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WATER RESOURCES AND FERTILITY IN SOUTH AFRICA

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Paper Summary

There is growing concern about the exhaustion of natural resources caused by increasing populations. Recently scholars have suggested that declining resources may, in turn, lead to population change. This paper provides a descriptive analysis of the relationship between water resources and fertility (births) using household level data from South Africa. Access to water is unequally distributed across the South African population. There are significant differences in source of and distance to water across racial and income groups, and between rural and urban communities. Simple correlations suggest that fertility rates tend to be higher among women who travel large distances to collect water.

Key Words: Water, fertility, births, South Africa

INTRODUCTION

Statistics on the impact that population growth will have on available natural resources often attract a lot of attention in the popular press as well as in the academic community. Such statistics, often very alarming, suggest an impending global problem. However, for framing policies it is important to realize that neither the rate of population growth nor the intensity of resource use is exogenously given. As Dasgupta (1993, p.76) points out, "they are determined jointly by a complex combination of opportunities, human motivation, ecological possibilities and chance factors." In this paper we explore some empirical aspects of the rather complex interaction, between population growth and resource use, by looking specifically at the relation between water scarcity and women's fertility (i.e., births) decisions in South Africa.

In many less developed countries, water collection and management for household level use is primarily the responsibility of women (Cleaver and Elson, 1995). Significant time and energy is spent in collecting water just for the everyday needs of the household. A recent World Bank study estimates that obtaining water for household needs can take up to 15% of women's time (World Bank, 1993). As water resources become increasingly scarce and far-flung, the burden on women also rises. Women may respond to this situation in various ways, depending on the socio-economic characteristics and cultural practices of the household. In the very short run, women may tend to decrease, within certain limits, on the household's consumption of water. Alternatively, they may reduce the quality of water collected. Instead of collecting water from a far off safe bore hole, for example, women may shift their water fetching activities to a nearby open stream. To make additional time for water collection, women may have to cut back from time spent on other important household activities such as child-care, cooking, or taking care of the home garden.

In the medium to long run, several other behavioral responses may arise. The household may migrate to a different place with better water availability or elect to have more children. The latter response is more likely to be observed in less developed countries. From a very young age, children in these countries frequently perform vital household activities, such as water and wood collection, child-care, and care of animals (Dasgupta, 1993). As essential resources become increasingly scarce thereby increasing the time and effort required to collect them, the relative value of children may rise. This creates an incentive for increased fertility. Of course, a larger family increases the resource requirements of a household and this suggests that the positive fertility incentive may be at least partially offset by a negative incentive for more children.

We explore the relationship between relative water scarcity and fertility using data from a recent household level survey in South Africa. It is estimated that 29% of the entire South African population and around 53% of the rural population does not have access to adequate potable water (Schur 1994; Ministry of Water Affairs and Forestry, 1994). Currently the population is growing at an average rate of 2.3 to 3.6% per annum (United Nations, 1994). A population driven increase in water demand, in the presence of large sectoral and racial differences in access to water, is likely to intensify public attention on this issue in South Africa (Ministry of Water Affairs and Forestry, 1994). In fact, already in the

early 1980's, the South African government's policy of low national population growth was based on the premise that the country's resources (especially water) could not sustain the prevailing high levels of population growth. The recently published South African White Paper on Population Policy (Ministry for Welfare and Population Development, 1996) also emphasizes the interrelationships between population, development and the environment. Thus, South Africa presents an interesting venue for our research.

The present paper is organized as follows. We begin with a brief background on water resources and water policy in South Africa. This is followed by a discussion on some theoretical issues related to the link between family structure and access to water. Our data source is described subsequently followed by an analysis of the evidence on access to water and fertility issues. Finally, we present our conclusions.

