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The Value of Water: Economics of Water for a Sustainable Use*

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Abstract: The following work deals with a very controversial but nevertheless very important topic in the sustainable management of water as a natural resource: the value of water and the macroeconomics of water.

Population growth, increasing demand, climate change and declining water supplies present a short- and medium-term outlook where water stress and shortages may keep arising. Water stress is a situation that arises "… when water demand is more important than the amount available for a specified period or when it is restricted by its low quality." This in turn "… causes deterioration of resources fresh water in terms of quantity (aquifer overexploited, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.)." (UNEP, 2012) If global patterns continue, we can see that we are headed into an increasingly complex landscape where water mismanagement increasingly compromises water availability. Added to this we have the phenomenon of climate change, which is already having an impact on water systems and cycles globally.

This is why we must change the ethnocentric approach of our current development model, where resources are exploited without regard for the future. This analysis will use another approach based on sustainable development, and will go beyond ideological approaches and economic or political agendas, to treat water management and the macroeconomics of water pragmatically. Life on the planet depends on our success to manage our water resources in an efficient, responsible and fair manner; this paper provides the general guidelines and practical recommendations to do so.

I INTRODUCTION

The following work deals with a very controversial but nevertheless very important topic in the sustainable management of fresh water as a natural resource: the value of clean potable water and water economics.

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Population growth, increasing demand, climate change and declining water supply forecasts make the short- and medium-term outlook where global water stress may keep arising. Water stress is a situation that arises "… when water demand is more important than the amount available for a specified period or when it is restricted by its low quality." This in turn "… causes deterioration of fresh water resources in terms of quantity (over-exploited aquifer, dry rivers, etc.) and quality (eutrophication, organic matter pollution, saline intrusion, etc.)" (UNEP, 2012). If global patterns continue, we can see that humanity is headed to an increasingly complex landscape where water mismanagement can increasingly compromise availability. Added to this, "… we have the phenomenon of climate change, which is already having an impact on water systems and cycles globally." (Gabaldón, 2012)

This is why we must change the anthropocentric approach of current development models, where resources are exploited in the present without regard for the future. That is why in this analysis we will use another approach based on sustainable development. This approach goes beyond ideological approaches and economic or political currents. It is an attempt to treat the subject of water management pragmatically by addressing the value of water from both a human development and economic approach.

II THEORETICAL FRAMEWORK

The approach that will be applied to the water economics in this paper is based on the following definition of Sustainable Development: "Meeting the needs of the present without compromising the ability of future generations to meet their own needs". (Brundtland Report, 1987).

This definition came from two different and sometimes antagonistic disciplines that have a common concern: sustainability. The first discipline, economics, worries about the effects of unlimited economic growth, and on the false premise that natural resources are inexhaustible. The second discipline, ecology, emerges as a defender of the environment and nature. This defence is aimed at the attack, caused by the consumption patterns of the world, which points to the progressive and in some cases irreversible destruction of the environment and nature.

These two schools of thought formally conciliated at the World Commission on Environment and Development of the United Nations in 1983. This commission was created by the General Assembly of the United Nations in 1983 and bears the fruit of the Brundtland Report. This report, also called "Our Common Future" is a socio-economic report prepared by different nations to the UN in 1987, and its development was headed by Dr Gro Harlem Brundtland. In this report we see the formal convergence of sensitive economic

and environmental schools giving way to a new development paradigm under the name of Sustainable Development.

This definition is the basis for the analysis that will be undergone in this work. Sustainable Development's five dimensions will be considered. These dimensions are: political, social, economic, environmental and cultural. (Duque, 2012) Even though one might tend to associate water to a particular dimension, its underlying importance extends to all five dimensions.

When referring to water as a natural resource throughout this work, the reader must think of clean potable water. The definition, components, and overall quality of clean potable water will inevitably vary globally. The management and specific valuation analysis may also vary locally due to the aforementioned variables. However, the main general analysis and economic principles discussed can be applied globally.

The analysis brings forth the dilemma that presents an inescapable dichotomy between economic development and environmental conservation. This tradeoff seems to be an apparently unsolvable dilemma, but sustainable development, supported by analysis of this sort, aims to become a viable alternative.

