Freshwater scarcity and pricing in South Africa: conflicts between conservation and equity in the post-apartheid state

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South Africa faces water scarcity due to the contribution of climatic, geographic, and human variables. As reported by Statistics South Africa, persistent water scarcity and distributional inequity has arisen in a changing political arena from the period of colonization to the most recent chapter of South African governance from 1994 onwards [1]. In the policy context of a state struggling with the legacy of apartheid, conflicts regarding the pricing of freshwater resources have arisen [2]. With discrepancies between the higher price for water required to promote efficiency and conservation, and the alternative pricing system that would meet the South Africa's responsibility to improve distributional fairness, the most recent challenges took place between 1994 and 2000 [3]. Consequently, the predominant problem linked to South Africa's freshwater resources is how to allocate water amongst the competing uses of long term environmental and human welfare, without compromising the needs of the country's urban poor. One perspective, which can provide insight on the issue of water scarcity in South Africa, is free market environmentalism. This branch of economic thought supports a system of water markets with prices that reflect the true cost of providing the resources along with subsidies to address the needs of the poor. Based on an evaluation of the impact of market incentives in South Africa since the 2001 market reforms, it has been determined that a pragmatic, free market environmentalist approach to water can yield economically efficient outcomes for the resource while mitigating distributional equity issues.

According to Julian Simon, scarcity is a concept determined by the twin factors of actual resource stocks and human demand [4]. Despite increasing population pressure, situations of resource exhaustion are often avoidable through what Hayek termed as the "marvel" of the price system [5]. Price, as a quantifiable manifestation of scarcity, constrains societal resource depletion behavior, providing incentives for conservation. One resource used in both the human and ecological spheres is potable freshwater. Despite a supply of freshwater that exceeds demand by a factor of 10, unequal global distribution and limits on accessible freshwater make the resource scarce in regions such as South Africa [6]. According to Muller, a history of below-cost pricing, subsidies and policies focused on supply management has reduced the water available for domestic consumption in the nation [2]. However, efforts to correct this economic mismanagement of water resources have failed to take into account the extent of the distributional inequity still inherent in urban centers within post-apartheid South Africa. Therefore, the purpose of this report is to document the scarcity of South Africa's freshwater resources and the failure of pricing policies from colonial times to 2000 to

address both environmental sustainability and the welfare of the nation's urban poor. Through an analysis of the free market environmentalist perspective on water provision, and the outcome of more recent efforts to address this resource conflict, the appropriate solution to water pricing in South Africa will be identified. The thesis of this report is that pragmatic, free market environmentalism in the form of progressive block pricing has been an appropriate mechanism to resolve the South African water pricing debate to the benefit of the environment, and the country's impoverished urban citizens.

BACKGROUND: ECONOMIC, SOCIAL, AND BIOPHYSICAL TRENDS ON FRESHWATER IN SOUTH AFRICA

Characteristics of South African Freshwater Endowments

In South Africa, climatic and geographic features collude to create a low volume of freshwater relative to the Sub-Saharan African region and the world [1]. In terms of per capita renewable freshwater resources (the volume of freshwater that moves freely through the hydrologic cycle

and is not trapped in inaccessible aquifers), South Africa has 85% less water than the Sub-Saharan African average, 86% less water than the average for developing countries, and 87.2% less than the world average. Correspondingly, although the country receives a mean of 611.6 million cubic metres of precipitation annually, due to evapotranspiration, only 8% of this total is readily available. To exacerbate these conditions, precipitation and temperature are highly variable over time. Similarly, due to limited groundwater reserves, 77% of the nation's total water yields are derived from surface water sources [7].

Social Trends: Population Growth and Poverty

According to Statistics South Africa, as of mid 2008, South Africa's population was 48.7 million [1]. Moreover, pertinent to this report's examination of urban water demand, the UN Department of Economic and Social Affairs has revealed a notable increase in urban migration since the 1950s [8]. In particular, the urban population as a percentage of South Africa's total population has undergone a steady increase from 42.2% in 1950 to the most recent level of 59.3% in 2005. Further, in line with trends exhibited by Sub-Saharan Africa and the world, the increase is projected to continue with the urban population growing by an additional 12% by 2030.

