WATER USE IN ZARAGOZA´S HOUSEHOLDS

Research on the attitudes, information, equipments and behaviour in households with relation to the use of water, realised by Ramón Barberán Ortí and Manuel J. Salvador Figueras, has been published by Environmental and Sustainability Agency of Saragossa.

This report pretends to collect the key aspects of a book where the first results of a research developed by the University of Zaragoza in collaboration with the Municipality are described. The aim is to improve knowledge on factors affecting water consumption in households, and contributing in this way to improve water demand management policies for the conservation and promotion of its efficient use.

The target population is Zaragoza´s Actur-Rey Fernando district, and is developed from the selection of a representative sample of households, obtained through a process of stratified sampling by the age of the buildings and number of people living there –according to data given by the Municipality- and using proportional allocation.

To make feasible the installation of electronic water counters in all the households of the sample –necessary to obtain the type of information required about water consumption- it was decided to organise the sample process by buildings and make a cluster sampling, forming groups with buildings stratified according to its age.

The sample was formed by 405 households with 107 substitutes to prevent possible events during the process of collecting information. From the households selected at first, it was possible to have access to 73.58% of them. Therefore, the sample was completed with substitute households, having access to a 80.37% of them. The final number of households used was 384 (94.81% of the number initially considered), and the estimated error was a 5%, with a reliability level of 95%.

The households of the sample were divided in three groups with similar characteristics: a control group which was only surveyed and two other groups that passed also and additional intervention –different in any case- that can have an influence on subsequent water consumption.

The main source of information for this research work has been the survey made on the residents of the households included in the sample.

The survey was divided in four questionnaires:

- A general questionnaire on the characteristics of the residents and their household, as well as about the quantity and cost of the water used by them at home;

- A second questionnaire to know on the information available in the households on water problems and good practices and their attitude before these questions;

- A third questionnaire to make an inventory of equipments that use water (valves, closet, electrical appliances,…) in every household and its characteristics, mainly related to the potential consumption of water;

- And finally, a fourth questionnaire in which residents registered during a week the number of water uses and the moment every one of them takes place such as personal hygiene, housework…

The general questionnaire was to be filled up by all the households of the sample. The second questionnaire only by the households of one of the three groups previously established, and the third and fourth only by the households of one of the groups.

The control group only filled out the general questionnaire. The second group – that will be called "sample for informing and raising public awareness", after filling in the general questionnaire, they received and were explained a brochure -made by the Agency of Environment and Sustainability of the City of Zaragoza- explaining good practices in the use of water at home. They were also asked to fill in the second questionnaire in order to value their previous knowledge and attitude on the topic. In the third group, that we will call "sample on saving devices", after filling in the general questionnaire, the number and characteristics of the equipments of the household related to the use of water were checked, and the saving devices (sprayers) of the valves were installed or replaced. A process during which the survey taker in charge of those tasks filled in the third questionnaire on the register of water uses, that was collected after a week.

Apart from the information obtained through the survey, a key role is also played by the information on water consumption on the households of the survey. Data were available on quarterly water consumption in all the households of the survey between 2000 and 2009 as well as daily consumption, divided into six time intervals by day, during the first four months of 2009. All these data come from the reading of the meters that register water consumption in every household. The data of every three months correspond to the reading systematically made by the Municipality –as body responsible for the supply of drinking water in the city- to invoice consumption to every household

Daily data by time stretches were obtained specifically for this research by installing in the households of the survey sample, electronic counters able to register this kind of information and of supplying a wide group of indicators on the patterns followed by water consumption.

The work made was structured in three parts.

- The first was to present the characteristics of the sample to be researched into, mainly the characteristics of the people living in every household.

- The second part was addressed to analyse the attitudes, information and equipments of households in relation to water consumption, as factors that determine consumption as well as the characteristics included in the first part.

- The third part focused on the analysis of water consumption in every household. It was studied the evolution of consumption and the influence of the socio-economic conditions of every household on the one hand, and the intervention of information-awareness and of installation-replacement of saving devices on the other. The different activities of the households implied in water consumption and the distribution of that consumption among the main use types were also studied.

1. CHARACTERISTICS OF THE HOUSEHOLDS

Bar chart No. 1 presents the distribution of households in the sample according to their size. It can be observed that the biggest part (61%) is composed of 3 or 4 members, being relatively scarce the number of households composed of 1 member (9.6%) or of 5 or more (6.5%).