III THE CURRENT PANORAMA

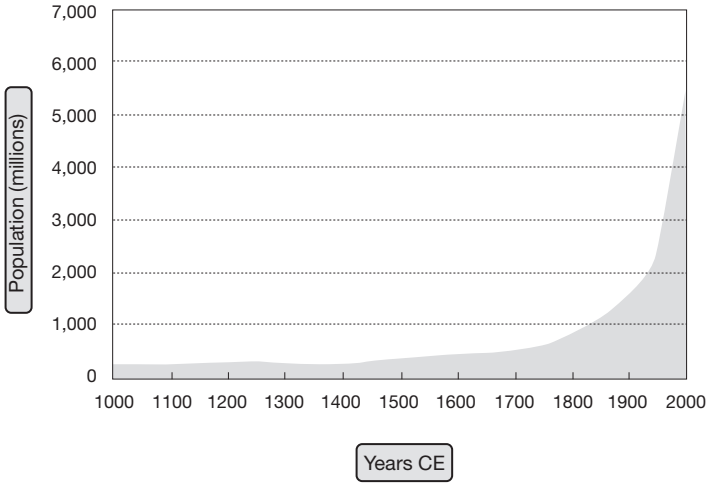
Access to clean water has been recognised by the countries of the world as a basic human right. The sixty-fourth session of the UN General Assembly in 2010, declared water and sanitation as a human right through the following resolutions:

1. Declares the right to safe drinking water and sanitation as a right.
2. Calls upon States and international organisations to provide financial resources and foster the capacity building and technology transfer through international assistance and cooperation, in particular to developing countries, in order to intensify efforts to provide all people affordable access to safe water and sanitation;
3. Welcomes the decision of the Human Rights Council to request the independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation present an annual report to the General Assembly 17, and encourages the independent expert to continue working on all aspects of its mandate and in consultation with all agencies, funds and programs of the United Nations, to include in its report to the Assembly at its sixty-sixth session of the main difficulties related to the realisation of the human right to clean drinking water and sanitation, and the effect of these on the achievement of the Millennium Development Goals.

Thus, water is recognised as a human right essential to the full enjoyment of life. Water is the basis for life on the planet and central to life and development of human beings. Among human development goals of the Millennium, MDGs, the UN provided the basis for an agreement between 193 countries that agreed 8 goals to be met by 2015. Water plays an important role in human development. So much so that within Goal 7 (Ensure environmental sustainability), the main indicator to be achieved is to "… halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation." (UNDP, 2013). Furthermore, the ongoing *UN My World 2015* global survey from 194 countries reveals "access to clean water and sanitation" as a top five priority among a pool of 16 human development priorities.

If we consider that currently only 83 per cent of the world population has access to drinking water, then we have more than one billion people that are left without access to safe drinking water (WHO, 2004). This alarming figure of 17 per cent of the global population without access to safe drinking water presents a significant challenge for the countries of the world. Furthermore, "… each year about 1.5 million children under 5 years die, and 443 million school days are lost, as a result of diseases related to water and sanitation" (UN, 2010). Governments are faced with a difficult dilemma, diminishing water resources versus growing demand. This is where another big dilemma comes into play; the issue of whether the natural resource of water is a universal human right or a scarce economic good?

Figure 1: *Population Growth in the Last 1,000 Years*



Source: World Bank (2012).

