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DOMESTIC WATER CONSUMPTION IN ALGERIA – CASE STUDY TLEMCEN

CONSOMMATION DOMESTIQUE DE L'EAU EN ALGERIE - ÉTUDE DE CAS TLEMCEN

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ABSTRACT

In Algeria, domestic water consumption data are not systematically collected, though most service connections are equipped with water meters. Water meters, however, are not maintained or periodically replaced leading to unreliable meter readings, if they are read at all. No long – or even short – term records of water consumption exist that could serve as empirical basis for the prediction of water demand in infrastructure planning and design. Several official documents propose values for water demand. These values all differ from one another, sometimes considerably. Thus, most hydraulic studies on the local level are still based on a customary value of 150 l/cap/d. This article gives an overview of the available information on domestic water demand and presents two studies that were carried out to determine domestic water consumption in the city of Tlemcen.

Keywords Domestic water consumption, water demand, Algeria, Tlemcen

RESUME

En Algérie, Les données sur la consommation d'eau domestique pouvant servir de base empirique pour la prévision de la demande en eau sont inexistantes. Plusieurs documents officiels proposent des valeurs pour la demande en eau. Toutes ces valeurs diffèrent les unes des autres, parfois considérablement. Ainsi, la plupart des études hydrauliques au niveau local sont encore basés sur une valeur habituelle de 150 l / hab / j. Cet article donne un aperçu des informations disponibles sur la consommation d'eau à usage domestique et présente une étude visant à déterminer la consommation d'eau dans la ville de Tlemcen, qui présente des caractéristiques typiques de l'approvisionnement en eau en Algérie: ressources limitées, la gestion déficiente et les conditions d'approvisionnement discontinu. La consommation d'eau a été déterminée à 80 litres par personne et par jour pour la période de 2008 à 2009. Les données recueillies ont également permis de déterminer des modes de consommation quotidiens et hebdomadaires qui ont été comparé à des modes de consommation typiques pour des conditions d'approvisionnement en continu.

Mots clés : Consommation d'eau domestique, la demande en eau, l'approvisionnement en eau, distribution de l'eau, Algérie

INTRODUCTION

Few studies exist trying to determine water consumption in Algeria. In the course of the water transfer project “Taksebt”, in 1992, a household survey had been carried out to determine domestic water consumption in the provinces Algiers, Bourmerdès and Tizi Ouzou. Per capita water consumption was determined at 96 to 133 litres a person a day (l/cap/d) depending on the type of dwelling (DGAIH-S/D, 1996). Several national plans and programmes concerning water resources development base the determination of water demand on these findings, as for example the report on domestic and industrial water demand which was elaborated in 1997 within the framework of the national water plan PNE-93. Figures, however, have been adapted, leading to different values for different provinces, from 69 to 215 l/cap/d (DGAIH-S/D, 1997). The findings of the above mentioned “Taksebt” study are still being referred to in more recent years, for example within the framework of the programme for the development of the coastal area. The integrated management of water resources is one aspect of this programme. The correspondent technical report stipulates values for water demand from 50 to 125 l/cap/d (MATE, 2005).

A number of other reports about water resources present values for the per capita water demand though without specifying how these values were determined. The so-called hydraulic registers of the catchment areas establish water demand at 60 to 300 l/cap/d subject to catchment area and population density (D.E.A.H., 2006). The National water resources development plan from 2009 distinguishes between people connected to the public water supply and those who are not, defining a water demand of 100 l/cap/d and 40 l/cap/d, respectively (SOFRECO, 2009). A study elaborated in the context of the transfer project North-South (SAFEGEE, 2004), the new national water plan PNE-2006 (SOFRECO, 2009) and a study on drinking water tariffs (D.E.A.H., 2002) stipulate different values from 60 to 120 l/cap/d to predict water demand.

As can be observed, a variety of values are used to predict water demand in water resources planning and management in Algeria. These values are rarely based on measurements or the analysis of long – or even short – term records of water consumption. The use of different values is not explained. Being aware of that problem, the Ministry of Water Resources organised a workshop where the figures to be used in the prediction of water demand were discussed. Using the spectrum of values established in previous documents, they came up with yet another set of values, establishing actual per capita water demand between 60 and 100 l/cap/d in function of type and size of the settlement. Based on these values predictions were made for the years 2015, 2020, 2025 and 2030 (SOFRECO, 2009). Most hydraulic studies, however, are still based on a customary value for the per capita water demand of 150 l/cap/d instead of trying to chose from a plethora of values offered by official documents for water resources planning and management. For a summary of the mentioned studies please refer to table 1.

