



The Management of Drinking Water and Long-term Perspective: Tunisia Case

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ABSTRACT

This article analyzes the current situation of the management of drinking water in Tunisia, focusing on the constraints that the said management is subject. The empirical results show the absence of a long-term equilibrium between production capacity and consumption structure. In addition, the pricing policy is not an incentive tool to lower consumption. In fact, for domestic sector, water appears as a necessary good, while for both industry and tourism sectors declining consumption due respect to the fact that these two sectors have adopted other sources of supply substituting water of the National Water Distribution Utility. In addition to these three sectors, the hypothesis of co-integration (long-term equilibrium relationship) between the level of consumption, the price and the number of subscribers is rejected in most cases. To solve these problems, we propose a new pricing structure based primarily on the size of households to reduce waste.

Keywords: Water Management, Pricing Policy, Co-integration, Simultaneous Equations

JEL Classifications: C22, Q21, Q25

1. INTRODUCTION

The availability of adequate quantity and quality of water is a major constraint to economic and social development especially in arid and semi-arid region. Previously, this resource was regarded as a mere fluid or a chemical while today it is seen as a living environment that must be preserved quantity and quality. Therefore, water must be managed as a precious heritage that its use is organized to allow optimal satisfaction of all users' needs, avoid waste and prevent degradation (Amigues et al., 1995).

There is no doubt that water is a vital resource both for humans than for other species. Thus, According to Mayor (1999) "Water is first a natural and ecological property that plays a vital role in the biosphere, and whose functions useful to humanity, cannot be reduced to that of a material first exploitable and expendable at will. It is a social and heritage property which human uses are regulated by law." Thus, water is the source of life on earth, it is essential for many sectors (social, economic, agricultural, etc.). His presence in sufficient quantity and good quality is a fundamental human right.

From the moment that globally, water is in limited supply and that fresh water is unevenly distributed across the globe, from very strong regional disparities in the availability and quality of water soft available is recorded (Jaglin, 2001). In addition, the current water crisis was caused by the misuse of resources by the unsustainable development mode. On the other hand, the scarcity of drinking water resource that more than one billion people do not have access to clean water. The quality issue is one of the leading causes of death and disease worldwide. Climate change and pollution threaten drinking water which represents only 3% of the world's water. Faced with this challenge political, socio-economic and ecological, the World Bank in recent statistics estimates that the water supply would require \$180 billion a year to developing countries in the next 25 years, while effective investment is around 70-80 billion now. Therefore, it is necessary to review the current patterns of resource use in production and consumption; so that any water use is made, safeguarding the needs and rights of future generations. Current uses of water should seek its savings and its renewal (OCDE (1999).

As long as the demand for water is the sum of all actual uses and the losses, the demand management is all the interventions

and organization system that governments and regulatory bodies can implement (Valérie et al., 2001). Said demand management aims; therefore, to reduce the physical and economic losses and better meet the demands of present and future generations. In this general context, Foster (1996) provides an analytical framework for the process of modernization and restructuring of the water and sanitation sector. It offers a planning model whose general objective is to improve the welfare of the population (Agthe and Billings, 1997). To follow a management of drinking water resources, Tunisia is accustomed to making the most of its water resources recovered by the years when precipitation is high. But these resources are often limited, random and unevenly spread across the country. Note that the same cyclical or structural shortages are old realities which Tunisia has learned to manage the consequences objectively.

The path of modern economic development in Tunisia since independence materialized resulting in rapid urbanization very centered on the coast. The state model is initially based on the French model. This results highlight interventionist policy with a major role in the administration and centralization which affirmed further the role of the capital. The Water Code declared in 1975 reaffirms the public water resources and calls for measures relating to the pollution of surface and ground water; it prescribes general provisions for wastewater treatment and regulation of discharges into the environment. The tariff policy in Tunisia aims to ensure sustainability of the water sector by the coverage of operating expenses and financing costs of equipment. Water demand management and the economy were apprehended especially by using a tariff policy tariff escalation to penalize excessive consumption and reduce waste. Thus the objective of this paper will then analyze the current situation of the management of drinking water in Tunisia focusing on the constraints that said management is submitted.

