J Hum Ecol, 43(3): 257-265 (2013)
PRINT: ISSN 0970-9274 ONLINE: ISSN 2456-6608 DOI: 10.31901/24566608.2013/43.3.06

Estimates of Fertility for South Africa based on Rele Method, 1996-2011

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KEYWORDS Census. Fertility. Rele. South Africa. Survey

ABSTRACT The paper uses the 1996, 2001 and 2011 censuses and 2007 Community Survey to study levels, trends and differentials in fertility in South Africa using the Rele method that estimates fertility from the reported age distributions. At national level, Total Fertility Rate (TFR) remained constant at 3.3 children per woman between 1996 and 2001 but declined to 2.4 and 2.2 children per woman in 2007 and 2011, respectively. There are variations in fertility by province and population group. Fertility is lower among the affluent provinces of Gauteng, Western Cape and Free State than the disadvantaged provinces of Limpopo, Mpumalanga, Eastern Cape and North West. Fertility has remained largely unchanged in Free State and Mpumalanga and has decreased in all the other provinces with exception of Western Cape and Kwazulu-Natal which suggest a rise in fertility during the period under review. The factors responsible for such a pattern are not fully understood and remain to be established by further research.

INTRODUCTION

There have been profound changes in fertility rates in Africa in the past two to three decades (Cohen 1993; Garenne 2007; Ezeh et al. 2009). An article in *Population Headlines* in 2005 noted "Global population has experienced a major and unprecedented reduction in fertility levels, driven mostly by the decline in fertility in developing countries" (Population Headlines, No. 304, January-February, 2005: 4). In South Africa available evidence suggests that fertility transition has been under way for nearly five decades (Moultrie and Timaeus 2003).

The availability of new data has allowed a better documentation of the fertility transition and underlying causes, more so for some countries in Africa. The underlying causes of fertility change are, however, still a matter of debate among scholars and policymakers. This paper contributes to this debate by presenting another set of fertility estimates for South Africa by province and population group.

This overview proceeds as follows. Section 2 reviews existing fertility estimates in South Africa. Section 3 discusses the sources of fertility data in South Africa before describing the estimation procedure used in this study. Section 4 present fertility estimates based on Rele method. The final section discusses the plausibility of the derived estimates and argues that the method may be used to obtain fertility estimates for other subdivisions in the country. This will provide an opportunity to study levels, trends and differentials in fertility at these levels.

Studies on Fertility in South Africa

The objective of this section is to summarize existing knowledge on levels, trends, and differentials in fertility in South Africa. Prior to the introduction of the democratic processes in South Africa little was known about the nature and patterns of fertility in the country, especially among the now-white populations (African, Coloured and Asian). With the democratisation of the country that began in early 1990s and culminated in the first democratically elected government in 1994, several comprehensive studies on fertility have been conducted (Garrene et. al. 2007; Moultrie and Timaeus 2003; Udjo 1997, 1998, 2003, 2004; Sibanda and Zuberi 1999; Chimere-Dan 1997). The level of fertility in South African is among the lowest in the whole of sub-Saharan Africa (Moultrie and Timæus 2002, 2003). South Africa was the first country in Sub-Saharan Africa to experience fertility decline (Rossouwl et. al 2012). The available estimates indicate that TFR declined from 6.5 children per woman in the mid 1960s to 3.5 children per woman during the early 1990s and to 2.8 children per woman in the early 2000s (Udjo 2005; Caldwell and Caldwell 2003; Moultrie and Timæus 2002, 2003).

However, as new sources of data become available it is necessary to update the available

demographic estimates. Moreover in situation of deficient demographic data, there is need to apply as many techniques as possible in order to establish robust levels, trends and differentials in fertility.

Objectives

Against the aforementioned background, the main objectives of the study are: (1) to estimate fertility for South Africa and its provinces using Rele methods; and (2) to examine provincial differentials in fertility in South Africa.

Sources of Fertility Data in South Africa

There are several sets of data from which fertility estimates for South Africa can be derived. These data sets include the October Household Surveys, 1998 and 2003 South African Demographic and Health Surveys, 1996, 2001 and 2011 South African Population Censuses and 2007 Community Survey. Women aged between 12 years and 50 years in the censuses and the fore mentioned surveys were asked to report: (i) the number of "live" births which had occurred to them in the last twelve months; current fertility, (ii) the number of children they have ever born alive; lifetime fertility. These data are available by five-year age group of the mother, and from them various measures of current and lifetime fertility can be calculated. Analyses by Udjo (1997, 1998, 2003, 2004) has exploited these estimation procedures that we do not intend to repeat them here. Rather our intention is to apply other estimation methods.

