68220	240174	1146543	4.77
18	349756.1	200,255	0.57255	200254	906369	4.53
19	347456.1	183,316	0.52759	183315	706115	3.85
20	345156.1	125,393	0.36329	125393	522799	4.17
21	342474.36	114,914	0.33554	114914	397406	3.46
22	339792.62	88,651	0.26090	88650	282493	3.19
23	337110.88	60,845	0.18049	60845	193842	3.19
24	334429.14	53,629	0.16036	53629	132998	2.48
25	331747.4	33,291	0.10035	33291	79369	2.38
26	329020.94	14,313	0.04350	14313	46078	3.22
27	326294.48	11,473	0.03516	11473	31765	2.77
28	323568.02	10,360	0.03202	10360	20292	1.96
29	320841.56	9,689	0.03020	9689	9932.000	1.03

APPENDICES E

School Life Table for the Total and Enrolled Female Populations of Sierra Leone

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	387158	223,534	0.57737	223534	3657344	16.36
7	384598	257,714	0.67008	257713	3433811	13.32
8	382037	269,347	0.70503	269347	3176098	11.79
9	379477	283,329	0.74663	283328	2906751	10.26
10	376916	272,131	0.72199	272131	2623423	9.64
11	375119	297,008	0.79177	297007	2351293	7.92
12	373323	281,431	0.75385	281430	2054285	7.30
13	371526	280,121	0.75397	280120	1772855	6.33
14	369730	267,164	0.72259	267164	1492735	5.59
15	367933	207,343	0.56353	207342	1225572	5.91
16	365962	210,257	0.57453	210256	1018229	4.84
17	363991	192,395	0.52857	192394	807973	4.20
18	362020	153,743	0.42468	153742	615579	4.00
19	360049	147,008	0.40830	147007	461837	3.14
20	358078	77,913	0.21759	77913	314830	0.40
21	355846	74,426	0.20915	74426	236917	0.32
22	353615	57,931	0.16382	57931	162491	0.28
23	351384	35,871	0.10209	35871	104560	0.29
24	349153	32,443	0.09292	32443	68689	0.21
25	346922	12,851	0.03704	12851	36246	0.28
26	344423	7,080	0.02056	7080	23395	0.33
27	341924	6,313	0.01846	6313	16315	0.26
28	339425	5,049	0.01487	5049	10002	0.20
29	336926	5,075	0.01506	5075	4953	0.10

School Life Table for the Total & Enrolled Female Populations In The Eastern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	387158	240,105	0.62017	240104	3624428	15.10
7	384598	273,087	0.71006	273086	3384324	12.39
8	382037	279,830	0.73247	279830	3111238	11.12
9	379477	292,448	0.77066	292447	2831408	9.68
10	376916	279,746	0.74219	279745	2538961	9.08
11	375119	297,782	0.79383	297781	2259216	7.59
12	373323	286,293	0.76687	286292	1961435	6.85
13	371526	283,168	0.76217	283167	1675143	5.92
14	369730	272,494	0.73701	272493	1391976	5.11
15	367933	215,609	0.58600	215608	1119482	5.19
16	365962	213,430	0.58320	213429	903875	4.23
17	363991	184,904	0.50799	184904	690445	3.73
18	362020	150,231	0.41498	150230	505541	3.37
19	360049	135,606	0.37663	135605	355311	2.62
20	358078	72,496	0.20246	72496	219706	3.03
21	355846	51,989	0.14610	51988	147210	2.83
22	353615	42,077	0.11899	42077	95221	2.26
23	351384	18,283	0.05203	18283	53144	2.91
24	349153	17,015	0.04873	17015	34861	2.05

School Life Table for the Total and Enrolled Female Populations of Sierra Leone (cont'…)

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
25	346922	7,670	0.02211	7670	17846	2.33
26	344423	2,872	0.00834	2872	10176	3.54
27	341924	2,901	0.00848	2901	7304	2.52
28	339425	2,413	0.00711	2413	4403	1.82
29	336926	2,087	0.00620	2087	1990	0.95