The rest of this article is organized as follows. The second section will give rise to a theoretical analysis of the management of drinking water in Tunisia. The third section examines an empirical methodology to assess the situation of the current policy. The fourth section will book the results of empirical observations, as well as discussing made about the nature of these results. The fifth section will focus on extending the model of the current management of the water resource. In the end the sixth section concludes the study.

2. THEORETICAL ANALYSIS

The report “analyzes the strategies and prospects of water in Tunisia,” Blue Plan (2000) addresses the various water resources characteristics in Tunisia, as well as policy and water strategies that are currently being applied. Thus, the general field in which current strategies are based, is characterized by high variability over time of water resources, poor distribution of this resource in the territory for different users and strong heterogeneities in the distribution Space saline quality of the water resources. Faced with growing water demand for the development needs of the country, the strategy adopted by the officials of the sector aims to stabilize this development. Indeed, the search for maximum technical control of all water resources through mobilization and regulation of most of the flows and the establishment of an

interconnection network, aims to pool nationally the problems of development of consumption. In addition, water management strategies, looking for optimal use of this resource available, they highlight the importance of optimal national allocation decision of the resource between uses and between regions.

Moreover, some concepts of demand management demand to consider increasing the efficiency intra-sectoral. It is then to implement the economic, technical and regulatory instruments to reduce losses, and stabilize the unit consumption within each use. Allen and Bower (1985) points out that the principle of demand management can only be a short term solution; therefore the demand management is also interested in increasing inter-sectoral efficiency. Note that the inter and intra-sectoral efficiency of water resources in Tunisia are still problems of distribution and satisfaction.

2.1. Water Resources

Tunisia is in a semi-arid zone, characterized by a failure and irregular rainfall, which causes periods of more frequent droughts. The total water production by National Water Distribution Utility (NWDU) shows an evolution for the period 2002-2009 with an average annual growth rate of 3.6%. This production and constituted by surface water and groundwater. However, surface water produced by the various dams amounted to 270.3 million m³ in 2009, including 2.9 million m³ was recycled for reuse. This resource type represents 53.8% of total product. In addition, groundwater produced in 2009 by the different drilling, surveys, wells, amounted to 219.9 million m³ against 178.7 million m³ in 2002, representing an average annual growth rate of 3.3%. If resource type represents 46.2% of total production.

At the beginning of the creation of NWDU, surface water primarily fueled Greater Tunis and some parts of the country the edge. Since 1993 northern waters arrivals to the South to fill the gap needs. In addition, and on the needs by region, the distributed volume accused variations ranging from -1.9% in the North 1% in Greater Tunis. More and center of the country's water supply was down 0.8%. Both the South of the country's water supply was down 0.4%. In addition to these stated problems, the temporal variability that is to say, the availability of the resource between years, and the spatial variability that is checked by the unequal distribution of resources between different regions of the country, makes management this resource can delicate.

2.1.1. Temporal variability

Like any country subject to a Mediterranean climate, Tunisia is facing a high seasonal rainfall variability and therefore surface water concentrated in the winter. This seasonal variation is coupled with a strong inter-annual variability (severe drought, the drought years 1989-1992). Indeed, the fight against such variability, it will provide great works for storing high flows wadis in years of high rainfall.

2.1.2. Spatial variability

The geographical distribution of rainfall implies large imbalances between sometimes very watered north and south desert¹. Indeed the region of Greater Tunis and the North region are generally

¹ Statistical report of NWDU (2014).

provided by surface waters which have the largest share in the resources available. As against the South Region and has generally by groundwater resources that have most of the resources available. Alternatively, the non-coincidence of the development zones with such distribution of resources can lead to water resources development issues to ensure some national equalization.

2.2. Price Policy

The way of securing drinking water price is one of the tools to rationalize the consumption of this vital resource (Opaluch, 1982). In this context, the policy of NWDU is mainly based on non-linear pricing by consumption bracket and whose objective is to penalize consumer groups who waste the most water resources. Note that the average selling price of water had an average change of 2.2% per year during the period 1976-2014. By sector price trends experienced multiple disparities. Indeed, on the domestic and industrial sector, the price has increased quite progressive evolution and especially for the lower tranches of consumption. However, the tourism sector, the price was uniform and since 1984 this price is equal to the last price range (151 and more) for domestic and industrial use.