It has been demonstrated that the age-sex distribution of the population is largely determined by the level of fertility (Rele 1967). As such, in situations where the knowledge of the latter is minimal, plausible measures of fertility can be derived from the reported age statistics, unless the age-sex structure is greatly affected by migration or age mis-statements. In other countries, plausible measures of fertility have been estimated from reported age-sex distributions (Mhloyi 1992).

This study is based on the analysis of the reported age-sex distributions based on the 1996 and 2001 censuses and 2007 Community Survey. The age-sex distributions has been evaluated using the commonly used methods and have been found to be of high quality (Palamuleni 2008; Bah 1999; Simelane 2002, 2010). A method based on the reported age structure is used. Two factors motivated us to use this method. First, up to now the 2001 census results on fertility have not yet been released. This means that researchers have to resort to other means of estimating fertility. Second, the international isolation in the 1970s and 1980s meant that for the outside researchers little was known about what was happening to the South African demography. Researchers working in South Africa carried out some demographic studies and analysis but in most cases, these studies were influenced by the political ideology of the day. With the collapse of apartheid, more studies have been conducted to examine the various aspects of the South African demography. There is need to exploit as many estimation procedures as possible to come up with a plausible picture of the demographic situation of the country.

Thirdly, the available demographic data are fraught with many problems. As such, fertility data collected in the censuses and sample surveys are not only inaccessible to researchers but also cannot be relied upon without adjustments. In some cases, even when the data are available, they are of such a questionable quality that they are practically unusable without further adjustment. For instance, the fertility data collected in the 2003 South African Demographic and Health Survey are fraught with problems that they cannot be relied upon (Department of Health 2007). This means that the available fertility estimates are a function of the assumptions, strengths and limitations of different estimation procedures.

Geographical Setting

South Africa occupies 1,219,080 square kilometres at the southernmost tip of the African continent, stretching from the Limpopo River in the North to Cape Agulhas in the South. On the west coast border is the Atlantic Ocean, while the eastern coastline runs along the Indian Ocean. In the north, South Africa borders Namibia, Botswana and Zimbabwe, while Mozambique and Swaziland border on the North-East. South Africa is one of the highly urbanised countries on the continent. The proportion urban has increased from 55.1 percent in 1996 to 57.5 percent in 2001 (Statistics South Africa 2003).

The country is divided into nine provinces each having its own distinctive features. These provinces are Western Cape, Eastern Cape,

Northern Cape, Free State, Kwazulu-Natal, North West, Gauteng, Mpumalanga and Limpopo. The Western Cape includes Cape Town, popularly referred to as the mother city, and the Cape Peninsula, the Wine lands, the Overberg Mountains, the West Coast and the Garden Route. The Eastern Cape ranges from the inland Great Karoo area to the varied coastline on the Indian Ocean, where the cities of Port Elizabeth and East London are found. This province offers a great variety of scenery, including majestic mountain ranges, lush forests and valleys, the semi-desert area of the Karoo, a rugged coastline and vast unspoilt beaches.

The Northern Cape is South Africa's largest province, but has only one city Kimberley, which grew as the centre of the diamond industry in the 19th century. The "Big Hole" in Kimberley is one of the deepest man-made holes in the world and is a major tourist attraction. The Northern Cape is an agricultural area for the sheep, wine and dried fruit industries. The region incorporates the Kalahari Gemsbok National Park, which together with the Botswana National Park forms one of the world's largest conservation areas.

Free State is landlocked, but lies between the Vaal River in the north and the Orange River in the south. Its major city is Bloemfontein, the judicial capital of South Africa. While the southern Free State is mainly an agricultural area, the northern Free State is built on the gold industry.

Kwazulu-Natal is one of the populous provinces in South Africa. The two cities of KwaZulu-Natal are Durban and Pietermaritzburg. Durban offers an atmosphere that is a blend Western, African and Eastern cultures. It is also one of the most popular holiday destinations and divides the KwaZulu-Natal coastline into the south coast and north coast, both of which offer numerous holiday resorts. In addition to the warm waters of the Indian Ocean, KwaZulu-Natal is also home to many game resorts and reserves in the majestic Drakensberg Mountains.

The North-West is primarily an area of agriculture and mining, but is also home to game farms and guest resorts for those who wish to get away from city life.

Gauteng, is the industrial and financial centre of South Africa. Both Johannesburg and Pretoria are situated in this province. In addition, the Magaliesburg Mountains to the north of Pretoria offer resorts and facilities for those who enjoy the outdoors: fishing, hiking, bird watching, horse riding and so on.

Mpumalanga (Eastern Transvaal) is home to one of South Africa's main tourist attractions - the Kruger National Park. In addition, the region offers the beautiful scenery of forested mountains and the lakes and waterfalls of the Blyde River Canyon. The town of Witbank is a centre for the coal mining industry, while the lowveld is a fertile agricultural area.