Figure 2: *Daily Per-capita Water Consumption by Country*

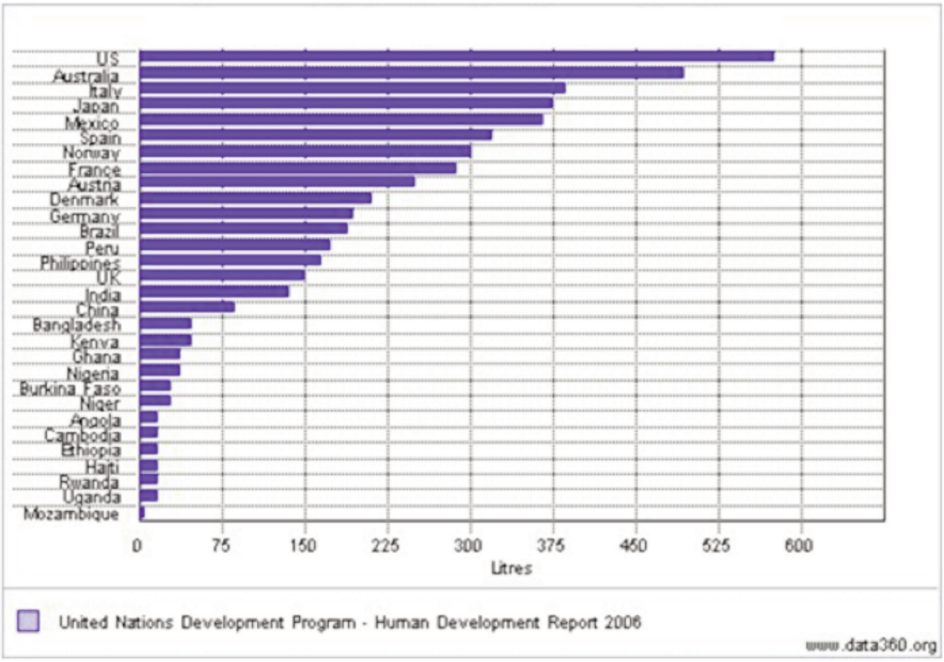
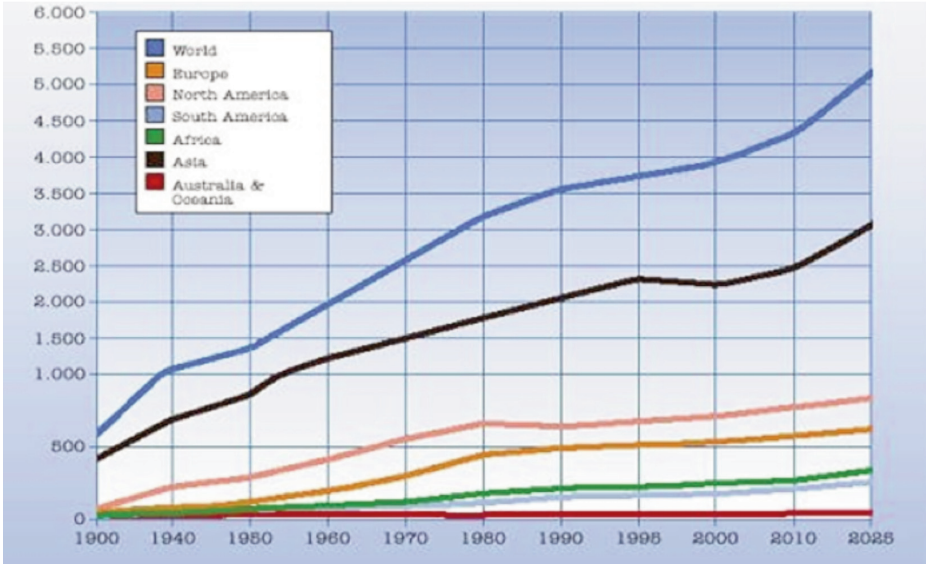
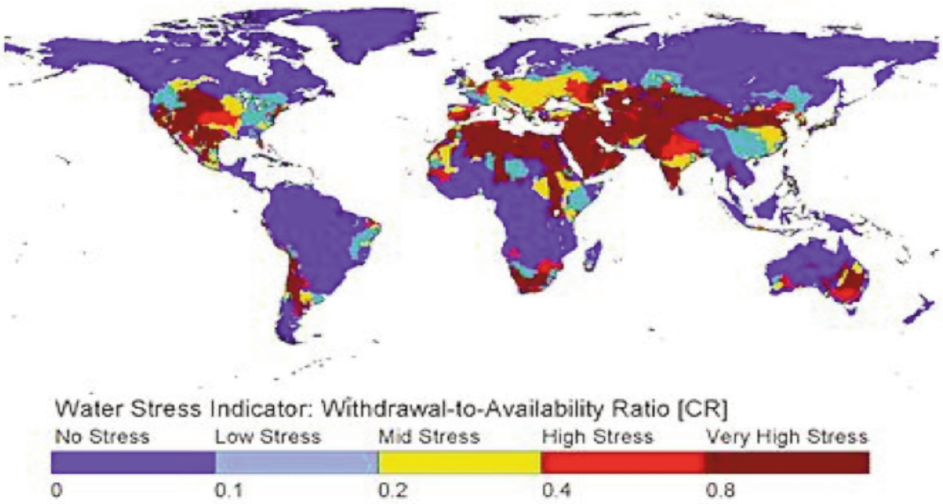


Figure 3: *Global Water Consumption 1900-2025*
(By Region, in Billions of m³ a Year)



Source: UNEP (2010).