In the domestic sector, and despite the changes in the price, water consumption has kept a pace strong enough evolution. This is explained by the fact that drinking water is a basic necessity for households (Chicoine and Ramanurthy, 1986; Gaudin, 2005). For both industry and tourism rising prices may explain, at least partially, the decrease in consumption for both types of users.

2.3. The Challenges of the Water Sector

In recent years, the potential water resources, including groundwater in Tunisia are limited to 47 km³ of which only 4 are mobilized by water projects. Surface flows are more irregular rainfall over a period of 20 years is very random, there is an average of 3 wet years, average years 6 and 11 years of deficit which 5 are dry. Moreover, these resources are very unevenly distributed across the country and 50% of these resources have only <1.5 g/L salinity and 23% of resources are characterized by poor quality, where salinity is higher 3 g/L.

However, in Tunisia, the water resource is rare and random, which presents an obstacle facing the economic and social development. In addition, and although the control of population growth, rational management of water resources and the economic choices adopted by Tunisia are very significant, the growing mismatch between the needs of the population of water resources and food needs poses many problems (Vincent, 2003). In Tunisia, the general principle of the water supply is centralized decision that can put in most of the time problems that are often attached to the poor distribution among regions and between users. The short-term consequences of this principle are clear to allocate access to water equitably throughout the country depending on the location of users, but in the long-term, this principle can focus on other users in terms quantitative and qualitative satisfaction (Serge et al., 2003).

3. EMPIRICAL METHODOLOGY

In a context of sustainable management of the resource of drinking water scarcity can be a barrier that coincides with the policies

of the management of this resource (Burucora, 1995). Further population growth followed by increasing the number of users complicates further the problem. So, to what extent the current policy of drinking water management in Tunisia can stand before these constraints? Faced with growing water demand for the development needs of the country, the optimal water management strategy seeks to maximize the use, preservation of this resource and the achievement of social justice to finally achieve long-term economic balance (Daniel and Martou, 2003). This is to implement technical and regulatory economic instruments to reduce the losses and stabilize the unit consumption.

Note that in the demand management approach, the instrument price can guide us to a rational use of water resources (Spiller and, Savedoff, 1999). It appears as an incentive mechanism that can react on users' consumption structure for efficient use of existing capacity. In this context, the price elasticity is an economic indicator that can tell us about the reaction of consumers against increases in water rates (Howe, 1982). The tariff (Matoussi and Branzini, 1998; Katzman, 1977) policy in Tunisia aims to ensure sustainability of the water sector by the coverage of operating expenses and capital financing costs. Indeed, the management of water demand and its economy were apprehended especially by using a tariff policy tariff escalation to penalize excessive consumption and reduce waste in order to achieve sustainable water resources management. The long-term balance between production capacity and changes in consumption structure is the solution that can guarantee sustainable management for the present and future generation. Indeed, a preliminary analysis is essentially to provide information on the variation of the main variables in the management of drinking water demand, such as changes in the relationship between consumption, production, prices and different determinants this consumption is an indicator on the sustainability of this vital resource in our country (Nauges and Raymond, 2001).

Thus, the econometric estimation aims to explain the influence of variables (price, number of consumers, production ...) on the structure of users' consumption. It can give us information on the one hand, the evolution of the consumer face to the limited capacity of production, on the other hand, the impact of price changes regarded as an incentive instrument on consumption levels, then the effect of the increase in the number of consumers on the amount consumed. At this level, the validity of the temporal variation we will assess these variables to ensure the conservation of drinking water resource considered rare and limited and the measures taken to ensure the sustainable management of its use.

3.1. Data Collection

The data come from statistical reports of NWDU. In fact, these data allow us to build all the necessary variables for an empirical study. These variables focus on production, consumption, price and number of subscribers. In addition, and a description of the variables, the production of water requires all drinking water resources available at national level; it includes surface water and groundwater. Regarding the consumption of drinking water, this variable appears in two stolen: The total consumption that includes all the quantities distributed to users using the water of the NWDU and sector consumption recorded in each of the domestic industry

and tourism sectors. To present the price of drinking water in this study, this variable is given by the average price of the various tranches of consumption. However, this price is uniform for both domestic and industrial sectors, against it shows the evolution of the last tranche of tariff for the tourism sector. In the end, and on the number of subscribers, this variable requires all consumers who are fed by the water of the NWDU. Note that the drinking water supply which was carried out in most countries of the region has therefore to change the number of mostly domestic subscribers.