Limpopo (formerly known as the Northern Transvaal and then Northern Province) is an important agricultural area with plentiful forests, tea plantations and fruit orchards. Game farms are also abundant in this province and there is a northern entrance to the Kruger National Park. The Northern Transvaal is known for its hot mineral springs and for the diversity of the countryside which ranges from mountains to extensive grasslands and wetlands. The main city in the region is *Polokwane*, which is located 260 km north-west of Pretoria.

South Africa is one of the highly urbanised countries on the continent. The percentage urban has increased from 55.1% in 1996 to 57.5% in 2001 and 62.9% (Statistics South Africa 2003, 2012). According to Population Reference Bureau (2012), apart from South Africa, the following are the most highly urbanized countries in Africa in which over 50 per cent of the population lived in urban areas: Libya (78%), Algeria (72%), Tunisia (65%), Western Sahara (94%), Djibouti (76%), Gabon (73%) and Congo (63%). The level of urbanisation in South Africa varies by province. According to the 2011 census, the percentage of the population living in urban areas ranges from 18% in the Limpopo to 97% in Gauteng. Gauteng (97%), Western Cape (92%), Free State (84%) and Northern Cape (76%) are the most urbanised provinces in South Africa, while Limpopo (18%), Mpumalanga (43%), North West (44%), Eastern Cape (45%), KwaZulu-Natal (48%) are the least urbanised provinces. The same pattern was also observed when one considers the 1996 and 2001 census data.

METHODOLOGY

Data

The study will make use of the age-sex distributions as collected in the three recent population censuses, namely the 1996, 2001 and 2011 South African Population Censuses and 2007 Community Survey (Statistics South Africa 1998,

2003, 2008, 2012). The 1996 and 2001 population censuses are the first and second censuses conducted in the country after the first democratic elections in 1994. In all previous censuses, the majority Africans who constitute nearly 75% of the national population were only estimated. However, given the high costs associated with censuses, it was not possible to conduct a census in 2006 (Palamuleni 2008). Instead a major demographic survey was planned in its place. The 2007 Community Survey had three main objectives: to provide data at lower geographical levels than existing household surveys; to build human, management and logistical capacities for Census 2011; and to provide inputs into the preparation of the mid-year population projections (Statistics South Africa 2008). The 2011 census is the most recent census undertaken in democratic South Africa (Statistics South Africa 2012).

Rele Method

Rele (1967) developed a method of estimating fertility (TFR) from the reported Child Woman Ratios (CWR). It is based on the finding that in a stable population the relationship between Gross Reproduction Rate (GRR) and CWR can be approximated by a linear equation. That is

$$GRR = \propto + \beta CWR$$

$$TFR = 2.05GRR$$

Where á and â are constants and GRR and CWR are as defined above. CWR can be calculated in various ways but CWR derived from children aged 0-4 and women aged 15-49 was found to be closer to linearity than CWR based on children aged 0-4 and women aged 15-44 years (Rele 1967). Consequently the use of the former is recommended, unless children under the age of 5 are severely under-enumerated, in which case the CWR calculated using children aged 5-9 and women aged 20-54 is recommended. In the case of South African population statistics various studies have shown that children under the age of 5 are underreported (Bah 1999). As a result of the under enumeration of children under the age of 5, fertility estimates presented in this study were based on averaging the estimates for children aged 0-4 and 5-9.

Using stable populations generated from the original United Nations model life tables, Rele has presented regression coefficients for the equation and for each level of mortality as defined by expectation of life at birth ranging from 20 to 60 years in multiples of 10. In this study expectation of life at birth for each province were obtained from the 1996 and 2001 censuses (Statistics South Africa 2000; Palamuleni 2008). Some researchers have modified the method to improve on some of its shortcomings such as the use of original UN model life tables instead of the more robust model life tables (see for example, Mahapatra 2005). This study has however made use of the original Rele method.

The method was tested for its validity using data from the developed countries where it was possible to compare fertility estimates derived from this method with measures obtained from the vital registration system. It was then applied to Latin American countries where the estimates were found to be consistent with those obtained from other indirect procedures. Since then Rele (1987, 1988) has further demonstrated the applicability and relevance of the method by using data from the Asian section of the developing countries and subsequent studies by other researchers have further confirmed that the method produces acceptable estimates (Mahapatra 2005; Mhloyi 1992). In theory the estimated level of mortality should refer to the period when the children were born. In practice this creates some problems especially in statistically underdeveloped countries where mortality statistics are far from being complete and our knowledge about the level is just as minimal as that of fertility.