Equally important to the discussion of water usage in South Africa is the income profile of its citizens. By focusing solely on the trend of GDP per capita from 1981 to 2006, which reached \$3562 USD in 2006, the World Bank classifies South Africa as a middle income country [9]. However, despite its middle income status, South African income statistics are misleading. Specifically, the bottom 20% of the population receives only 1.4% of this GDP [10]. Furthermore, with half of the population trapped in chronic poverty bestowed by decades of apartheid, the urban poor live in informal and often illegal settlements without essential services such as secure shelter, sanitation and water. As of 2001, the UN Human Settlements Programme estimated that 33.2% of South Africans lived in these 'slums', which differs greatly from the levels of informal habitation in the developed world at 7.5% [11]. Nevertheless, South Africa is in line with the percentage of "slum inhabitants" in developing countries at 43.4%, and below the Sub-Saharan African levels with 72.5% of the populations in slum conditions. More recently, from 1996 to 2008, urban slums increased by 30%, and density conditions are projected to worsen.

With respect to the demand for domestic water supplies for the use in cooking, cleaning and consumption, the UN Food and Agricultural Organization estimates that as of 2000, 31% of South Africa's freshwater reserves were devoted to these domestic consumers [11]. This reported consumption rate is significantly higher than the average for Sub-Saharan Africa at 11% [12]. In addition, there has been a

steady increase in consumption for the last 20 years, and this growing domestic demand is projected to persist [12].

Determinants of Scarcity: Demand and Supply Characteristics

For freshwater reserves, as with other resources, it is the interface of human and biophysical factors that lead to its supply and demand characteristics [7]. For the issue of freshwater in South Africa, one pertinent measure of scarcity is the Water Poverty Index, which measures the impact of water resources and water provision on human populations [13]. Assigning each country a number between 0 and 100, lower scores indicate water poverty and higher scores indicate sufficient provision. According to UN Food and Agricultural Organization, South Africa's Water Poverty Index score is 52 out of 100 [12]. Although consistent with the low scores for the African continent, this score is significantly lower than the Water Poverty Indexes attained in the Americas and Europe [13]. Finally, with respect to future projections, the United Nations Economic Commission for Africa expects that the country will move from a state of water stress (1,000 to 1,700 cubic metres per person per year) to the level of water scarcity (less than 1000 cubic metres per person per year) by 2025 [14].

The Importance of Water Access and Quality to Human Health in South Africa

According to the UN Educational, Scientific and Cultural Organization, access to water and water quality are significant contributors to human health [15]. In particular, improved water supplies can reduce diarrhea infections by 17% as well as other sanitation and hygiene related conditions such as schistosomiasis, trachoma and infectious hepatitis. Particular to the South African experience, a study by Genthe *et al.* found that water used in slum dwellings without direct access to water supplies contained 108% to 125% more faecal coliforms and *E. Coli* than households with formal water connections [16]. Furthermore, the World Bank reported that South Africa spent 3.6% of the nation's GDP or an equivalent of \$6,551 million USD (base year 2000) on health care in 2005 [9]. In this way, the World Bank deems health care a considerable budgetary concern in South Africa.

THE INSTITUTIONAL AND POLICY CONTEXT IN SOUTH AFRICA

Water Institutions under Colonial Rule and the British Commonwealth (1672-1961)

The Walmsley and Silberbauer report on the state of South Africa's environment thoroughly explores South African history despite the scientific nature of the piece [7]. This degree of attention is due to the recognition that resource issues are intricately woven into the fabric of the institutions that have historically governed their use. By extension,

Statistics South Africa notes that water issues are linked to the nation's colonial roots, beginning in 1672 with the colonization of South African lands by the Flemish [1]. Governed intermittently by Britain and Holland throughout the 18th and 19th centuries, the Union of South Africa came into existence on May 31, 1910 [17]. While still considered a Dominion of Britain, the creation of the Union of South Africa permitted resident South Africans more autonomy in their affairs. Finally, South Africa was eventually granted independence in 1931, but remained part of the British Commonwealth until 1961 [1, 17].