3.2. Sector Analysis

The volume of water consumed by the domestic sector is characterized by an average annual growth rate of 3.8%. This gradual evolution, which is partly explained by the demographic growth of the population, negatively affects the program for the conservation of the resource in our country. Moreover, the industrial sector recorded a decrease in water consumption NWDU. Said consumption follows a slow pace and sometimes decreasing, despite the development experienced by the sector, especially since 1998. The tourism sector has experienced a similar reality to the industrial sector despite changes he experienced and the role it plays in the national economy.

In addition, the number of subscribers connected to the networks NWDU present variations across different users. Indeed, a significant increase of 3.9% was recorded in the number of domestic subscribers. For cons, the number of subscribers for industrial and tourist use increases with a slower pace and with a rate of 1.9% and 1%, despite the evolution of these two sectors in the payroll through economic development. Faced with the demographic and economic growth which the country; tariff policy aims to make more efficient water management and to ensure the viability of the water sector (coverage of operating expenses and financing of equipment cost). Thus, the policy of the management of drinking water then is to ensure the conservation of water resources and rationalize consumption for each sector to ensure sustainability of the resource.

In this context, the evaluation of the current policy in terms of power management in drinking water in different sectors, forcing us to use an econometric study that aims to explain the influence of price and number subscribers on the structure of sector consumption. Thus, we propose to estimate linear regressions for each sector in order to know the relationship established between the consumption of water (endogenous variable) and the price and the number of subscribers (exogenous variables).

Indeed all regressions are presented in the following form:

$$C_t = \alpha_0 + \alpha_1 P_t + \alpha_2 NS_t + \varepsilon_t$$

Where, C_t : Drinking water consumption, P_t : Water prize, NS_t : Number of subscribers, ε_t : Error terms.

Economic relations are often complex to be described from a single equation. Indeed, the evolution of the economy is well approximated by the description of the dynamic behavior. In reality, the relationships that govern the behavior of economic agents are numerous, and a better understanding of the phenomenon requires application of a system of equations. Note that in most econometric

models studied, specific relationships between variables are based on economic theory.

To analyze the current situation of the management of drinking water resources in Tunisia, we will introduce a system of equations that determines the consumption depending on several variables that have direct or indirect effects on consumption. All variables are expressed in logarithms and therefore parameters are elasticity.

$$\text{Log}(DC) = c_1 + c_2 * \text{Log}(PROTOT) + c_3 * \text{Log}(DIP) + c_4 * \text{Log}(POPULATION) + e_1$$

$$\text{Log}(IC) = c_5 + c_6 * \text{Log}(PROTOT) + c_7 * \text{Log}(NIC) + c_8 * \text{Log}(DIP) + c_9 * \text{Log}(IAV) + e_2$$

$$\text{Log}(TC) = c_{10} + c_{11} * \text{Log}(PROTOT) + c_{12} * \text{Log}(NST) + c_{13} * \text{Log}(TP) + c_{14} * \text{Log}(TAV) + e_3$$

With, DC : Domestic consumption, NIC : Number of industrial customers, IC : Industrial consumption, NST : Number of subscribers tourism, TC : Tourist consumption, IAV : Industrial added value, $PROTOT$: Total production, TAV : Tourism added value, DIP : Domestic and industrial price, $POPULATION$: Tunisian population, TP : Tourism price, and e_1 , e_2 and e_3 error term.

The simultaneous appearance that certain model variables are simultaneously explanatory and endogenous variables allows us to apply a system of simultaneous equations to see the relationships between the variables considered fundamental in the drinking water of consumer policy in our country.

3.3. Long-term Balance

To analyze the current situation of the management of drinking water, it becomes necessary to consider measures efficiencies in the management of this resource. Indeed, the empirical study of the evolution of two variables total consumption and production over time allows us to observe a balance or imbalance in this vital good management policy adopted. In addition, and in a sector study we will look at the effectiveness of price policy and changes in the number of subscribers on the consumption structure for a long-term projection. To do this, we study the stationarity and the co-integration between consumption and its components. In order to test the co-integration between sets, an augmented Dickey-Fuller (ADF) test is applied which has the objective to test the existence of a unit root in the estimated residuals of the long-term statistical relationship.

$$\hat{e}_t = y_t - \hat{\alpha}_0 - \hat{\alpha}_1 x_t$$

With, y_t : Represents the global or sector consumption of drinking water and x_t has in each case the total production, price and number of subscribers.