The method has several advantages. First, it is simple to use and less demanding in terms of data and parameters since the level of mortality can be specified to the nearest multiple of ten. Another attractive aspect of the method, especially as regards to the South Africa situation, lies in the fact that Rele (1967) chose "indices, which makes the assumption of quasi-stability less crucial in the estimation procedure". In fact, Rele (1967) concluded that the method produces plausible estimates in populations which are "far from stable".

The method is also relevant for developing countries with a long series of censuses and surveys of acceptable quality in that it allows one to obtain fertility measures for two different periods in the past. This stems from the fact that children aged 0-4 years were born in the last five years whereas those aged 5-9 years were born 5-10 years before the enumeration. It follows then that on average the estimated TFR calculated from these age groups refers to the respective periods 2.5 and 7.5 years preceding the enu-

meration. Therefore, in countries where fertility data is lacking and the reported age statistics are reasonably good, the method provides an ingenious way of measuring any changes in fertility during the last eight years or so. But in view of the nature of the reported statistics in South Africa this approach is not attempted here. Moreover if the censuses and surveys are available at five (or ten) years interval the calculated CWR from one survey can be compared with corresponding CWR calculated from another survey. This may be useful in determining the quality of data and the robustness of the derived estimates (Rele 1987, 1988).

RESULTS AND DISCUSSION

Child-Woman Ratio

The CWR_{5-9} for South Africa and its provinces calculated from the 1996, 2001 and 2011 population censuses and 2007 Community Survey are given in Table 1.

For South Africa as a whole CWR_{5-9} has declined from 492 in 1996 to 442 in 2001 and 222 in 2007. There are variations by province and population group. On the one hand, high values in excess of the national averages are observed in Limpopo, Mpumalanga, Eastern Cape, North West, Northern Cape and Kwazulu-Natal. On the other hand, low values are observed Gauteng, Western Cape and Free State. In 1996 CWR_{5-9} range from 308.5 in Gauteng to 729.6 in Limpopo. In 2001 CWR_{5-9} varied from 270.2 in Gauteng to 627 in Limpopo. Similar values for 2007 were 157.3 and 31.9 respectively. All the three data sets indicate that Eastern Cape, Kwazulu-Natal, Mpumalanga, Limpopo and North West had CWR_{5-9} higher than the national average whereas CWR_{5-9} estimates for Free State, Gauteng, Northern Cape and Western Cape were lower than the national average. CWR_{5-9} by population group ranged from a high estimate for the African population, closely followed by that of the coloured population, then that of the Asian population and s low estimate for the white population.

From the calculated CWR_{5-9} several tentative points regarding fertility levels and differentials in South Africa can be suggested. Firstly, the ratios indicate that the level of fertility in the country is very low. Secondly, the ratios indicate marked differences in fertility by population group and provinces. Generally speaking, the CWR_{5-9} is not a very satisfactory measure for comparing fertility levels of the various regions and districts. For instance, Gauteng being the most urbanized province in the country is likely to be characterized by a lower level of infant and child mortality, and by a greater proportion of the younger and more fertile women in the adult female population due to the selective effects of rural-urban migration. However, the small difference observed between the rural and urban areas suggest the absence of rural-urban differentials in terms of fertility behaviour. Thus it can be argued that migration have a negligible effect on the reported CWR_{5-9}. The effect of the other distorting factor - mortality - will be eliminated through the application of the technique.

A more useful and simpler summary measure of fertility is the child-woman ratio (the ratio of young children to women of reproductive age group at a given period of time). A commonly

Table 1: Child woman ratios and estimated TFR for South Africa and its provinces, 1996 – 2011

Province/Country	*CWR_{5-9}*				*TFR*			
	1996	*2001*	*2007*	*2011*	*1996*	*2001*	*2007*	*2011*
Eastern Cape	647.9	589.5	305.7	475.8	4.1	3.8	2.9	3.7
Free State	446.0	404.5	197.2	380.2	2.9	2.8	2.2	3.1
Gauteng	308.5	270.2	157.3	261.4	2.2	2.0	1.9	2.2
Kwazulu-Natal	512.2	497.4	254.9	413.1	3.4	3.5	2.6	3.3
Mpumalanga	539.8	499.2	248.0	408.2	3.6	3.6	2.6	3.3
Northern Cape	476.6	418.4	189.9	410.0	3.2	3.1	2.1	3.0
Limpopo	729.6	627.6	319.2	460.9	4.6	4.1	3.0	3.7
North West	501.9	443.3	207.1	399.1	3.4	3.1	2.4	3.4
Western Cape	373.9	338.5	167.1	291.6	2.5	2.8	2.0	2.2
African	539.5	480.2	476.0	392.7	3.6	3.2	3.3	3.0
Coloured	444.6	395.6	363.5	346.4	3.1	2.7	2.6	2.6
Asian	338.4	284.8	279.3	236.3	2.2	1.8	1.8	1.7
White	270.5	239.1	201.0	208.6	1.7	1.5	1.4	1.6
South Africa	492.6	442.0	431.5	367.2	3.3	3.3	2.4	2.2

used age category of women and children that is applied to compute this ratio is the number of children aged under five years and women who are aged 15 to 49 years. The ratio does not directly refer to any actual number of births in the incidence of childbearing, but rather to the child population between the ages of 0-4 years; assuming that the children were enumerated correctly by age, they ought to be the survivors of births during the five-year period preceding the census.