Since water availability has been a longstanding problem South Africa, the first water policies date back to the British Dominion, and particularly the 1913 Land Act [17]. Access to freshwater in the colonized nation was linked to the ownership of land, which bestowed riparian rights to the use of surface waters on or bordering the land claim [1]. Relatively well-managed with clearly defined property rights, scarcity was not an issue for the affluent European colonists. However, as land ownership and by extension water rights were determined by race, a lack of basic water accrued to the black majority [1, 17]. Also under the period of British direction, the 1956 Water Act further guaranteed the rights of private landowners to use of surface and ground water [1].

Water Policies in the Era of South African Republic and Apartheid (1961-1994)

The second period of pertinent institutional arrangements for South African freshwater supplies spans from 1961 to 1994, a period in which South Africa ceded from the British Commonwealth to become a republic, but also adhered to apartheid policies [17]. According to Walmsley and Silberbauer, the independent state continued to uphold the Water Act of 1956; however, with increasing population pressure, the dominant policy goal of the period became the provision of a constant and adequate supply of water [7]. Focusing on supply side management through the construction of large engineering projects such as dams, the impact of inaccurate water pricing was often overlooked. Based on the expenditures associated with these large-scale projects, a culture of subsidies emerged with 33% of the cost of the construction of water works funded by the government until 1984.

Water Policies in Post-Apartheid South Africa (1994-2000)

The US Bureau of African Affairs highlights 1994 as a turning point in the South African political landscape [18]. Following the legal abolition of the apartheid regime, the country held its first non-racial elections from April 26 to 28, 1994. The democratic government which was subsequently established under Nelson Mandela emphasized non-racial water institutions and equal opportunities. With the African National Congress in power, water policy was a centerpiece of the new government's platform. For instance, Act 108 of

the Constitution of the Republic of South Africa attempted to legally enshrine the right of South Africans to "...an environment which is not harmful to their health or well-being" and likewise, to have "...the environment protected for present and future generations" [3]. Building on these themes of resource sustainability, section 27 of the Constitution also specifically legislated a right to sufficient water [3]. In this way, the importance of water stewardship and equal provision was accepted in law, if not yet in practice.

In the wake of these constitutional arrangements, practical policies were implemented [2]. Notably, there was a distinctive shift in the management of water resources with the creation of the Department of Water Affairs and Forestry. In the Walmsley and Silberbauer report, the authors evaluate many of the Acts passed in conjunction with the new government agency, highlighting the Water Services Act 108 of 1997 [7]. Intended to rectify the lack of distributional concerns inherent in the remaining colonial legislation, the Act sought to provide sufficient water to meet the basic needs of all South Africans. Calling for sound planning and an extension of water services, the authors worried that the emphasis on human water needs would limit ecological concerns. Walmsley and Silberbauer add that, in 1998, the National Water Act replaced the British Water Act of 1956. The authors describe that the Act aimed to promote conservation, pollution control and the more equitable management of water resources. The legislation established organizations such as "Catchment Management Agencies", which control water resources according to ecological boundaries such as watersheds instead of political boundaries. Although leading to more decentralization, the authors were concerned that real institutional changes did not take place. Finally, the most striking change of these water policies was the rejection of private riparian rights in favour of nationalized water resources, and attempts to decrease the demand for water by increasing the price of the resource.

Based on the policy changes of the mid to late 90s, water pricing evolved over the period [2]. The African National Council's "Reconstruction and Development Programme" proposed a progressive block tariff for potable water. The goal of the African National Council was to ensure the long term recuperation of costs while recognizing the fiscal limitations of South Africa's impoverished citizens. Therefore, the program consisted of higher tariffs for greater water consumption, and lower tariffs for conservative use. In particular, the payments of these higher users are described as "luxury water fees", and the profits from these higher level consumers were used to subsidize the price of water for consumers who used less water. However, despite the African National Council's original plan to provide water for all income levels, the affordable lower tariffs were revised under a later plan, entitled the "Growth, Employment and Redistribution Programme" [10]. More actively supported by world players such as the UN and the World Bank, under the

new plan, the price of water for users at all income levels was increased to promote greater efficiency, and to recover more of the costs of water utility operations.