WATER IN SOUTH AFRICA

Water issues have been central to South African governments for decades because water is in relative short supply, is highly stochastic, and is poorly distributed. The average annual rainfall is 500 mm (in comparison, the world average annual rainfall is 857 mm), but more than half of the nation receives less than that amount. In fact, 21% of the country averages less than 200 mm of rainfall annually. In addition, in most regions, the average annual evaporation exceeds the annual rainfall. There is a narrow region along the eastern and southern coasts that is moderately well watered, but the greater part of the interior and the west are arid or semi-arid. Total water resources, including rivers fed by low rainfall and limited groundwater resources, are estimated at 5.4 billion cubic meters per year (Ministry of Water Affairs and Forestry, 1994). This amount of water results in a substantial shortage of necessary drinking water for the growing population in South Africa. The statistics are alarming. For example, available water per capita dropped from 3250 cubic meters per person (cm/pp) in 1955 to 1349 cm/pp in 1990. According to various population predictions, this amount is expected to decline further to a level of 748 cm/pp by the year 2025 (Engelman and Leroy, 1995).

The problems generated by inadequate water supply and distribution are recognized, and thus, as Schur (1994) points out, numerous water resource management organizations were established in South Africa in recent decades. However, these institutions were not well coordinated, and often had overlapping responsibilities. This has contributed to institutional fragmentation that led to inefficient water resource development in the country. As a result, roughly one-third of the South African population does not have access to adequate water and sanitation services (Ministry of Water Affairs and Forestry, 1994). Continued economic development in South Africa will require that the government remedy the current inefficiencies that are inherent in South African water distribution (Bath 1996).

Fallon and Pereira de Silva (1994) suggest that in order to promote economic growth and decrease economic inequality, South Africa must narrow the gap in provision of public services - namely water - across racial groups. It is estimated that while almost all white and Indian households and 79% of colored households enjoy access to piped water; only 18% of Africans have access to this basic service. There are substantial rural-urban differences too:

only 8% of African households in rural areas have an indoor tap while 40% of metropolitan African households enjoy such services (Wilson, 1996).

Following a 1994 water crisis in rural South Africa that resulted from a prolonged drought, the South African government, under the Government Reconstruction Program, launched a program that explicitly aims to ensure that all South Africans will have access to basic sanitation and water services within seven years, or less. The proposed guidelines call for the immediate provision of 25 liters of water per person, daily, and a maximum distance to the water source of 200 meters from each dwelling. In the medium term, the goal is to provide an on-site supply of 55 liters of clean water per person daily with a long-term goal of providing accessible water supply and sanitation facilities (South African Yearbook, 1995). Furthermore, the government has set water quality standards to ensure that not only the quanitity of supply, but also the quality is acceptable (e.g., Ministry of Water Affairs and Forestry, 1994).

Water rights and the water law have been modified, as well. The water law of South Africa was initially developed to serve the interests of agricultural producers, and only recently have the needs of industry and urban municipalities been considered. The allocation of water rights in South Africa is inexorably linked to land ownership. To correct this situation, the cabinet approved in late 1996 new objectives for the water law in South Africa. In particular, the cabinet first established that all water was subject to national control, and as a result, individuals no longer had outright ownership of the water. Rather, the cabinet recognized only an authorization for the use of water, and declared that the water-land link was no longer sufficient to confer preferential usage rights and riparian principle was no longer valid (Ministry of Water Affairs and Forestry, 1996).

These recent administrative and legal changes are likely to lead to a more equitable distribution of water. However, change will clearly take time. For now, the distribution of water resources remains highly skewed and inadequate given the demands of the growing population in the country. In the next section we look at some theoretical issues related to the link between access to water and fertility rates.

WATER SCARCITY AND FAMILY STRUCTURE: THEORETICAL ISSUES

The basic premise underlying economic models of fertility is that adults choose to have a child if the perceived benefits of that child are greater than the percieved costs. Three broad motivations are generally used in such models to explain fertility decisions. They are based on the idea that children provide parents with consumption benefits, with old-age security and contribute to the productive capacity of the household. In this paper we focus on the idea of children as producer goods.