Figure 4: *Water Stress Indicator: Withdrawal-to-Availability Ratio [CR]*



Source: Alcamo *et al. (*2000) at Gabaldón (2012).

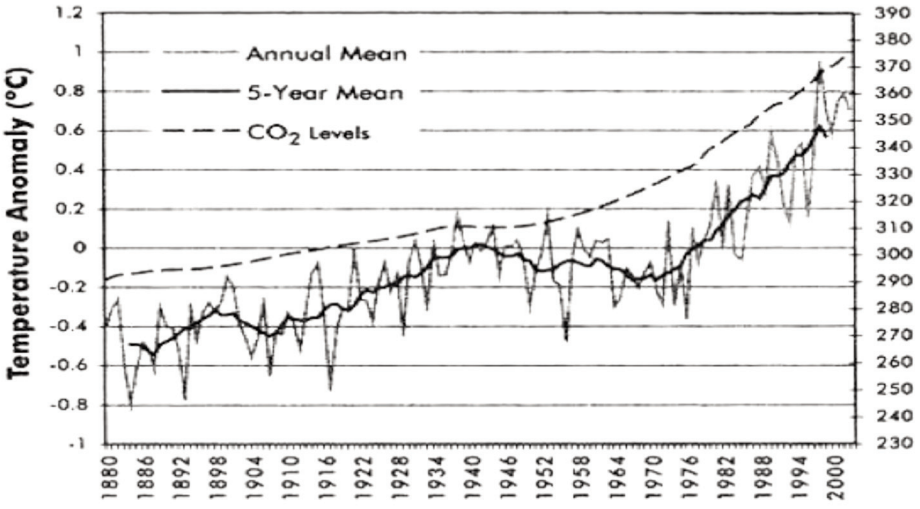
IV CLIMATE CHANGE

Climate change, including its causes, is another issue of great complexity and great controversy. This is why we will only contemplate and consider the effects of this phenomenon. All this is in order to avoid entering into controversies of causality, but rather directly addressing the subject that interests us: climate change and its impact on the global potable water supplies.

Climate change, comprises two stages, natural climate variability and changes arising "directly or indirectly to human activity". The latter "… alters the composition of the global atmosphere and adds to natural climate variability observed over comparable time periods." (UNFCCC, 1992). The first and most obvious effect of climate change is global warming understood as the general increase in global temperatures caused by increased greenhouse gases. The following graph shows the historical trend in the increase in global temperature.

The overall increase in temperature has affected the hydrological cycle. Not surprisingly, this occurs because water systems that are intrinsically linked to the levels of rainfall and runoff. These in turn are dependent on the

Figure 5: *Global Temperature 1880-2003*

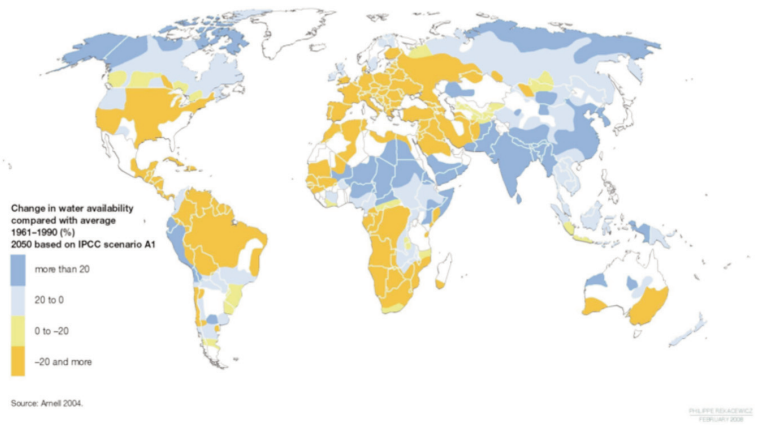


Source: giss.nasa gov

evaporation and air currents, which are directly determined by the temperature and atmospheric composition.