GETTING THE PRICES RIGHT: THE TENSION BETWEEN CONSERVATION AND DISTRIBUTIONAL EQUITY

The emergent issue in South Africa's freshwater story is the balance between environmental protection and distributional concerns. Due to its situation of low water reserves, careful stewardship of the scarce resource is needed to ensure long term environmental sustainability and the continued provision of drinking water. However, past attempts at supply-side management through dam construction were insufficient tools to battle scarcity [7]. As economists such as Hayek have explained, natural resources can only be properly valued through prices, which provide the correct incentives for use and consumption [5]. However, since these same economists note that economic theory must be tempered with ethical considerations during policy formation, distributional equity is also a concern [19]. Achieving both objectives simultaneously is considered quite challenging as water pricing reforms can often impact the poorest consumers the most; thereby, stalling the nation's efforts to promote equity [6]. Therefore, pricing schemes for conservation and alternatively, for human welfare are in direct conflict.

To fully describe the tensions between modern economic thinking regarding water pricing and distributional equity we look towards Chettri and Venkatesan's study of water resource pricing [20]. According to the authors, the appropriate price for water is the long-run marginal cost of supplying the resource. Calculated through the value of existing assets in the water supply infrastructure, the present value of future infrastructure replacements and expansions, the terminal or salvage value of water systems, and finally by including intangible costs, prices will reflect the true cost of water. In contrast, the South African pricing system of the 1990s failed to take all of the true costs into account [2]. Therefore, the average price for water in South Africa, which the UN Educational, Scientific and Cultural Organization reported as \$0.47 USD per cubic metre, does not reflect the true cost of water provision [15].

The other viewpoint in the South African water pricing debate is centered on the distributional inequities in the nation during the 1990s. In 1994, 12 million out of a total of 36 million South Africans were without safe drinking water [2]. Furthermore, considering that in 1994, 100% of East Indians, 99% of white individuals and 95.4% of coloureds had access to safe drinking water while only 43% of Africans enjoyed the same privilege of sufficient access, a disturbing picture emerges [10]. Therefore, although the World Health Organization and UNICEF reported that 83% of South

African population had access to improved water source as of 1990, the remaining 23% of citizens lacking access likely resided in the country's poorest black communities [21].

With respect to the later 1990s, proponents of distributional equity emphasize that, despite the campaign promises of the African National Congress and the flowery wording of constitutional arrangements, the prices set in the "Growth, Employment and Redistribution Programme" failed to aid the impoverished members of South African society [10]. In particular, the lowest pricing block in the tariff system was inaccessible to thousands as it is estimated that one fourth of South Africans had their water disconnected due to inability to pay for water [22]. As an example, between 1999 and 2001 in Cape Town, there were 159,886 water cut offs [10].

THE FREE MARKET ENVIRONMENTALIST PERSPECTIVE ON FRESHWATER RESOURCES

According to Terry Anderson and Donald Leal, free market environmentalism is one of many perspectives regarding the appropriate allocation scheme for natural resources [23]. Described by Jan Narveson as a system whereby individuals own exchangeable items; free market environmentalism rejects central control and the use of force [24]. Free market environmentalism also rests on the dual premises that "wealthier is healthier" and that "incentives matter" [25]. Specifically, free market environmentalists, like Anderson, argue that markets create wealth, and that this wealth allows for greater concern for the environment [25]. Furthermore, recognizing that all individuals act in their own self interest, free market environmentalists believe that if personal incentives can be changed to correspond to environmental stewardship, as is accomplished through private ownership, conservation schemes will succeed to the benefit of the economy and the environment [25].