Children often assist parents in various income-generating household activities, such as agricultural production or crafts (Mueller, 1976; Boserup, 1986). As we discussed previously, children may also contribute by assuming vital household production activities such as child care or collection of fuel wood and water. In many less developed countries these household tasks are extremely time-consuming (Dasgupta, 1993). In the absence of children, adults, most likely women, would perform these tasks. The more is the time

required for a particular task, the higher is the opportunity cost to the adult of performing it. As the opportunity cost to an adult of household production rises, the potential benefit of a child also rises.

The greater is the distance that families must travel to collect a household resource, and the longer the time that must be allocated to collection activities, the higher is the marginal value product of a child that can gather that resource for the household (Filmer and Pritchett, 1996). Thus, we expect that there may be a positive correlation between distance to water and fertility. On the other hand, increased fertility also increases the water requirements of the family, thus a long distance to water may discourage fertility. The precise nature of the relationship between resource scarcity to the household and family size is therefore an empirical issue which we explore in the next section.

WATER AND FERTILITY IN THE SOUTH AFRICAN INTEGRATED HOUSEHOLD SURVEY

In 1993 the World Bank, with the cooperation of the South African government, surveyed 9000 households containing 43,974 individuals (South African Integrated Household Survey (SAIHS), 1994; World Bank, 1994). The goal of the survey was to obtain an accurate picture of the living standards of the population. In the analysis that follows we utilize a subset of women who are of child-bearing age, 15-49. These data are cross-sectional and so we are able to explore only the current water situation and completed – as opposed to lifetime – fertility. We use one woman per household in our sample, which consists of 6674 women almost equally divided between rural and urban areas.

The rest of this section is organized in the following way. We first discuss the main sources of water used by rural and urban households in South Africa. We present statistics on the average distance they travel and the average time they spend on water collection activities. These statistics point to the burden that water collection activity place on different households. Next, we turn to the question of who in the household spends the most amount of time on water collection activities. We present statistics to show that women and children are the primary water collectors for the households in our data set. Finally, we turn to the evidence on fertility rates among our sample in South Africa and explore the possible correlation between water collection activities and births.

Differential Access To Water

There is a large difference between urban and rural populations in terms of their available sources of water. Over 88% of the urban households in the sample get their water supply through private sources such as pipes and water carriers/ tankers, while only around 17% of the rural households in the sample gets their supply through these sources (Table 1). The rest of the rural households rely largely on common sources such as public taps, bore holes, rainwater tank, and open streams. This information suggests two things. The rural population, on average, invests a larger effort in water collection activities than the urban

population. Second, it is likely that the rural population is relatively more exposed to lower quality of water and thus to water-borne diseases than the urban population.

Table 1. Primary Source of Water among South African Households in the Sample

Source of Water	Percentage of Rural Households	Percentage of Urban Households
1. Piped – Internal	6.6	63.8
2. Piped – yard tap	11.1	24.8
3. Water carrier/tanker	2.5	0
4. Piped – public tap/kiosk (free)	24.7	10.1
5. Piped – public tap/kiosk (paid for)	3.5	0.7
6. Bore hole	21.4	0.2
7. Rainwater tank	1	0
8. Flowing river/stream	15.5	0
9. Dam/stagnant water	2.3	0.1
10. Well (non-bore hole)	5.3	0
11. Protected spring	4.5	0
12. Other	1.6	0.1

Of the rural (urban) population that gets its water from non private sources (i.e., from sources 4 to 12 indicated in Table 1), 41% (73%) obtain the water from a source located up to a 100 meters from residence, 36% (21%) travel a distance of 100 to 499 meters and 15% (4.8%) travel a distance of 500-999 meters (Table 2). Approximately 29% of the rural population spend up to an hour per day fetching water and an additional 26% spend between one to two hours. The remaining 23% devote between two to three hours per day on this activity. These statistics suggest that not only is infrastructure poorly distributed between urban and rural areas but it is poorly distributed within the rural areas as well.