Thus, global water systems have intensified, sometimes bringing disruption and crisis. The general trend shows that in high rainfall areas, rainfall has tended to continue to increase, while in the lower rainfall areas, rainfall has tended to continue to decline. This phenomenon can be seen clearly in the figure below:

Figure 6: *Water Systems' Global Trends*



Source: Arnell (2004).

Based on this data, we assert that climate change will tend to reduce runoff in areas of low rainfall, becoming another negative factor to water stress. This is why we should seriously consider the effects of this phenomenon on water planning in the long term.

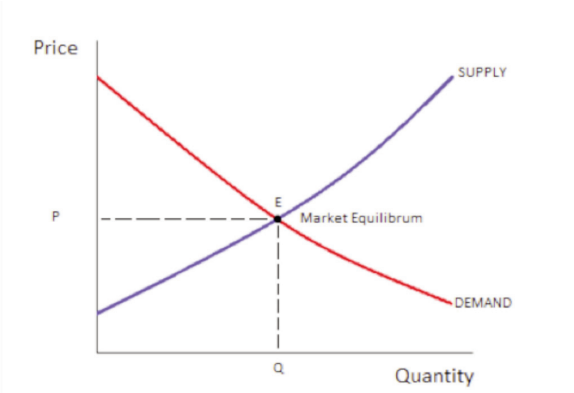
V WATER AS A FREE UNIVERSAL HUMAN RIGHT?

If we speak of water as a basic human right, then we must assume that governments of nations must ensure free, or low cost, water resources to the most needy. This school of thought is very popular in developing countries, which experience high levels of poverty. This is the case "… especially in Latin America, where privatisation efforts have led to catastrophic social effects." (Gabaldón, 2012) One such case is the so-called water war in Bolivia in 1999, where poor planning, corruption, and social insensitivity caused a series of protests that ended with the failed privatisation of water in Cochabamba.

We can say that social justice and sustainable social development involve universal access to safe drinking water. However, one cannot assume that we have an unlimited supply of potable water in the world. On the contrary, increasingly we are destroying basic ecosystems that support water cycles and polluting groundwater reservoirs, in addition to population growth that puts pressure on water demand. This is why water, despite being a basic human right, is also a resource that has economic value. It is a scarce resource; therefore, it has an intrinsic economic value. According to basic economic principles, increasing the demand of a finite good or service results in a price increase. The price increase, in turn, motivates a higher offer of good, as supply increases, prices are matched and stabilised in equilibrium. This situation of supply and demand leads us to consider the effects of undervaluing water as a free commodity.

In Figure 8, we note that whenever water is considered as a free commodity, assuming for a perfectly elastic supply of water, the quantity demanded increases. This can lead to waste. These cases occur when a locality, settlement or city does not control the use of water and provides a free supply. Such is the case of Mexico City, where "… for every 10 litres of water 3.8 are lost due to leakage in the network, the misuse of the liquid in homes and because some do not have a meter to register consumption". (Miranda, 2010.) If a situation like this is maintained in the long term, water resources will be depleted to the point that the water supply will be severely limited and become inelastic. This situation is exactly what Mexico City inhabitants have to live with: daily rationing and water shortages. Moreover, shortages usually tend to affect the most remote or poorly planned areas in urban or rural settings,

Figure 7: *The Market*



Source: Author.

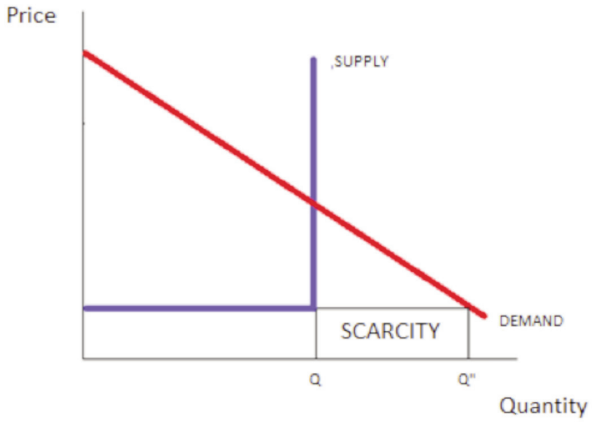
Figure 8: *The Water Market: Fixed Price or Free Supply*

Source: Author.

where low income families are demographically present. This type of situation further increases inequalities and hampers human development.