The CWRs presented in Table 1 were used to estimate TFR in South Africa. Table 1 presents fertility estimates for South Africa as a whole, four population groups and nine provinces based on Rele method. Estimates of fertility for the country as whole are also depicted in Figure 1. According to this procedure, TFR based on 1996 and 2001 censuses was 3.3 children per woman and declined to 2.4 and 2.2 children per woman in 2007 and 2011 respectively. These estimates suggest that fertility remained constant between the 1996 and 2001 censuses and continued to decline thereafter. On the one hand it should be mentioned that the fertility estimates based on Rele method are within acceptable limits and are comparable with estimates based on other estimation procedures (Udjo 2003; Dorrington et al. 2004; Moultrie and Timaeus 2003; Moultrie and Dorrington 2004; Simelane 2010; Kyei 2011). For instance, Dorrington et al. (2004) reported that TFR for 1996 is 3.23 whereas our estimate is 3.3 children. The observed TFR in 2007 is the same as our estimate for 2007 (Simelane 2010). Furthermore, Dorrington et al. (2004) observed that during 1996-2001 period fertility declined by 12.1 per cent. If one assumes that this trend continues then TFR in 2007 would be 2.4 children per woman. On the other hand the finding that Rele method produces reasonable estimates contradicts an earlier observation by Udjo (1997). Based on the analyses of survey data Udjo (1997) concluded that Rele method does not give plausible results. It is our contention that this observation was specific to the data set he was using.

In addition, Table 1 and Figure 2 indicate that there are variations in fertility by province. In general, all the three censuses indicate that fertility is lowest in Gauteng and Western Cape and highest in the provinces of Kwazulu-Natal, Mpumalanga, Eastern Cape and Limpopo. In fact, in 1996 the estimated TFR ranged from 2.0 in Gauteng to 4.6 in Limpopo. The same pattern is observed in 2001 and 2007. In 2011 TFR is lowest in Gauteng and Western Cape and highest in Limpopo and Eastern Cape. Two provinces (Limpopo and Eastern Cape had TFR in 1996 greater than 4 children per woman Four provinces (Mpumalanga, Kwazulu-Natal, North West and Northern Cape) had TFR between 3 and 4 children per

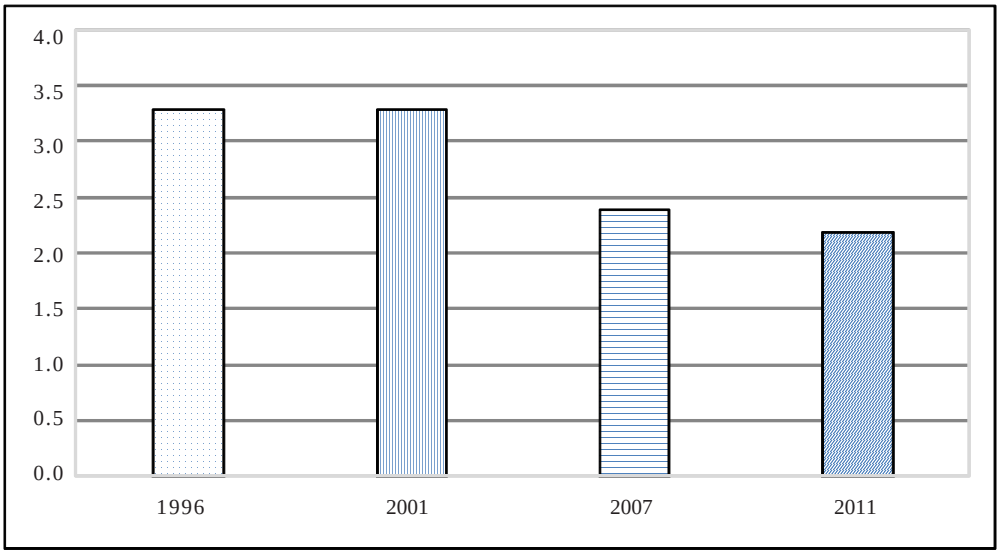

Fig. 1. Estimates of fertility for South Africa, 1996-2011

woman. Three provinces (Free State, Western Cape and Gauteng) had TFR below 3 children per woman. A similar pattern is observed in 2001 with one exception in that Eastern Cape joins the provinces with TFR below 3 and 4.