The only way to find the most suitable value to be used for water demand predictions in the Algerian context is to establish the actual water consumption as a sound empirical data base. In most Algerian cities, however, water consumption is not measured and if it is, data are rarely reliable due to water meter degradation. Few attempts have been made to characterise and quantify actual water consumption. In 2004, Masmoudi et al. (2008) carried out a measurement campaign to determine domestic water consumption in the villages Biskra, Tolga and Sidi Okba. They selected 147, 68 and 44 households respectively, where consumption per household and day was determined as well as seasonal, weekly and diurnal variations of consumption. Per capita consumption was not determined. Ghizzellaoui and Djebbar (2007) conducted a study to predict the future water demand of the city of Constantine. Current water consumption data were obtained from the records of the water utility.

Analysis of these data led to a per capita consumption of 114 l/cap/d between 1990 and 1998, 120 l/cap/d between 2000 and 2004 and 124 l/cap/d in 2004. No information about the method of measurement or the reliability of the data is given. To predict future water consumption, a per capita demand of 160 l/cap/din 2006, 175 l/cap/d in 2010, 190 l/cap/d in 2015 and 205 l/cap/d was assumed.

Table 1 : Available studies on domestic water demand/consumption in Algeria

Study / Plan / Programme	Year	Estimated demand		Method
		(l/cap/d)	function of	
Study „Taksebt“ (DGAIH-S/D, 1996)	1992	96 - 133	type of dwelling	household survey (Wilayas Algiers, Boumerdes, Tizi Ouzou)
National Water Plan, PNE-93 (DGAIH-S/D, 1997)	1997	69 - 215	Wilaya and population	estimation based on the results of the study “Taksebt”
Study on drinking water tariffs (D.E.A.H., 2002)	2002	100	type of dwelling	not specified
Study SAFEGEE (SAFEGEE, 2004)	2004	60 - 120	Urban / rural area and type of dwelling	Literature review and consumption data of water providers
Masmoudi et al. (2008)	2004	-		Measurement campaign in households of the villages Biskra, Tolga and Sidi Okba
Programme for the development of the coastal area (MATE, 2005)	2005	50 - 125	type of settlement	estimation based on the results of the study “Taksebt”
Hydraulic registers (D.E.A.H., 2006)	2004, 2005, 2006	60 - 300	catchment area and population density	not specified
National Water	2006	95 - 105	scenario	not specified

Plan, PNE-2006 (SOFRECO, 2009)				
Ghizzellaoui and Djebbar (2007)	1990-1998 2000 - 2003 2004	114 120 124	Domestic water consumption	Analysis of data of the water utility in the city of Constantine
National water resources development plan (SOFRECO, 2009)	2009	40 / 100	Not connected / connected to public water supply	not specified
Workshop on water demand (SOFRECO, 2009)	2009	60 - 100	type and size of the settlement	estimation based on previous studies, plans and programmes

The present article describes the study that were carried out to determine domestic water consumption in the city of Tlemcen. In the following paragraphs the study areas, methodologies and results are described and discussed.

STUDY AREA TLEMCEN

Geography

The city of Tlemcen is situated in the extreme North-west of Algeria. The city has developed in the centre of the province of the same name at the foot of the Tlemcen mountains in the Atlas mountain range and includes the townships Tlemcen, Mansourah and Chetouane. According to a census carried out in 2008, its population is estimated at 276,414 (ONS, 2009).

Water Supply

Tlemcen's water supply depends on the water extracted from 20 groundwater wells, eight natural founts and the three reservoirs Meffrouche, Sikak and Béni Bahdel. For 25 years, rainfall has been decreasing significantly leading to a diminished inflow to the reservoirs. Consequently the city's water supply heavily depends on groundwater resources. Constant overexploitation over the past few years is evidenced by sinking groundwater levels (Habi and Harrouz,

2011). The extracted water is stored in more than 37 water tanks. The distribution network is divided into 24 sectors but connections between sectors exist (Cembrowicz et al., 2004). Despite the rehabilitation of an important part of the network, water losses are high.

As continuous water supply cannot be achieved, the water provider has established a distribution programme according to which some sectors are to be provided with water twice a week, others only once, each for a period of six to seven hours, theoretically. A small part of the population is supplied on a daily basis (Habi, 2003; Habi and Harrouz, 2011). Considering the humble frequency of water supply, most households are equipped with private storage tanks, generally with a storage capacity of 1 to 3 m^3. Informal water vendors bridge the remaining gap between demand and supply.