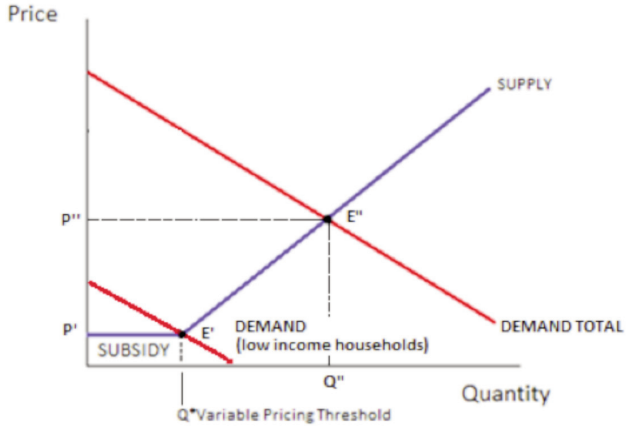
On the other hand, access to clean water can be ensured for those in need through a subsidy, while applying variable pricing for some consumption levels. This ensures that high intakes are controlled by a high price variable. In other words, the price increases relative to increased consumption. This way, price serves as a detriment to wasteful or inefficient water use. Policies that penalise resource wastage can also be implemented. These types of measures are now being implemented in Mexico City and are "… expected to reduce overall water demand by at least 2.2 m^3/s", also helping to reduce city emissions of CO_2 by 552,977 tons per year.

Figure 9: *The Water Market: Free or Fixed Supply in the Long Term*



Source: Author.

Figure 10: *The Water Market: Subsidy with Variable Pricing*



Source: Author.

From this basic economic relationship, we can infer that water should not be regarded as a free good in order to be a basic human right. Considering water as a free good incentivises inefficient use, and, in the long run, this policy of apparent social inclusion only leads to a situation of scarcity. These

situations are usually catastrophic, given that these scenarios are usually difficult to correct in the short term, they require structural reforms such as appropriate measurement and fair pricing. In addition, the most affected families under scarcity usually are those in the lower-income strata. Lower income families do not have the means to acquire or construct large water storage tanks or purchase water delivery services. On the other hand, supply can be ensured through a mixed-variable pricing policy that includes subsidies to low income households. Therefore, considering water's economic value paves the way to an efficient use of the resource. "When water is available below its fair price, it tends to be wasted. This is why it is said that the most efficient investment in water services is that aimed at reducing waste." (Gabaldon, 2012.)

VI WATER AS AN ECONOMIC RESOURCE

According to the Dublin Declaration, Principle 4°. "Water has an economic value in all its competing uses and should be recognised as an economic good." However, this protocol must not take precedence over the basic human right of access to water. On the contrary, this protocol searches the appropriate valuation of water in order to preserve it.

Oscar Wilde aptly said: "Nowadays people know the price of everything and the value of nothing." Globally, water is undervalued and misused and low prices reflect this. More than 70 per cent of available water is currently used for agriculture irrigation (FAO, 2013). In many cases, farmers enjoy subsidies and rarely use water efficiently. Moreover, "… higher prices of irrigation water, which are generally very low due to subsidies, can promote more efficient and selective farming, expand grid systems to un-irrigated areas and thus help to bridge the food gap". (Gabaldón, 2012.) On the other hand, poor governance, or poor legal framework, in many cases allows farmers to waste water resources. This is in addition to the high pollution by pesticides and chemical fertilisers that are percolated into the blue waters and groundwater.

Industrial and mining activities also result in a high degree of water pollution. Government mismanagement, coupled with poor legal framework, allowed industrial and mining activities to develop with few environmental controls. As a result, mining activities continue to proliferate in areas of high biological diversity, where water resources are contaminated with highly toxic substances such as mercury and lead. As population pushes industrial and agricultural use of water, this leads us to believe that "… appropriate pricing policy can help achieve a more efficient use of water and provide access to clean water to those who lack it" (Prager, 2006).