Table 2. Distance to Primary Water Source among South African Households*

Distance to Water (in meters)	Percentage of Rural Households	Percentage of Urban Households
Less than 100	41.0	72.7
100 - 499	36.1	21.3
500 - 999	15.0	4.8
1000 – 4999	7.3	1.3
More than 5000	0.6	0

* Only households using water sources 4 to 12 as indicated in Table 1 are included.

The unequal distribution of resources within the rural areas is apparently linked to differences in income level across rural households. In Table 3, we divide the rural households in the sample into five categories according to income levels and look at varous indicators of water availability such as primary sources of water, time spent on daily water collection and quantities carried home daily. Rural households in the lowest income quintile spend five times more time on daily water collection and carry four times more water quantities than their counterparts in the highest income quintile. Moreover, lower income households obtain water primarily from non-private sources such as public pipes, bore holes, and flowing rivers and streams. High-income households, on the other hand, generally have water supply on the premises, and thus spend only an average of 32 minutes daily on water collection. These findings are consistent with the long-standing preferential distribution of water rights and privileges to large agricultural producers in South Africa.

Table 3. Water Collection by Rural Households According to Income Level

Households' Income Level	Average time spent on daily water collection (in minutes)	Average water quantitiy carried home daily (in liters)	Main sources of water*
First Quintile	156	88	a, b, c
Second Quintile	148	83	a, b, c
Third Quintile	139	72	a, b, c
Fourth Quintile	100	58	a, b, d
Highest Quintile	32	23	e, d, a

* (a) piped – public tap/kiosk (free), (b) borehole, (c) flowing river/stream, (d) piped – yard tap, (e) piped – internal.

It is interesting to note that the urban households in the sample spend a very small

amount of time on water collection activities regardless of income level (Table 4). As shown earlier, this is because a majority of these households have access to piped water. In fact, the importance of piped water as a public investment needed in order to improve the quality of life was given a first priority among 45% of the people surveyed in rural areas (only 4.9% of the urban population expressed a similar sentiment). Therefore, in the subsequent portions of this paper, we will focus only on the water collection activities of the rural households and its relation to observed fertility rates.

Table 4. Time Spent on Water Collection by Urban Households According to Income Level

Households' Income Level	Percentage of Urban Households in Sample	
	Less than 30 minutes	Greater than 30 minutes
First Quintile	90.5	9.5
Second Quintile	96.0	4.0
Third Quintile	98.5	1.5
Fourth Quintile	98.5	1.5
Highest Quintile	100.0	0

Primary Water Collectors

Respondents to the SAIHS, who used water sources numbered 4 through 12 in Table 1, were asked to identify the three primary water collectors in the household and the time they spend in daily water collection. It is interesting to note that for around 90% of the rural households in our sample, the main water collector is a female. This validates the point made earlier that water collection for household use is primarily the responsibility of women and female children. The median age of the three main water collectors (in order of importance) was found to be around 32, 20 and 17 respectively. In particular, children between the ages of 8 and 16, were found to spend around 80 minutes every day in fetching water. As mentioned earlier, the average time spent by a rural household in daily water collection activities is around 114 minutes. This suggests that children contribute significantly to this important household task.

Link Between Observed Fertility and Access to Water

In Table 5, we show the distribution of number of children born per women (in the ages 15-49) in rural South Africa. There is a wide range of family size among the women in the SAIHS sample, and in part this is due to age differences among the women, with completed

fertility generally higher among older women because of their longer period "at risk" of pregnancy. The average number of children born to date to sample women in the ages 15-49 in rural households is 2.4. The aggregate total fertility rate – the number of children a young woman is expected to have in her lifetime if age-prevailing fertility rates continue – in South Africa is currently about 3.9. The average in our sample is lower because the majority of women have not yet completed their families. Overall, fertility rates in South Africa are quite low when compared to other less developed countries. Total fertility rates differ significantly among racial groups in South Africa, with the lowest rates observed among the white population (2.1) and the highest among the black population (4.6) (Caldwell and Caldwell, 1993). Family planning services have been widely available for many years in South Africa, and as the SAIHS data indicate, there is an average distance of 12.7 (10.2) kilometers between a residence and the nearest family planning worker (clinic), may explain these low fertility rates.