4. RESULTS AND DISCUSSION

4.1. Limitations of the Current Strategy

The management of drinking water resources in Tunisia can cause inefficiencies. Indeed, the price factors no longer appear as an

incentive mechanism to limit consumption. Moreover, the evolution of subscribers can pose major constraints in the consumption structure for the limited production capacity. To check this, the consumption patterns of the estimates are given in the Table 1.

In the domestic sector the estimated coefficients are widely significant at the 95% threshold which means that the variables price and subscribers have a multiplier effect on consumption. Similarly, we note that if the price increases by 1% consumption increases by 0.2%. This brings us to affirm that the price factor no longer appears as an incentive tool for resource conservation. Indeed, the fact that drinking water is a basic necessity for households, its application seems inconsistent with the famous "law of demand." Furthermore, the significance of the change in DC relative to the number of subscribers shows that a 1% increase in the number of subscribers has therefore to increase consumption with a relatively high proportion of around 0.62%. This result proves that the mass effect can deplete resources in the medium and long-term, given the limited capacity of production.

In the industrial sector variables P_t and NS_t affect positively and significantly the level of consumption at the 99% threshold. Indeed, a price increase of 1% leads to an increase in consumption of 0.22%. This positive relationship shows that the price can be considered as an incentive tool to lower consumption. This is not surprising because industrial users, who are considered heavy consumers are generally contained within the consumption 151 m³ more when the price is highest. Concerning the NICs, a change of 1% of this variable has the effect of increasing the consumption of 0.27%. Indeed, the variable number of subscribers does not have a significant effect on consumption. This phenomenon is explained by the use of the industries of partial or total way of sources of supply other than NWDU.

In the tourism sector the coefficients of both variables P_t and NS_t are significant at the 99% threshold. Also what was said for other sectors we can reaffirm for the tourism sector, the inability of the instrument prices act as an incentive that can streamline water consumption whenever the elasticity of demand compared to prices is positive. The variable does not seem to have a big effect on consumption which is explained by the fact that many hoteliers have resorted to using water from their own wells including different uses (watering the lawn, showers and toilet, etc.). In addition, the estimation of a simultaneous equation model to analyze the objectives of cross-sectoral impact of variables in the model of consumption structure (Table 2).

The level of t-statistic shows that the estimated coefficients of most variables are different from zero and significant at 95% confidence level. Or even in case of non-significance of some variable coefficients, this can be explained economically. The variable regression coefficient *PROTOT* for the three sectors indicates that the change in output is roughly proportional to that of consumption, this result is criticized because it can not have the specific production for each sector.

In the domestic sector, we note that if the price increases by 1% the amount consumed will increase by an amount of 0.1%,

which explains the price factor has no significant effect on the consumption structure Household. This is a reality since water is a basic need for humans, making the demand for this property inelastic for this category of consumers. Regarding the other two sectors that is to say, industry and tourism, consumption trends and prices vary in the opposite direction, and in this case the pricing structure has a positive effect in terms of resource conservation. However, water demand appears resilient, and the variation between these two variables (consumption and prices) obeys the law of diminishing demand, which states that better price increases over the quantity consumed decreases. However, this result does not meet reality as these two sectors will gradually abandon NWDU water and seek their own power supplies.

The change in consumption compared to the NICs is not significant, because in principle if the number of industries increases consumption should also increase, but this justification we stated above and that the majority industries are characterized by a partial independence of the water of the NWDU. In addition, for tourism, a 1% increase in subscribers is followed by a small increase in consumption (only 0.1%), despite the development of tourism in our country. Also the evolution of industrial and tourist value added does not have a great effect on the rationalization of consumption, variations are lower and therefore this explains a bad strategy adopted by these two sectors for sustainable development of the resource drinking water.