Water consumption is measured by the local water provider and serves as basis for the clients' billing. However, water meters are often tempered with by clients or simply degraded by time. Widespread under-metering can be assumed.

METHODS

Sample

Water consumption has been determined at a sample of 20 households, which were chosen equally from three different areas, corresponding to different levels of social state. The wealthier part of the population lives in area one, which is characterized by spacious individual houses. The middle-class lives in smaller individual houses or apartments in the north and west of Tlemcen (area two). Area three is situated in the south of the city and is inhabited by those with limited resources living in precarious constructions. The different social status in the three areas is reflected in the number of residents per household, being 5.52 in area one, 6.6 in area two and 6.93 in area three (Habi, 2003; ONS, 2009). All households in the three areas receive water twice a week.

Measuring method

Consumption was measured by controlling the water level in the household's storage tanks. To do so, the existing tanks at the selected households were replaced by new storage tanks with known storage capacity (1 m^3) and a water level meter. In area one two water tanks per household were installed as higher water consumption was expected. Households in area two and three were equipped with only one storage tank. Water consumption was measured twice a week the day after the households were supplied by the local provider and the storage tanks had been refilled. To calculate consumption the water levels had to be documented at the beginning and at the end of a 24 hrs period. The participating households agreed on documenting the water levels between 23:00 and 24:00 hrs. The interval between readings of the water level has been found to be 24 hrs +/- 10 to 20 minutes.

Measurement period

The participating households documented the change in water level in their storage tank twice a week over a period of two years (2008 and 2009). Loss of data due to illegibility or forgetfulness turned out to be minimal as household members responsible of the documentation of water levels had been instructed carefully and a trial period of two month had been realized before actual measurements began. Due to different distribution dates, water consumption was calculated for different days in the three areas. In area one, water consumption was determined for Sundays and Thursdays, in area two, for Sundays and Wednesdays and in area three for Mondays and Thursdays. Assuming that the average water consumption is the same for different workdays, a comparison of monthly averages of the three areas is possible.

Analysing method

As the volume of the storage tank (1 m^3 and 2 m^3 respectively) and the water levels at the beginning and end of a 24-hour period are known, the consumed volume of water can be calculated. Per capita consumption of the household is determined by dividing the daily water consumption by the number of persons per household. Daily water consumption could be calculated for eight days of each month. The average of these values was calculated to determine the monthly per capita consumption per household. Averages per area as well as the

overall monthly averages were then calculated as well as the average per capita consumptions for the years 2008 and 2009.

RESULTS AND DISCUSSION

The variation of the average monthly per capita consumption between households is very small within one area. Comparing averages between the three areas nevertheless reveals major differences. In area one, an average per capita consumption of 87 l/cap/d was determined for the measurement period (2008-2009). In sample area two, the average consumption amounts to 54 l/cap/d in 2008 and 2009, and in area three, average per capita consumption is 26 l/cap/d in 2008 and 23 l/cap/d in 2009. The average per capita consumption of the whole sample for the measurement period 2008 to 2009 amounts to 56 and 57 l/cap/d, respectively. Month to month variations in all three areas show a slight increase of water consumption in the summer month June, July and August. This maximum is most pronounced in area three, whereas in areas one and two these variations are less visible. The results are summarised in figure 1 and 2.