With respect to water, the free market environmentalist perspective on the resource involves the use of market mechanisms to ensure its efficient allocation [26]. In this way of thinking, all resources, and water without exception, should be allocated to their highest valued uses through voluntary exchange. This standpoint echoes those of Austrian economists such as Hayek that the price system is the best way to make use of dispersed time and place information in contrast to the centralized model [5]. In the same way, since freshwater is often costly to extract, clean and distribute, it thought that it is inappropriate for the government to interfere and prevent full-cost pricing [26]. According to the UN Educational, Scientific and Cultural Organization, this notion became widely accepted with the declaration made at the 1992 International Conference on Water and the Environment that, "water has an economic value in all its competing uses and should be recognized as an economic good" [15].

Free market environmentalists in the Canadian context, such as Elizabeth Brubaker and Alexander Orwin of Environment Probe, also agree with the beneficial role of water markets. Particular to the issue of the privatization of water utilities, Orwin cites several successes, which lead to his conclusion that the private provision of water can be achieved equitably [27]. For example, Orwin recognizes the accomplishment of the city of Chenna in India. Chenna's private water contracts have yielded a cost savings of 40% to the municipality, and a 20% increase in profits to the contractor, all while bearing in mind distributional issues. Likewise, in an interview with Elizabeth Brubaker published by McCullough, Brubaker maintains that free-market solutions cannot be stalled by unfounded ideological opposition [28]. Addressing the criticism that water is a human right, and thereby too valuable to price, Brubaker insists that water is "[t]oo important not to price". Brubaker then begs the question, "[n]o one objects to food being bought and sold in the marketplace. Why not water?". These statements echo the perception that water resources have not and will not be managed properly without full-cost pricing, and that from the free market environmentalist perspective, water is no different than any other good.

Highly applicable to this paper's discussion of the impact of free market reforms on distributional equity, Terry Anderson has more recently discussed his view on poverty concerns when dealing with water markets [29]. Anderson disagrees with the common criticism that the free market environmentalist emphasis on full-cost pricing for water automatically excludes the poor. Anderson does not see any problem with progressive pricing systems whereby the poor are issued water stamps (like food stamps) in order to buy a minimum requirement for water. In this way, suppliers could charge less for some demand brackets and increase the price for "luxury" water users. Furthermore, Anderson builds on the public choice theory developed by Wolf and Yandle as the political allocation of water is cited as the true source of distributional inequity [30, 31]. Brubaker's beliefs are once again aligned with her counterparts in the United States as she maintains that the poor will not be "priced out" of water markets [32]. Rather, Brubaker suggests that subsidization is a valid method to address poverty concerns.

AN EVALUATION OF FREE MARKET ENVIRONMENTALISM AND ITS IMPLICATIONS FOR SOUTH AFRICAN FRESHWATER RESOURCES

According to Fox, there are five economic theories of property rights [33]. In this way, the notion of free market environmentalism encompasses a broad spectrum of ideologies regarding the best ownership schemes for property, and the role of the state. Similarly, the proponents of free market environmentalism mentioned above are just some illustrations of the ideologies that exist within this

range. For example, Elizabeth Brubaker and Terry Anderson are more pragmatic in their viewpoints. Fox defines this branch of pragmatism as a focus on what works rather than on what should be, and an emphasis on examining resource issues on a case by case basis instead of adhering to theoretical generalizations. In contrast, the Austrian economists and individuals such as Jan Narveson have a modern libertarian leaning [24, 33]. This classification is highly respectful of the rights of the individual, and wishes to limit the intrusion of the state [33].

Based on the categories mentioned above, it follows that the capacity for free market environmentalism to address the conflict over freshwater is highly dependent on the ideology in question. In the case of South Africa, the full-cost pricing strategy, which would be advocated by modern libertarians, led to water being inaccessible to many urban citizens [2]. Therefore, this version of free market environmentalism may not be the answer. As an example, a transition to cost-recovery strategies in 2003 in the province of KwaZulu Natal led to a devastating outbreak of cholera in the city's slums when households could not afford water payments [19]. It is for these equity reasons that fully deregulated water markets may be inappropriate in the South African context.