Table 1: Sector analysis

Variables	Coefficients		
	Domestic sector	Industrial sector	Tourism sector
P_t	0.2 (2.36)	0.22 (3.2)	0.16 (4.06)
NS_t	0.62 (13.52)	0.27 (4.06)	0.5 (7.21)

The number in parenthesis represents the student statistics

Table 2: Associate analysis

Variables	Coefficients		
	Domestic sector	Industrial sector	Tourism sector
<i>PROTOT</i>	0.99 (10.84)	1.016 (3.12)	0.429 (2.72)
<i>DIP</i>	0.102 (2.8)	-0.22 (-2.01)	-
<i>POPULATION</i>	0.629 (3.53)	-	-
<i>NIC</i>	-	-0.035 (-0.30)	-
<i>IAV</i>	-	0.28 (0.78)	-
<i>NST</i>	-	-	0.198 (3.43)
<i>TP</i>	-	-	-0.91 (-3.20)
<i>TAV</i>	-	-	0.57 (6.02)

DC: Domestic consumption, NIC: Number of industrial customers, IC: Industrial consumption, NST: Number of subscribers tourism, TC: Tourist consumption, IAV: Industrial added value, TAV: Tourism added value, DIP: Domestic and industrial price, TP: Tourism price

In addition, population growth presents an obstacle for a resource conservation program. Indeed, for an increase of 1% of the population believes the consumption of 0.6%. This result is not desirable due to the limited production capacity, which can then ask very complicated problems for future projection. However, the analysis provided on the current management policy of drinking water in Tunisia show amazing results in the structure of the demand function. Thus, the strategy currently adopted almost reached its limits, given the scarcity of this vital resource. The inefficiency observed in the consumption of factors is an indicator that complicates the objectives of sustainable management of this resource.

4.2. Measures for Sustainable Management

The empirical study of the evolution of two variables total production and consumption over time allows us to observe non-preferred results to achieve sustainable management. For this reason we consider the annual series of these two variables available on the period from 1976 to 2014. Figures 1 and 2 show that the two series seem to have a common upward trend over the whole the period. Therefore, the two series seem stationary and not because of their apparent similar evolution, it is legitimate to be interested in the study of co-integration between these two variables (Sandrine and Mignon, 2002).

Figure 1: PRO level series

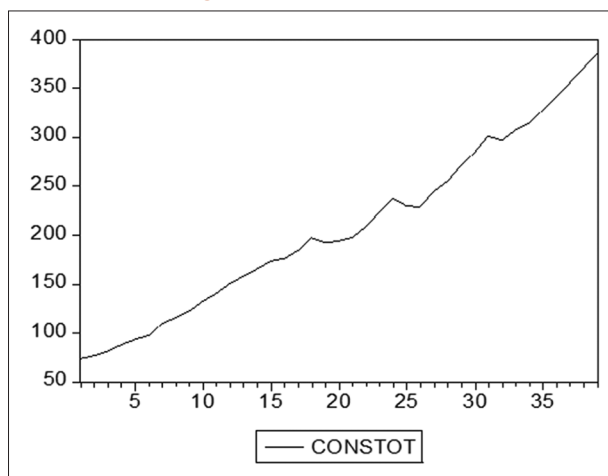
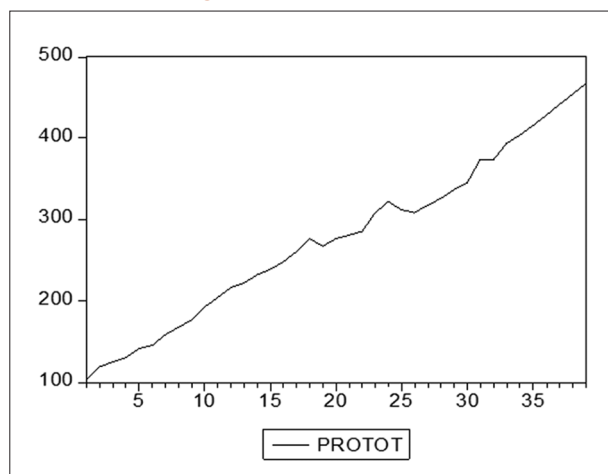


Figure 2: COT level series



To the extent that the method of Engle and Granger (1987) is valid for integrated series of order 1, it is first necessary to determine the order of integration of each of our series. To this end, we apply the test of Dickey Fuller on series production and consumption. The results show, first, that the consumption series is non-stationary, the estimated value of the ADF statistic (-0.51) is greater than the critical value (-3.53) at the 5% threshold. Similarly, and secondly the results show the non-stationary of series production, the estimated value of the ADF statistic (1.58) is higher than the critical value (-3.53) the statistical threshold of 5%. therefore, test the null hypothesis of unit root on the series in first differences stationarity provided two sets consumption and production, given the estimated values and critical (-5.39<-3.53; -6.58<-3.53) the statistical threshold of 5% (Figures 3 and 4).