The "average" family includes a member of reference (100% of households), a couple (76.2%) and a number of children between 0 (36.2%), 1 (27.1%) and 2 (32.8%). Households with three children are only a 3.9%. The presence of the parents of the member of reference or his/her couple is relatively reduced (9.8% of households). The same happens with other family members (5.2%), and even more with other people with no
degree of kinship.
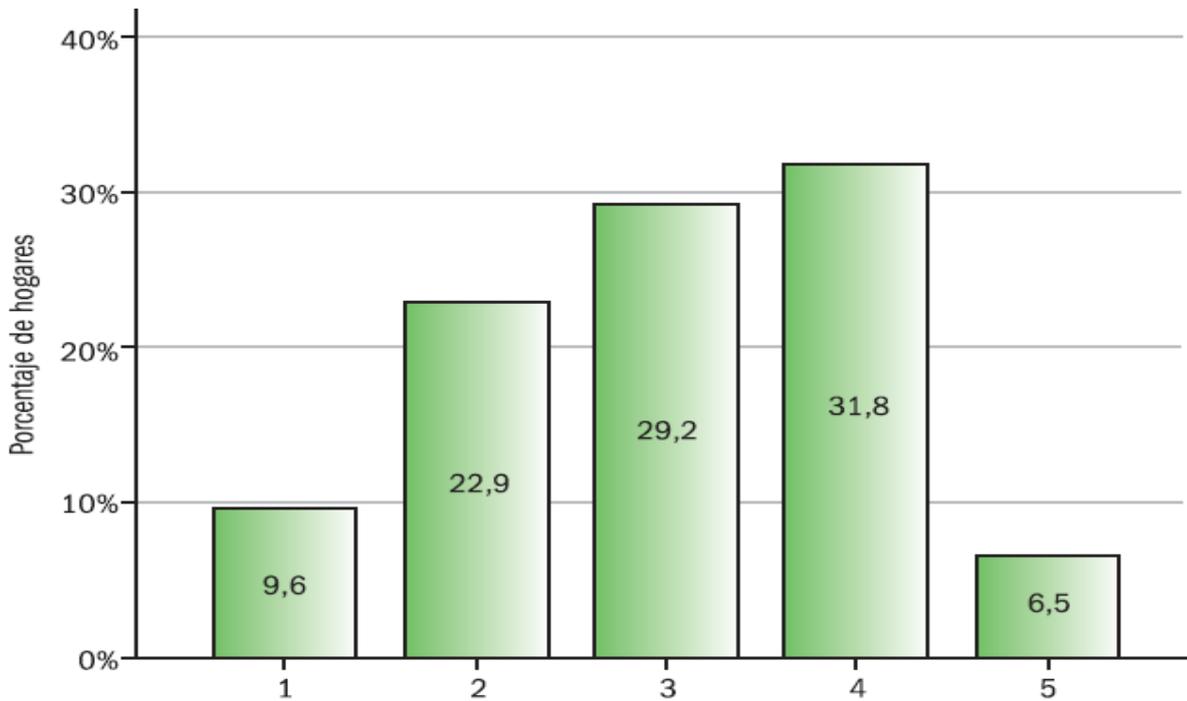
Bar chart No. 1: Number of inhabitants by household

The average age is next to 38 years but there are two trends: a main one around 50 years and another secondary around 13-15 years, that reflect the existence of households with adults and children.

The work also shows the profile of the residents in the district. We can stress aspects such as: sex (similar percentage of men and women), academic record (20% hold a university degree); work situation (41% employed and 27% students), average monthly salary 2,500 € (a 65% of households between 1,500 and 3,500 €/month).

With respect to other aspects related to water consumption, for a 99% of the people surveyed the household at the Actur is their first residence. The percentage of people that can take a shower out from home is 28%.

With reference to the characteristics of the households, the average home has 90 m2. The average time of residence is about 14 years, and a 95% is owned by the residents surveyed.

99% of surveyed residents has a system of hot water by gas (there has not been included households with central heating due to the difficulties to make a precise consumption survey). 70% of residents have made some reforms during 2000 in a system or equipment related to water consumption. The most frequent reforms are the replacement of the washing-machine (50.5% of the total of households), the water boiler (34.4%) and the dish-washer (31.0%).

2. ATTITUDE, INFORMATION AND DEVICES RELATED TO THE USE OF WATER AT HOME

2.1. Attitude before the research project

Before the visit of the survey takers, a presentation brochure of SWITCH project was handed down to every household, explaining the goals of the project.

The attitude of the interviewees in relation to the goals of this research project was collected by means of several specific questions included in the general questionnaire to be filled out by all the households of the survey.

In short, the brochure stressed that the last aim of the Project was to improve knowledge on the factors affecting water consumption in households, in order to contribute to design actions for water saving, without reducing the quality of life of the citizens.

It is observed that the wide majority of the people surveyed have had a positive opinion on the goals of the project (92.97%). They think that the results can be useful in a certain way for them (84.64%) and for society (94.53%) and believe that water saving is necessary in the households (97.40%).