Table 5. Distribution of Number of Children Born per Woman aged 15-49 in Rural South Africa

Number of Children	0	1	2	3	4	5	6	7 or more
Percentage of Rural Households	13.9	21.1	21.7	17.5	11.5	6.1	4.2	4.0

In the earlier part of this section we presented evidence to show that women in rural areas of South Africa often have to travel large distances to collect water for daily household use. Because children are actively involved in water collection activities, as water scarcity (measured in terms of distance traveled/time spent to collect water) increases, the marginal value product of children is likely to rise; and so distance to water source is likely to be correlated with observed fertility rates. In Figure 1 we show the distribution of number of children per woman by distance to primary water source. As shown in this figure, amongst the women who travel very large distances (greater than 5 kilometers) to collect water, 31% have more than 5 children. This is in sharp contrast to women who do not have to fetch water. Only 13% of these women were found to have more than 5 children. In fact, around 45% of these women have at most 1 one child, in comparison to 18% of women in the large distance category.

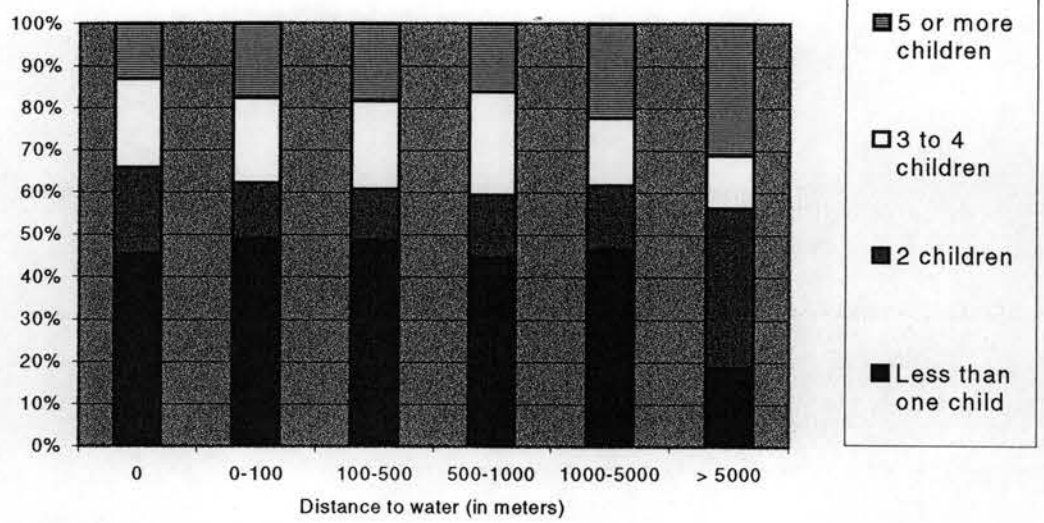

Figure 1. Distribution of Number of children per rural women by distance to water (by percentage)

CONCLUDING REMARKS

The evidence provided in this paper suggests that a positive relationship between water scarcity (as measured by distance traveled/time spent to collect water) and number of children per woman may exist. In order to validate this, a more rigorous statistical analysis than is presented here is required. In work in progress, we employ a more sophisticated econometric model and find that there is a significant positive relationship between "number of children born" and "time per trip for water" for a sample of South African women. Interestingly, we also find that women appear to respond to scarcity of wood, and the reasoning behind this is identical to those underlying water resources. This work is still quite preliminary, but it suggests that population is determined, in part, by resource scarcity.

This finding has significant implications for the design and the rate of implementation of water policies in South Africa, and more broadly, in countries facing similar water constraints. Greater accessibility to water resources, particularly in rural areas, would decrease the need for additional helping hands to carry water buckets from distant locations and thus reduce the incentive for having children. Eventually, this could, in turn, reduce population pressure on natural resources.

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