In addition, the estimate of the statistical relationship² between consumption and production, aims to derive the residue series. The results of the implementation of the ADF test on the series of residues of this statistical relationship show the non-stationarity of the series at the 5% threshold. Indeed, the estimated ADF statistics (-2.014) is greater than the critical value (-3.67) (critical value of Engle and Yoo, 1987) and the estimated relationship between consumption and production is a spurious regression. Therefore consumption and production series are not co-integrated that is to say, there is not a long-term balance between these two variables, and this poses a problem in the management of drinking water in our country for future projection (Table 3).

On the other hand the sectorial analysis shows that in the domestic sector both sets of consumption and price are stationary in first differences. Indeed, the estimated statistics of the ADF test is -5.028, -5.35 and below the critical value respectively (-2.96) at the 5% threshold. In addition, the results conclude that the non-stationary residuals of the statistical relationship between DC and the price³ of which the two series are not co-integrated and therefore there is not a long-run equilibrium relationship between these two variables.

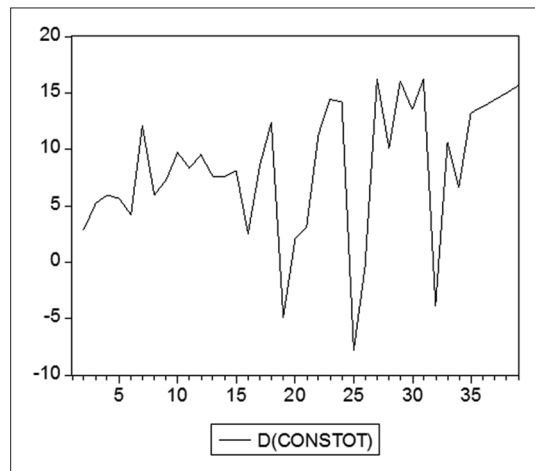
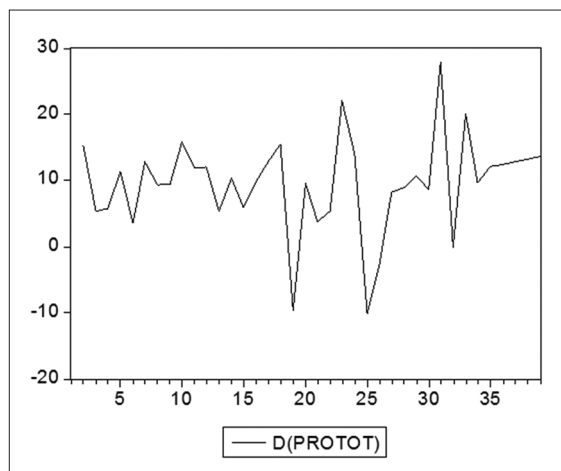
For the industrial sector, the results show that consumption, price and the number of subscribers series are stationary in first difference at the 5% threshold. The estimated values of the ADF statistic is respectively -5.53, -5.35 and -3.77 below the critical value (-2.96). Moreover, cointegration tests between the two couples consumption and a share price and consumption and many of the other subscribers are prone to spurious regressions. However the non-co-integration of these two couples shows that the long-term equilibrium could be reached. This explains why the current management policy strategy can only be effective for short-term projections.

Regarding the tourism sector applying the ADF test shows the stationary three series; consumption, price and number of subscribers, expressed in first difference at the 5% level (ADF

2 The statistical relationship is given by the regression $TC = a + \beta TP + e_t$ (TC is the total consumption of well water, TP : Total production of drinking water well, e : Error term).
 3 This relationship is given by the equation: $DC = a + \beta DP + e_t$ (DC : Domestic consumption, DP : Domestic prices).

Table 3: Co-integration relationship

Sector consumption	Domestic sector		Industrial sector		Tourism sector	
	Price	Number of subscribers	Price	Number of subscribers	Price	Number of subscribers
	No	-	No	No	No	Yes

Figure 3: Series in the first difference *COT***Figure 4:** Series in the first difference *PROT*

projection. This is verified by the co-integration relationship between the two variables. However, this result is very critical of the fact that the decrease in consumption in this sector is primarily due to the above mentioned consequences.