Furthermore, Table 1 indicates comparatively low fertility estimates for the provinces in 2007. In all the provinces, the estimates of fertility derived from the 2007 Community Survey are lower than the preceding and succeeding census. This is surprising and unexpected and could be attributed to unsuitability of mortality estimates used in determining the multiplying factors combined with errors in the reported age-sex distributions. Notwithstanding these challenges, the estimated TFR in 2007 ranged from 1.9 in Gauteng to 3.0 in Limpopo. All provinces with exception of Free State, Gauteng, Northern Cape and Western Cape had estimated TFR lower than the national estimate. The estimates of fertility by province for 2011 indicate that TFR was lowest in Gauteng and Western Cape and highest in Limpopo and Eastern Cape. Only Gauteng and Western Cape had TFR values similar to those of the country as whole.

Table 1 further indicate that fertility is declining in all the provinces with a possible exception of Western Cape where fertility appears to be increasing and Kwazulu-Natal where fertility remained more or less constant.

According to Table 1 and Figure 3 TFR varies by population group. TFR for Africans was the highest, closely followed by that of Coloured population, then Indians and lowest for Whites. Furthermore fertility estimates presented above indicate that TFR is declining for all population groups during the intercensal period 1996-2001. TFR for the Africans declined from 3.6 to 3.2 children per woman. TFR for the Coloureds declined from 3.1 to 2.7 children per woman. TFR for the Indians declined from 2.2 to 1.8 children per woman. This means that during the period under review the Indian population in South Africa completed its demographic transition. TFR for the White population declined from 1.7 to 1.5 children per woman.

The TFR estimates presented in Table 1 and Figure 2 suggest stagnation in the pace of fertility decline between 1996 and 2001 and an acceleration of fertility decline between 2001 and 2007. This trend though plausible is in contrast to the belief shared by most commentators who observe that fertility has continued to decline unabated in South Africa (Udjo 2005, 2009). The plausibility of this pattern is based on two accounts. First, the observation that fertility decline stalled in other African countries (Ezeh et al. 2009; Garenne 2007). It suffices to note that Garenne (2007) observed that fertility stall in Agincourt, a rural area of South Africa between