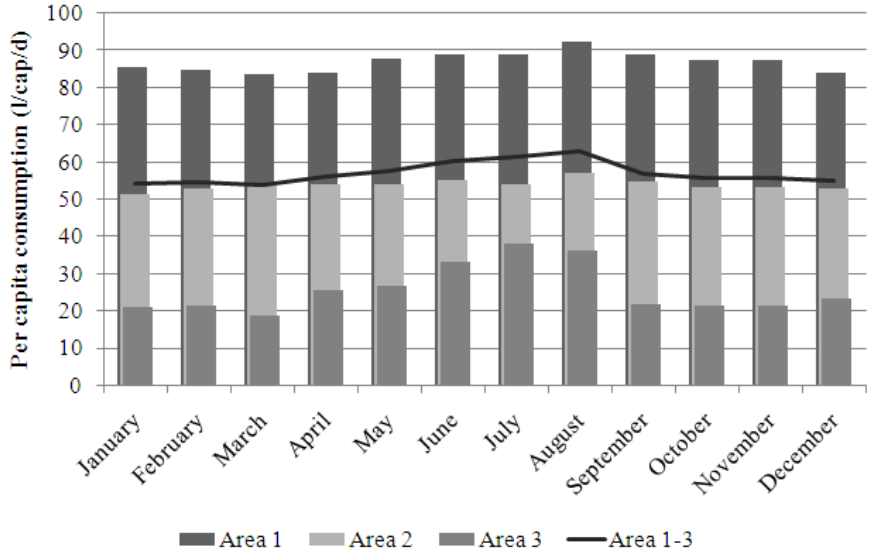

Figure 1 : Monthly per capita consumption in Tlemcen in 2008

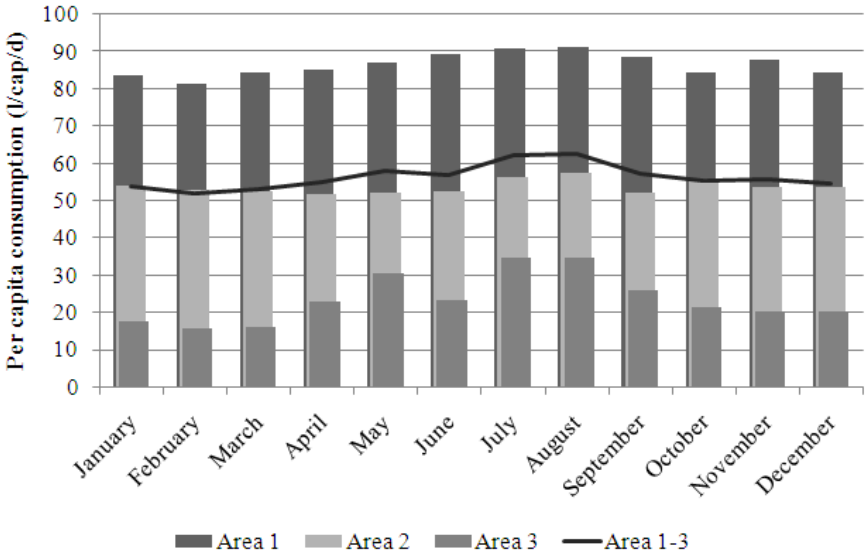

Figure 2 : Monthly per capita consumption in Tlemcen in 2009

In Tlemcen water supply of the sample households is comparatively reliable albeit intermittent. Replenishment of household storage capacities is guaranteed at least once a day and storage capacities per household are usually sufficient to satisfy the demand until the next day. Average per capita consumption, in area one of the study area, has found to be 80 l/cap/d. This value is similar to the average per capita consumption determined for Beni Abbès (Vogel *et al*., 2015), where – in contrast to the areas two and three – households could rely on 2 m³ of storage capacity instead of only 1 m³. The average per capita consumption in this area was determined at 87 l/cap/d. As replenishment of the households' water tanks in Tlemcen takes place only twice a week, water use patterns can hardly be assumed similar to those under continuous supply conditions. At least households in area two and three will need to economise their water use if they do not want to run out of water before their water tank is being refilled. It does not surprise then that per capita consumption in areas two and three are considerably lower than in area one, ranging between 20 and 60 l/cap/d. The influence of socio-economic factors, however, is also likely.

The low frequency of supply in Tlemcen may also be a reason for the small month to month variation of per capita consumption, as consumption is limited by the (constant) storage capacity of each household. The comparably mild

climate with less extreme seasonal variations may constitute another reason. Nevertheless, a small increase in consumption can be observed in the summer month June, July and August, increases being more pronounced in area three where water use levels are generally very low. This might explain the capacity for steeper increases of consumption during the summer.

CONCLUSIONS

In Algeria, water consumption data are not systematically collected, though most service connections are equipped with water meters. Water meters, however, are not maintained or periodically replaced leading to unreliable meter readings, if they are read at all. No long – or even short – term records of water consumption exist that could serve as empirical basis for the prediction of water demand in infrastructure planning and design. Several official documents exist where values for water demand are proposed. These values all differ from one another, sometimes considerably. It does not surprise then, that most hydraulic studies on the local level are still based on a customary value of 150 l/cap/d.

On the other hand, the wide-spread intermittency of water supply has traditionally been interpreted as an imbalance between supply and demand. Consequentially, demand management and efficiency measures have been considered of lesser importance than supply-side solutions. New water resources are often tapped although actual water demand could be satisfied with those resources already developed. Here again, knowledge of actual water consumption is needed for sound decision-making.

The results of the presented study show that the ranges of values proposed for water demand in the various official documents are certainly reasonable, but their variety reflect the uncertainty surrounding knowledge about actual water consumption. Even if domestic water consumption were measured, currently most consumption data would be collected under conditions of intermittent supply and comparability to consumption under conditions of continuous supply cannot be assumed. Further studies therefore have to be undertaken to understand water consumption in Algeria and form the basis for sound estimations of water demand in planning and design as well as for effective water demand management.

