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The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

IS IT TIME FOR A WATER TARIFF INNOVATION? THE CASE FOR DYNAMIC TARIFFS

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The primary premise is that the current pricing system might be inflexible to appropriately balance short-term water demand with available supply and that it is inconducive to the changing global and national developments impacting long-term water resources. In economic theory, the price of a good or service shows the benefit consumers derive from said good and the cost of providing the good, i.e. the value of consuming and producing the good respectively. Inefficient pricing systems can result in the poor allocation of the resource, i.e. allocative inefficiency, where the pricing system does not provide the good to where it is needed the most. It can also result in under-pricing and over-consumption if the price does not effectively reflect the economic value placed on a good or service.

Defining water as a good or service is complex. Unlike most other goods and services, water is essential for human survival in that all living organisms require a minimum level of water to live. However, water is also an economic good that is used to satisfy human wants and is used in the production of other goods and services. The development of mechanisms for the allocation and pricing of water needs to effectively account for these competing objectives of water use. This economic problem is further exacerbated by water being a scarce resource and, like other goods, such scarcity needs to be reflected in its value.

South Africa's management of water through its allocation and pricing mechanisms has tried to balance these competing needs for water. This is done through its complex water value chain, where raw water resources are managed by national government and provision of potable water is within the constitutional ambit of local government. The financing of the management of water resources is implemented through a raw water pricing strategy and is charged retrospectively to all users of raw water. Municipalities recover the costs of these water services through bulk water tariffs and municipal tariffs, which is charged to the final consumers of water services.

Given the importance of water for human and economic needs, as highlighted above, the allocation and pricing mechanisms that the government attempts to implement essentially balance the goals of social equity and economic efficiency towards the sustainable use and development of water resources. However, such mechanisms also need to be flexible to supply side issues driven by changing natural, social, economic and political circumstances.

One such circumstance is climate change and consequent increased pressure on water resources. Many developed and developing countries are facing significant constraints on water supplies that will continue over the coming decades, considering projected climate change impacts. Climate change and the prevalent water scarcity challenges currently plaguing the world have brought water debates concerning sustainability and efficiency of the pricing (and allocation) model to the forefront. Water policymakers are faced with the situation where they need to set cost-reflective tariffs, address equity, meet increasing demand, and manage water

supply in the face of these challenges of climate change and the sustainability of water resources.

The nature and impacts of climate change are complex but is usually characterised by a general increase in the Earth's average temperature. Such rising temperatures can have a significant adverse effect on the short- and long-term availability of water due to extreme and unpredictable weather events, such as heavy rains and severe droughts and a general variation in temperatures and rainfall patterns from their long-term averages. The impact of climate change is more pronounced in countries that are naturally water scarce, such as South Africa.

Given these challenges emanating from the growing impact of climate change, water decision-makers in the country that are responsible for setting tariffs face the challenge of incorporating climate change and general issues of scarcity into the water pricing model in addition to other water pricing objectives. Currently, at the raw water level, the water charges tend to recover the costs associated with water resources management and water resource infrastructure, amongst others, while the increasing block tariff (IBT) pricing mechanism has been adopted at the municipal level for potable water to strike a balance between these varied water policy goals.

The IBT structure, which is also predominantly applied for final water users in many countries around the world, is frequently supported as a good tool for achieving the goals of equity, water conservation and revenue neutrality. The IBT increases the price of water relative to greater use, thus intending to send the signal of greater value of water with higher levels of consumption. This can potentially discourage higher levels of water consumption when the additional cost of a unit of water exceeds the value a consumer places on its use. For this to work, though, the marginal cost of water needs to accurately reflect its scarcity and the concomitant marginal benefit consumers receive at higher levels of consumption. When marginal costs are lower at higher levels of consumption, this can result in overconsumption. As a result, the design and the ability of this mechanism to incorporate the climate change aspect and reflect it into the price to send a water scarcity signal to consumers currently remain under scrutiny.

It is important that the water pricing system effectively accounts for the scarcity of water and to send the appropriate signals to consumers when water supply is under pressure. While climate change and its consequences are a growing feature of water supply issues, other factors can also impact on the short- and long-term availability of water. This can include inadequate investments in new water resource and services infrastructure and poor infrastructure maintenance. In addition, water demand also puts pressure on available water resources. Population growth, urbanisation, economic growth and industrialisation can all change the dynamics of water demand resulting in a growing imbalance between water demand and available supply. In the face of these challenges, the key to an efficient and effective water pricing system is to contribute to maintaining an appropriate balance between the demand and the supply of water at different time periods across the short, medium and long term.

Given this background and statement of the problem, new mechanisms are needed that can be used to improve the incorporation of scarcity into the water management system in South Africa, particularly with regards to the allocation of water via the water pricing system. Most water management areas (WMAs) and Water Service Authorities (WSAs) in South Africa suffer from varying degrees of water supply volatility, which is usually accompanied by temporary but frequent water shortages. Such shortages are driven by a combination of long term and short-term factors related to the supply and demand for water. In terms of the former, insufficient planning, infrastructure investment and climate change are some of the long-term factors impacting on water supply, while poor infrastructure maintenance, water leakages and short-term climate variation and extremities can also impact on short term water supply.