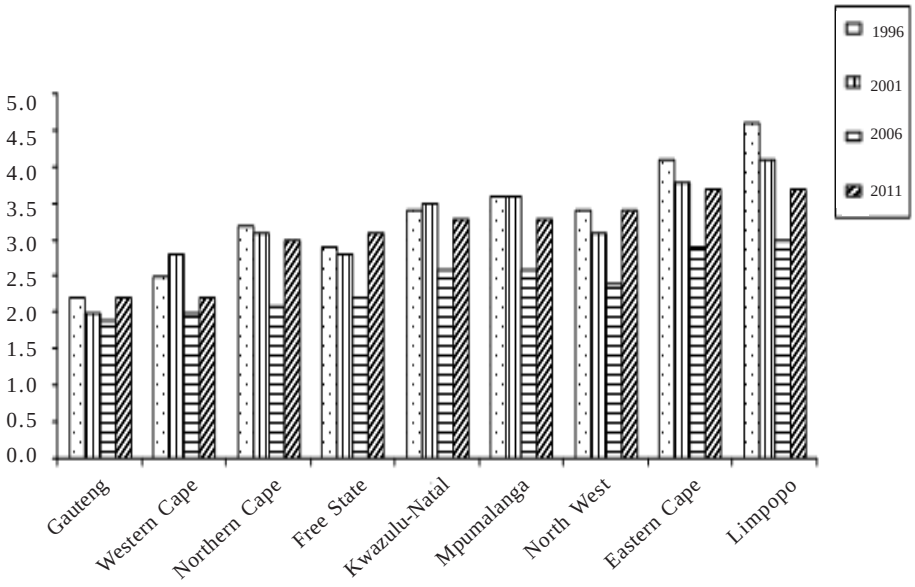

Fig. 2. Fertility levels and trends by province, South Africa, 1996-2011

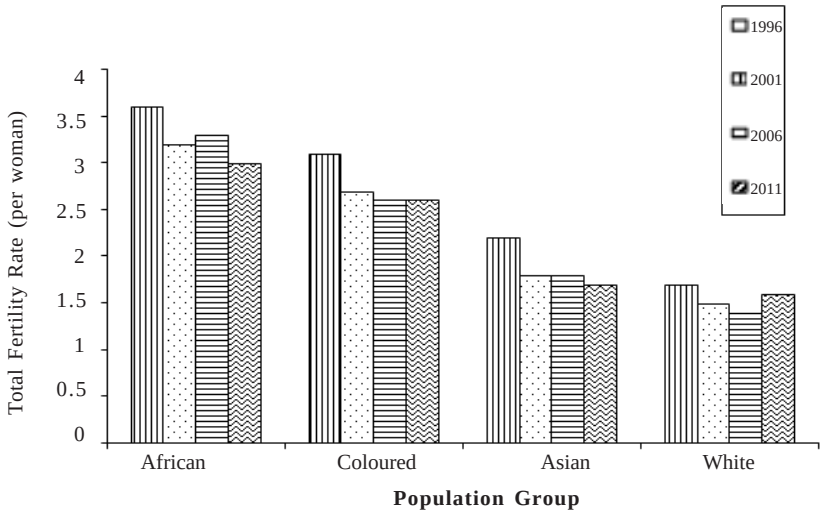

Fig. 3. Fertility levels and trends by population group, South Africa, 1996-2011

1995 and 1999 and further suggested that fertility stalled from year 2000 to 2005 in Hlabisa, another rural area in Kwazulu-Natal. With this in mind one may wonder whether or not the same pattern was observed in South Africa. Second, other researchers expected that following the new political dispensation in 1994 fertility in the country will increase (Swartz 2003). Although this study has not established an increase in fertility the findings indicate that the rate of fertility decline was somewhat reduced. Further studies should explore the plausible factors responsible for such a pattern.

CONCLUSION

The main purpose of the study was to re-estimate the levels, trends and differentials of fertility in South Africa. The need to re-estimate fertility arose because of the availability of additional data of acceptable quality and the changing socio-economic environment. The fertility estimates based on Rele method are within acceptable limits and are comparable with estimates based on other estimation procedures. Arising from the findings, it is evident that for South Africa as a whole, fertility remained more or less unchanged between 1996 and 2001 and continued to decline thereafter. In particular, it is estimated that TFR was 3.3 children per woman in 1996 and 2001 and declined to 2.4 in 2007 and 2.2 in 2011. From this perspective, this paper provides another credible view of fertility trends in South Africa. This trend though plausible is in contrast to the belief shared by most commentators who observe that fertility has continued to decline unabated in South Africa. Although this study has not established an increase the findings indicate that the rate of fertility decline was somewhat reduced. Furthermore, our findings support the observation from earlier studies that Gauteng and Western Cape exhibit low fertility whereas other provinces such as Limpopo, Mpumalanga and Kwazulu-Natal have high fertility. The more exciting finding, however, relates to the observation that fertility in Gauteng and Western Cape is below replacement level. This issue require further investigation. Future studies should examine the causes and consequences of below replacement level fertility in these provinces as well as the country as a whole.

RECOMMENDATIONS

The study sought to estimate fertility in South Africa using a method that makes use of widely available data of age-sex population distributions. Although the availability of demographic data covering all population groups have improved since the end of apartheid, there are still many areas that need a lot of improvement. For example, fertility and mortality data are not accessible to all researchers and yet such information is required to researchers and policy makers even at the smallest level of local municipality. Based on the findings of this study we recommend the use of as many estimation

procedures as possible. We also recommend that the methods based on age-sex distributions if properly used can provide robust estimates of fertility.

REFERENCES

Bah S 1999. Diagnostic Test on Assessing the Quality of Maternal Orphanhood Data from the 1996 South African Census and Implications for the Indirect Estimation of Adult Mortality. *Discussion Paper No. 99-5*, Population Studies Centre, University of Western Ontario.

Caldwell JC, Caldwell P 2003. The Fertility Transition in Sub-Saharan Africa in Department of Social Development (Ed.) (2003). *Current South African Issues of Poverty, HIV/AIDS and Youth – Seminar Proceedings*, HRSC, Pretoria, pp.117-123.

Chimere-Dan O 1997. Recent fertility patterns and population policy in South Africa. *Development South Africa* 14(1): 1-20.

Cohen B 1993. Fertility levels, differentials and trends in Africa. In: KA Foote, H Kenneth, K H Hill, L G Martin (Eds.): *Demographic Change in Sub-Saharan Africa*. Washington: National Academic Press, pp. 8-67.

Department of Health 2007. *South Africa Demographic and Health Survey 2003 – Full Report*. Department of Health, Pretoria.

Dorrington R, Timaeus IM, Moultrie, T, Nannan N 2004. Estimates of provincial fertility and mortality in South Africa, 1985-1996. *SA Journal of Demography*, 9(2): 25-57.