Although the wide application of the modern libertarian branch of free market environmentalism may not be suitable, there are potential improvements provided by market-based incentives. In the period from 2000 to the present, the South African experience is a testament to the benefits of the market [2]. Although the original water pricing schemes of the late 1990s were too high to meet the needs of urban slum inhabitants, in June 2001, this system was revised to provide a base of 6,000 litres of water per household, per month. Funded by higher prices for water at greater consumption levels, the policy is perceived to be a success. This is because as of March 2007, more than 75% of South Africa's population was served by this "free basic water", with 164 of a total of 169 municipalities receiving the service. Significant to an evaluation of the mitigation of poverty, 69% of those receiving this "basic water" are classified as poor. With respect to environmental stewardship, the policy's increased fees for the higher consumption brackets have communicated the incentive to conserve. To further this stewardship claim, even though the number of people serviced by water utilities has increased by 50% since 2001, the volume of potable water supplied has only increased by 20%. This observation is consistent with studies completed by Jansen and Schulz of South African cities, which have demonstrated that the nation's high income groups are very price sensitive to water, while lower income households do not change their consumption patterns due to an increase in price [34].

Based on this report's evaluation of the South African water pricing debate, the free market has demonstrated the scope to correct the resource conflict as long as its principles are applied in a pragmatic way. Although distributional

concerns continue to plague the South African nation, and although 25% of the population is still without access to safe water, the use of price incentives combined with water subsidies has led to improvements in environmental health and economic efficiency [2]. Likewise, based on appraisals of the situation through an equity lens, the subsidies, which provide a basic quantity of water for the poor, affirm the human right to water stated in the Republic of South Africa's constitution [10]. Since this viewpoint is echoed by free market environmentalists such as Anderson and Brubaker in their recommendations to provide subsidies for low income users, the solution is consistent with pragmatic free market environmentalism [29, 32].

CONCLUSION AND RECOMMENDATIONS

As this report has demonstrated, South Africa is a country subject to water scarcity due to the contribution of climatic, geographic and human variables. This chronic water scarcity has arisen in a changing political arena. During the period of British Dominion, the few water policies that were in place focused on property-derived riparian rights that were based on perceived racial inequities [17]. Following the establishment of the Republic of South Africa in 1961, the policy framework maintained the status quo, but began to develop supply-side management techniques to bolster limited water resources [1]. Meanwhile, in the most recent chapter of South African governance from 1994 onwards, specific water legislation aimed at efficiency and equity emerged, leading to the implementation of a progressive block tariff system. In the policy context of a state struggling with the legacy of apartheid, tensions regarding the pricing of the scarce freshwater resource have arisen. With discrepancies between the higher pricing point for water required to promote efficiency and conservation, and the alternative pricing system that would heed the Republic of South Africa's constitutional requirements for distributional fairness, the most recent challenges took place between 1994 and 2000 [27]. Consequently, the predominant problem linked to South Africa's freshwater resources is how to allocate water amongst the competing uses of long-term environmental and human welfare without compromising the needs of the country's impoverished citizens.

This report's discussion of the free market environmentalist perspective on freshwater has also noted that this ideology is comprised of multiple viewpoints, which range from modern libertarianism to proponents of pragmatism. However, in general, this economic philosophy supports a system of water markets with prices that reflect the true cost of providing the resource. Although free market environmentalists such as Terry Anderson and Elizabeth Brubaker recommend that freshwater should be treated like a commodity to promote conservation, the authors suggest subsidies as an economic tool that can address the needs of the poor [29, 32]. Based on an evaluation of this viewpoint, it

has been determined that a pragmatic free market approach to water can yield economically efficient outcomes for the resource while maintaining distributional equity issues. Therefore, while South Africa is unique in its natural endowments, demographics, and income distribution, the wider use of pragmatic free market environmentalism should be considered in resource policy analysis in both the developed and developing world.

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