School Life Table for the Total and Enrolled Female Populations In The Northern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	387158.38	187,928	0.48540	187927	3134737	16.68
7	384597.76	223,600	0.58138	223599	2946810	13.18
8	382037.14	240,142	0.62858	240141	2723210	11.34
9	379476.52	253,641	0.66840	253641	2483069	9.79
10	376915.9	243,742	0.64667	243741	2229428	9.15
11	375119.34	268,273	0.71516	268272	1985687	7.40
12	373322.78	251,211	0.67290	251210	1717415	6.84
13	371526.22	251,536	0.67703	251535	1466205	5.83
14	369729.66	233,047	0.63031	233046	1214670	5.21
15	367933.1	175,255	0.47632	175254	981623	5.60
16	365961.98	174,478	0.47676	174478	806369	4.62
17	363990.86	156,415	0.42972	156415	631891	4.04
18	362019.74	130,220	0.35970	130220	475476	3.65
19	360048.62	125,306	0.34802	125306	345257	2.76
20	358077.5	60,226	0.16819	60226	219951	3.65
21	355846.42	52,280	0.14692	52280	159725	3.06
22	353615.34	41,740	0.11804	41740	107445	2.57
23	351384.26	21,641	0.06159	21641	65705	3.04
24	349153.18	18,860	0.05402	18860	44064	2.34
25	346922.1	8,790	0.02534	8790	25203	2.87
26	344423.12	4,391	0.01275	4391	16413	3.74
27	341924.14	4,816	0.01408	4816	12023	2.50
28	339425.16	3,716	0.01095	3716	7207	1.94
29	336926.18	3,576	0.01061	3576	3491	0.98

School Life Table for the Total and Enrolled Female Populations In The Southern Province

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	387158.38	230,891	0.59637	230890	3574215	15.48
7	384597.76	263,188	0.68432	263187	3343325	12.70
8	382037.14	269,154	0.70452	269153	3080137	11.44
9	379476.52	282,617	0.74475	282616	2810984	9.95
10	376915.9	271,108	0.71928	271108	2528368	9.33
11	375119.34	297,396	0.79280	297395	2257260	7.59
12	373322.78	280,031	0.75010	280030	1959865	7.00
13	371526.22	277,191	0.74609	277190	1679835	6.06
14	369729.66	270,095	0.73052	270094	1402645	5.19
15	367933.1	202,802	0.55119	202802	1132551	5.58
16	365961.98	200,522	0.54793	200522	929749	4.64
17	363990.86	185,721	0.51023	185721	729227	3.93

School Life Table for the Total and Enrolled Female Populations In The Southern Province (cont'…)

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
18	362019.74	142,724	0.39424	142724	543506	3.81
19	360048.62	134,107	0.37247	134107	400783	2.99
20	358077.5	68,930	0.19250	68930	266675	3.87
21	355846.42	65,120	0.18300	65119	197746	3.04
22	353615.34	50,769	0.14357	50768	132626	2.61
23	351384.26	28,909	0.08227	28909	81858	2.83
24	349153.18	27,111	0.07765	27111	52949	1.95
25	346922.1	9,925	0.02861	9925	25838	2.60
26	344423.12	4,869	0.01414	4869	15912	3.27
27	341924.14	4,381	0.01281	4381	11043	2.52
28	339425.16	3,339	0.00984	3339	6663	2.00
29	336926.18	3,323	0.00986	3323	3323	1.00

School Life Table for the Total and Enrolled Female Populations In The Western Area

Age	L_x	l_x	s_x	L_{sx}	T_{sx}	eo_{sx}
6	387158.38	282,823	0.73051	282823	4608788	16.30
7	384597.76	311,611	0.81022	311611	4325966	13.88
8	382037.14	325,905	0.85307	325904	4014355	12.32
9	379476.52	332,680	0.87668	332679	3688451	11.09
10	376915.9	329,127	0.87321	329126	3355772	10.20
11	375119.34	336,873	0.89804	336872	3026646	8.98
12	373322.78	329,013	0.88131	329012	2689774	8.18
13	371526.22	320,893	0.86371	320892	2360761	7.36
14	369729.66	308,488	0.83436	308487	2039869	6.61
15	367933.1	275,024	0.74748	275024	1731382	6.30
16	365961.98	267,034	0.72968	267033	1456358	5.45
17	363990.86	248,316	0.68220	248316	1189325	4.79
18	362019.74	207,276	0.57255	207276	941009	4.54
19	360048.62	189,960	0.52759	189959	733733	3.86
20	358077.5	130,088	0.36329	130087	543774	4.18
21	355846.42	119,401	0.33554	119400	413687	3.46
22	353615.34	92,257	0.26090	92257	294286	3.19
23	351384.26	63,421	0.18049	63421	202030	3.19
24	349153.18	55,990	0.16036	55990	138609	2.48
25	346922.1	34,813	0.10035	34813	82619	2.37
26	344423.12	14,983	0.04350	14983	47805	3.19
27	341924.14	12,023	0.03516	12023	32822	2.73
28	339425.16	10,867	0.03202	10867	20799	1.91
29	336926.18	10,175	0.03020	10174	9932.000	0.98