VII WATER PRIVATISATION

Although privatisation of water management and distribution has been contagious in recent decades, "today more than 90 per cent of world water supply is in the hands of public bodies" (Prager, 2006). The theme of a universal solution to the water problem has a kind of utopian prescription that is distant from pragmatism. Privatisation has to be seen from a pragmatic, non-ideological, human approach. In many countries or regions where the state does not have the resources or means to efficiently manage water supply, water privatisation can be beneficial. This is provided that management complies with people's human right to have access to clean drinking water. On the other hand, in some countries with different cultures, and with an unsuitable legal framework, private interests may conflict with the interests of users. This may be reflected in unfair rates and discriminatory service, unjustified rates, etc. Interestingly enough, extreme undesirable situations rarely prevail in the long run because of massive public unrest. On December 1999, in Cochabamba, Bolivia, people's unrest led to a reverse in public ownership. In these cases, the state is responsible for ensuring better water supply to the citizens by creating the appropriate legal framework and regulation.

Recommendations to policymakers:

- Take into account that water supplies globally are finite.
- Consider that phenomena such as climate change and population growth sharpen water stress situations worldwide.
- Consider water as a universal human right, vital for life and human development.
- Consider that water is scarce and of finite proportion, and therefore, should be valued accordingly.
- Take into account that mixed pricing systems can guarantee the supply of water as a universal right, while punishing its indiscriminate use.
- Emphasise the rational and efficient use of water as the most economical and feasible way to improve the situation.
- Introduce systems and technologies to enable universal and efficient measurement of consumption, and also help generate a greater supply with less waste of the resource.

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APPENDIX I

Recommended Practices for Responsible Consumption of Water (Government of Catalonia 2010)

- Water supply management, should be part of local and municipal jurisdictions. This approach generally tends to be more efficient and successful than centralised systems.
- Using water meters can be owned or rented and you will be discharged in supply. These are vital to monitor the consumption of subscribers.
- The rates of water consumption must be authorised by the commission of national or local prices as appropriate. This ensures consumer protection.
- The invoice generally coincides with the quarterly meter reading.When meter readings are done, water usage is fairly and adequately accounted.
- The bill details the concepts and service fees (service fees and consumer segments) and other tax (canon water, sewer rates, VAT and other). These revenues must ensure the updating and maintenance of the infrastructure for the management, supply, and water treatment.
- The company can cut off the supply for non-payment, but not without first notifying vividly. This ensures the entry of vital resources necessary for the successful operation of the supply company.
- The company is responsible for the exterior of the water pipe to the entrance of the property. This ensures access to drinking water in remote areas.
- Adhesion contracts (eg., water supply contract) should be available in the local language. In order to have clear statutes.
- The water supply companies (being a basic service) must have a free telephone service to cater for incidents and complaints.

Table A1: *Techniques for Efficient Water Use by Grisham and Fleming*

Technique	*Advantages*	*Disadvantages*	*Savings in Percentage (%)*
Metering	– Easy to implement – Higher potential for savings	– High initial capital investment	25 per cent in non-metered areas
Leak Repairs	– Reduces amount of not metered water	– Costs may be higher than that of water saved	9 per cent approximately
Fares	– Can strongly lead to strong savings	– Objection by users – Requires properly designed structures for efficiency	10 per cent
Efficient Devices	– Cheap – Fast efficiency	– Requires users' cooperation	At least 10 per cent of residential use
Regulation	– Great potential for savings – Reduces residual water amounts	– Possible resistance by users	More than 10 per cent of residential use
Restrictions of use	– Effective in home exteriors, especially during droughts	– Requires users' cooperation – Hard to establish	10 to 20 per cent of residential use
Recycling and Efficient Gardens	– Significant savings – Low maintenance of water plants	– Low acceptance by users – Users' preference for determined water plants – Appropriate water plants may not be available	25 per cent of residential use
Education	– May change bad habits – Long-term results – Promotes voluntary participation	– Requires a well planned and balanced effort	5 per cent