Ezeh AC, Mberu BU, Emina JO 2009. Stall in fertility decline in Eastern African countries: Regional analysis of patterns, determinants and implications. *Phil Trans R Soc B*, 27.

Garenne M 2007. Situations of Fertility Stall in Sub-Saharan Africa. *Paper prepared for the UAPS Conference*, Arusha, Tanzania, 10-14 December 2007.

Garrene ML, Tollman SM, Collinson MA 2007. Fertility trends and net reproduction in Agincourt, rural South Africa, 1992-2004. *Scandinavian Journal of Public Health Suppl*, 69: 68–76.

Kyei KA 2011. Comparison of the historical fertility levels among the nine provinces of South Africa. *Journal of Human Ecology*, 35(2): 85-94.

Mahapatra B 2005. Rele Technique Revisited: With an Application to India and Major States. *Seminar Paper Submitted for the Partial Fulfilment of the Master in Population Studies.* Mumbai: International Institute for Population Sciences.

Mhloyi MM. 1992. Fertility levels and trends in Zimbabwe. *Zambezia*, XK(II): 79-97.

Moultrie TA, Timaeus IM 2002. Trends in South African Fertility between 1970 and 1998: An Analysis of the 1996 Census and 1998 Demographic and Health Survey. *Technical Report*, Burden of Disease Research Unit, Medical Research Council.

Moultrie TA, Timaeus IM 2003. The South African fertility decline: Evidence for two censuses and a demographic and health survey. *Population Studies*, 57(3): 265-283.

Moultrie TA, Dorrington R 2004. Estimation of Fertility from the 2001 South African Census Data. Centre for Actuarial Research, *Monograph No. 12*, University of Cape Town.

Palamuleni ME 2008. *Demographic Changes in South Africa, 1996-2007*. Germany: VDM Publishing Company.

Population Reference Bureau 2012. *2012 Data Sheet*. Washington.

Rele JR 1967. *Fertility Analysis Through Extension of Stable Population Concepts*. Institute of International Studies, University of California, Berkeley.

Rele JR 1987. Fertility levels and trends in India: 1951-81. *Population and Development Review*, 13(3): 513-530.

Rele JR. 1988. 70 Years of fertility change in Korea: New estimates from 1916 to 1985. *Asian-Pacific Population Journal*, 3(2): 29-54.

Rossouwl L, Burger R, Burger R 2012. The Fertility Transition in South Africa: A Retrospective Panel Data Analysis. *Stellenbosch Economic Working Papers: 03/12*, Stellenbosch University, Cape Town.

Sibanda A, Zuberi T 1999. Contemporary Fertility Levels and Trends in South Africa: Evidence from Reconstructed Census Birth Histories. *Paper presented at the Third African Population Conference*, 6-10 December, 1999, Durban, South Africa, pp. 79-108.

Simelane SE 2002. An Overall and Demographic Description of the South African Population based on the Census 1996. *Occasional Paper Series, 2002/1*, Statistics South Africa, Pretoria.

Simelane S 2010. Estimation of Fertility from the 2007 Community Survey of South Africa. *Report No. 03-00-04*, Statistics South Africa, Pretoria.

Statistics South Africa 1998. The People of South Africa: Population Census 1996- Census in Brief. *Report No. 1:03-01-11* (1996), Pretoria.

Statistics South Africa 2000. *South African Life Tables*. Pretoria.

Statistics South Africa 2003. *Census 2001: How The Count Was Done*. Pretoria.

Statistics South Africa 2008. *Community Survey, 2007 Basic Results: Municipalities*, P0301.1, Pretoria.

Statistics South Africa 2012. *Census 2011: How the Count Was Done*. Pretoria.

Swart L 2003. Fertility Transition in South Africa and its Impact on the Four Major Population Groups. South Africa: Human Sciences Research Council, HSRC Publishers.

Udjo EO 1997. *Fertility and Mortality Trends in South Africa: The Evidence from the 1995 October Household Survey and Implications on Population Projections*. Pretoria: Statistics South Africa.

Udjo EO 1998. *Additional Evidence Regarding Fertility and Mortality Trends in South Africa and Implications for Population Projections*. Pretoria: Statistics South Africa.

Udjo EO 2003. A re-examination of levels and differential in fertility in South Africa from recent evidence. *Journal of Biosocial Science*, l(35): 413-431.

Udjo EO 2005. Fertility levels, differentials, and trends. In: T Zuberi, A Sibanda, EO Udjo (Eds.): *The Demography of South Africa*. New York: M.E. Sharpe, Inc., pp. 40-64.

Udjo EO 2009. Trends in the age pattern of fertility, 1995-2005, in the context of the child support grant in South Africa. *Development Southern Africa*, 26(2): 289-299.