5. EXTENSION IN THE CURRENT MANAGEMENT

The analysis of the current strategy for the management of drinking water in Tunisia shows serious problems in this management. Indeed, the pricing policy practiced does not achieve its objective. Therefore, the trend in prices between different consumption blocks continues to decrease the quantities consumed various used. In addition, the first phase of so-called social consumption intended for the poorest consumers in the household can be easily exceeded by households. For both large consumers and tourism industry, changes in the price has an indirect effect, in fact, it's two sectors will gradually abandon water of NWDU and seek their own supplies. However, this strategic policy for both sectors has a negative effect on the limited production capacity of the water resource.

On the other hand, changes in the number of subscriber can pose major constraints facing such management. In the domestic sector the number of subscribers explained by population growth follows an incompatible pace as water resource production. For both industry and tourism developments subscriber does not have a large effect on consumption this and due to the above-mentioned consequences.

So far we can conclude that the policy in the current strategy can shout wasteful in resource management. In this context, a correction made on the current pricing policy as it presents a solution for a control program. In fact, the correction must take measures social and economic order. However, the decrease in the number of slices in the tariff structure NWDU, applying tranches based on household size, aims to provide measures of social justice. In this context and as the acceptable threshold according to the World Health Organization (OMS, 1989) is 100 L/J per person, building a first tranche of social consumption should be based on the size of the household. As the representative size of a Tunisian household is five members, the basic allowance will be of 0.45. The size of families than the reference size must have an additional slip reserved for other members. However, to ensure the conservation of the resource and prevent any kind of waste, an upper-limit of this tranche must be regulated with severe pricing procedures. Thus, a social block can be represented as follows (Table 4):

Therefore, this new fee constituted only by three slices of consumption can provide goals: By it can ensure social equity measures to put households under the same conditions in favor

are estimated respectively -5.008 , -5.27 and -3.62 below the critical value of -2.96). The results show the non stationarity of the residue series calculated from the statistical relationship between consumption and the tourist price⁴, against the stationary of the series of residuals calculated from the statistical relationship between consumption and the number of tourist customers⁵. Therefore in this tourism sector there is no co-integration relationship between the two variables and consumer prices, resulting in a long-term imbalance in the evolution of these two variables. For cons, the balance between the two variables and consumer subscribers appears to be reached, and thereafter you can have a stable relationship between the two variables for future

4 This relationship is given by the equation: $TC_t = \alpha + \beta TP + e_t$ (TC_t : Tourism consumption and TP : Tourist prices).

5 This relationship is given by the equation: $TC_t = \alpha + \beta NTS + e_t$ (TC_t : Tourism consumption, NTS : Number of tourist subscribers).

Table 4: Social consumption brackets

Household size	Slice (m ³)
1-5 people	0-45
6 people	0-54
7 people and more	0-63

of their consumer rights, and second, it can achieve economic measures that result in the reduction of waste in the management of the resource.

6. CONCLUSION

Faced with growing water demand for the development needs of the country, the optimal water management strategy seeks to maximize the use, preservation of this resource and the achievement of social justice to finally achieve long-term economic balance. Then it is to implement technical and regulatory economic instruments to reduce the losses and stabilize the unit consumption. Analyses on the current policy of the management of drinking water in Tunisia show amazing results in the structure of the function of the overall and sectoral demand. Thus, the strategy currently adopted almost reached its limits given the scarcity of this vital resource. The inefficiency observed in the consumption function based variable price and number of subscribers is an indicator that complicates the objectives of sustainable management of the water resource in the Tunisian case. In addition, and if we assume that the linear adjustments of variables performed on 39 periods of our study are checked in futuristic horizons in the sense that implicitly assumes the absence of structural changes in the structure of consumption, prices, the number of subscribers and the capacity of production of major constraints in water resources management can be asked. For this reason, policymakers in the sector must be prepared and take appropriate measures to overcome the crisis in the management of drinking water in order to protect future generations. Among snuff control modes can imagine a revision on the number of installments of the price charged and appeared as a mode of regulation that can solve even a partial manner the problems observed in the management of drinking water resources.

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