REFERENCES

DGAIH-S/D (1996). L'alimentation en eau potable et industrielle, évaluation de la demande en eau, rapport méthodologique (Supply of drinking and industrial water, evaluation of water demand). Report (unpublished). Algiers: Ministère de l'Equipement et de l'Aménagement du Territoire, Direction des Grands Aménagements et Infrastructures Hydrauliques, Sous Direction de l'Alimentation en Eau Potable (DGAIH-S/D).

DGAIH-S/D (1997). L'alimentation en eau potable et industrielle, évaluation de la demande en eau, rapport méthodologique. (Supply of drinking and industrial water, evaluation of water demand). Report (unpublished). Algiers: Ministère de l'Equipement et de l'Aménagement du Territoire, Direction des Grands Aménagements et Infrastructures Hydrauliques, Sous Direction de l'Alimentation en Eau Potable (DGAIH-S/D).

MATE (2005). Gestion intégrée des ressources en eau et assainissement liquide, Tendances et alternatives (Management of water resources and waste water, trends and alternatives). Report (unpublished). Algiers: Ministère de l'Aménagement du Territoire et de l'Environnement (MATE).

D.E.A.H. (2006). Cadastre des infrastructures d'alimentations en eau potable et industrielle (Registers of infrastructure for the supply of domestic and industrial water). Algiers: Ministère des Ressources en Eau, Direction des Etudes et des Aménagements Hydrauliques (D.E.A.H.).

SOFRECO (2009). Audit du fonds documentaire, la demande en eau potable (Document review, drinking water demand). Report Volume V-1 (unpublished). Algiers: Project "Réalisation de l'étude d'actualisation du plan national de l'eau (EuropeAid/126155/D/SER/DZ)", SOFRECO on behalf of Ministère des Ressources en Eau, Direction des Etudes et des Aménagements Hydrauliques (D.E.A.H.).

SAFEGEE (2004). Demande en eau potable (Drinking water demand). Report Vol. 1 (unpublished). Algiers: Project "Transfert des eaux du Sahara septentrional vers les régions du Nord de l'Algérie", Société Anonyme Française d'Étude de Gestion et d'Entreprises (SAFEGEE).

D.E.A.H. (2002). Etude de la tarification de l'eau à usage domestique et industriel (Study on pricing of domestic and industrial water use). Report Part 1 and 2 (unpublished). Algiers: Ministère des Ressources en Eau, Direction des Etudes et des Aménagements Hydrauliques (D.E.A.H.).

MASMOUDI R., KETTAB A., BRÉMOND B. (2008). Evaluation des paramètres de fonctionnement et de performance des systèmes de distribution d'eau potable en Algérie. Cas de la région de Biskra (Evaluation of technical and performance parameters of drinking water distribution systems in Algeria. Case study Biskra region). In: Proceedings of the 13th IWRA World Water Congress 2008, 1-4 September, Montpellier, France, International Water Resources Association.

GHIZELLAOUI S., DJEBBAR K. (2007). Prevision of the demand for water in the town of Constantine at the horizon of the year 2020. Desalination, 206(1-3): 457-464.

ONS (2009). Recensement Général de la population et de l'Habitat 2008, n°98 de Collection Statistiques, Alger, Algérie.

HABI M., HARROUZ O. (2011). Le rationnement de l'eau à Tlemcen en Algérie (The rationing of water in Tlemcen in Algeria), GWA, Vol. 3, 191-195

CEMBROWICZ R.G., DEUERLEIN J., SANZENBACHER G., GOMER D., BRADE R. (2004). Mängelanalyse und Rehabilitation des Wasserversorgungsnetzes einer algerischen Stadt, Beispiel Tlemcen (Deficiency analysis and rehabilitation of the water supply network of an Algerian city, example Tlemcen). GWF-Wasser/Abwasser, 145(11),788-797.

HABI M. (2003). Impact socio-économique de l'alimentation discontinue et irrationnelle en eau potable des villes algériennes: cas de la ville de Tlemcen (Socio-economic impact of intermittent and irrational drinking water distribution in Algerian cities: Case study Tlemcen). In: Proceedings of the Séminaire national sur l'eau et l'environnement 2003, Bechar, Algeria, 13-19.

VOGEL M., HABI M., KLINGEL P. (2015). Domestic water consumption in Algeria-literature review and a case sutdy of Beni Abbes. La Houille Blanche, n°1, 2015, p. 76-83.