In terms of water demand, an embedded culture of excessive water consumption for both domestic and economic purposes in a society, a growing population and varying structural changes (or lack thereof) in the economy can impact on long term demand for water. In addition, inefficient pricing policies can promote excessive usage in the short term and can also contribute to a culture of excessive water use in the long-term, if domestic and non-domestic water consumers do not adjust their economic decisions to consider the true value of water. Therefore, it is important to consider the possibility of incorporating issues of climate change and general scarcity aspects into the water pricing system in the South Africa in order to send the signal of the true value of water to consumers at any given point in time.

The incorporation of the scarcity component into the tariff setting model has become an integral part of cyclical water demand management in mostly developed countries. One of the growing mechanisms being implemented internationally (USA, Australia, UK) is what is called the dynamic water pricing. Under a dynamic water tariff regime, there are two approaches identified in literature most commonly used to account for scarcity in the water tariff:

- Linking the tariff to the available reservoir capacity/ water volume resulting in the volumetric price increasing by an amount that would reduce current water demand to the present (and restricted) water supply
- The water tariff is linked to seasonal variations (summer and winter) of water supply within the year. This common strategy links the tariff to exogenous factors such as the temperature and rainfall. In this approach,

a tariff adjustment factor is determined by the two climate variables: temperature and rainfall.

Essentially, dynamic tariffs adjust to reflect the degree of water scarcity at a given point in time to send the signal of water supply constraints to final consumers. The adjusted tariff is expected to alter consumers' behaviour to try and adjust their consumption patterns considering scarcity in order to better balance water demand and supply. Put differently, scarcity increases the value of an available good or services and the price is the mechanism that needs to reflect this increased value. Such a system has the advantage of embedding scarcity into the water pricing structure to proactively control consumption and ease the demand on currently available water resources, thus potentially preventing instances of drought tariffs, water restrictions and potential "day zero" scenarios driven by normal consumption patterns on a static water price leading to extreme levels of scarcity.

Depending on the method used, dynamic water pricing is an approach that includes seasonal water scarcity and dynamic connections between present and future consumption of water. It provides an effective tool for conserving water resources and to ensure that water supply is able to satisfy peak-season demand. Dynamic prices aim to enhance water use efficiency because they reflect present variations of water supply costs and incentivise water conservation among customers when costs are high. Several time-varying factors influence water supply costs, including demand peaks, demand trends, water scarcity, and opportunity costs related to alternative human and ecosystem-related water uses. In principle, dynamic pricing could help better consider these factors and help manage residential water demand. In particular, increasing water prices during scarcity scenarios could send end users a signal on water value, leading to a decrease in demand and more efficient water allocation across time and among uses.

Dynamic water pricing also offers a key opportunity to manage the growing uncertainty of future water demand and supply. Essentially, dynamic water pricing extends current water tariffs to account for the long-term interest of water consumers by increasing the water price to account for scarcity of water in different periods, provide signals to efficient water capacity expansion and account for the future value of in situ water into current consumption decisions.

The benefits it brings are as follows:

- An alternative to setting, in advance (with automatic adjustments for inflation), a water tariff that is independent of water inflows. Ideally, the dynamic price would increases in a stepwise fashion as the volume of water storage decreases. The key benefit of dynamic pricing is that it greatly reduces the need for water restrictions or rationing (which are estimated to have significant welfare loss and can also provide the revenues needs to fully recover all supply costs when water demand declines).
- Dynamic water prices define residential prices according to the marginal cost of supply at a point in time. This can reduce peak demand through peak pricing and subsequently lower the cost of a water distribution network operation, maintenance and expansion. It also has the potential to reduce the size of new mains when a city expands and new areas must be served or during the replacement of leaky mains in network maintenance operations; both of which translate into financial savings (Alternatively, peak pricing can help delay investment in new mains by postponing the date at which existing mains will no longer be able to handle a rising demand and by lowering the risk of pipe bursts caused by high pressure. As such, reducing peak demand is expected to reduce operational costs.

Water drought tariffs are currently being implemented in South Africa to curb short-run water shortages in certain parts of the country. Indeed, the implementation of such drought tariffs and related water restrictions seems to be occurring often and at specific times of the year. While there are provisions for water drought tariffs in the legislative and institutional framework of the country, the relative proliferation of its use shows an increasing need to control water consumption on the demand side in the face of water supply constraints. Given these developments, there is clearly a need for a dynamic water pricing system to be institutionalised in the South African water sector. However, the current institutional set up in the water market was not fully designed for the implementation of demand side controls using the price mechanism. This is due to the system being designed at a time when there was not an imperative need to control water use. Therefore, this position paper intends to introduce the concept of dynamic water pricing into the debate to continuously review and reform the ever-evolving South African water pricing framework.

The design of a pricing mechanism that attempts to balance sometimes competing objectives is complex. Pricing structures should be continuously innovating and evolving, particularly when it comes to being sensitive to the changing political, economic, social and natural changes. Dynamic water pricing essentially adjusts the price of water for a change in the marginal cost or marginal benefit of the use of the good, thus sending the signal of an increased value of water at time of water scarcity or changes in demand behaviour. Ideally, dynamic factors that impact on the supply and demand of prices need to be incorporated into the pricing of water.