With respect to the reasons that justify the necessity of water saving in households, the answers chosen –among the eight offered in the questionnaire- were that water is a limited and very valuable resource (80.20%), that allows a reduction of household expenses (35.60%) and solidarity with future generations (35.30%).

A scarce number of households considered water saving as unnecessary (2.60% of the total) due to: the scarce importance of that saving compared with the strong consumption in agriculture and industrial activities (60%); that there is plentiful of water (40%); that goes back to the river after being treated without causing any environmental damage (40%); that investments in infrastructures must be increased to cover every need (30%.).

2.2. Information and attitudes on the use and fare of water
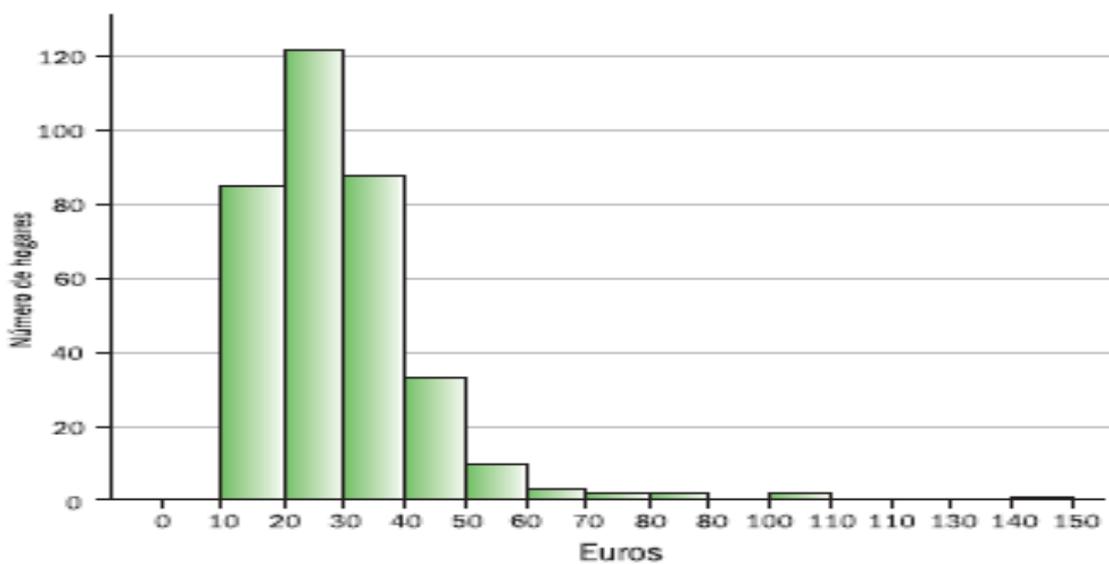
A survey was made also on the degree of knowledge on water consumption at home and on the cost of that consumption. The following bar charts show the perceptions and the real situation.
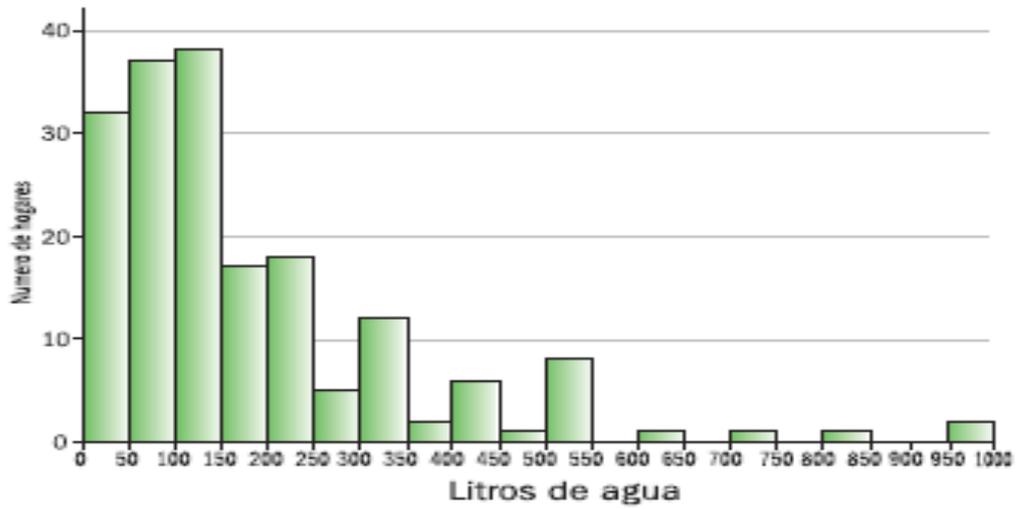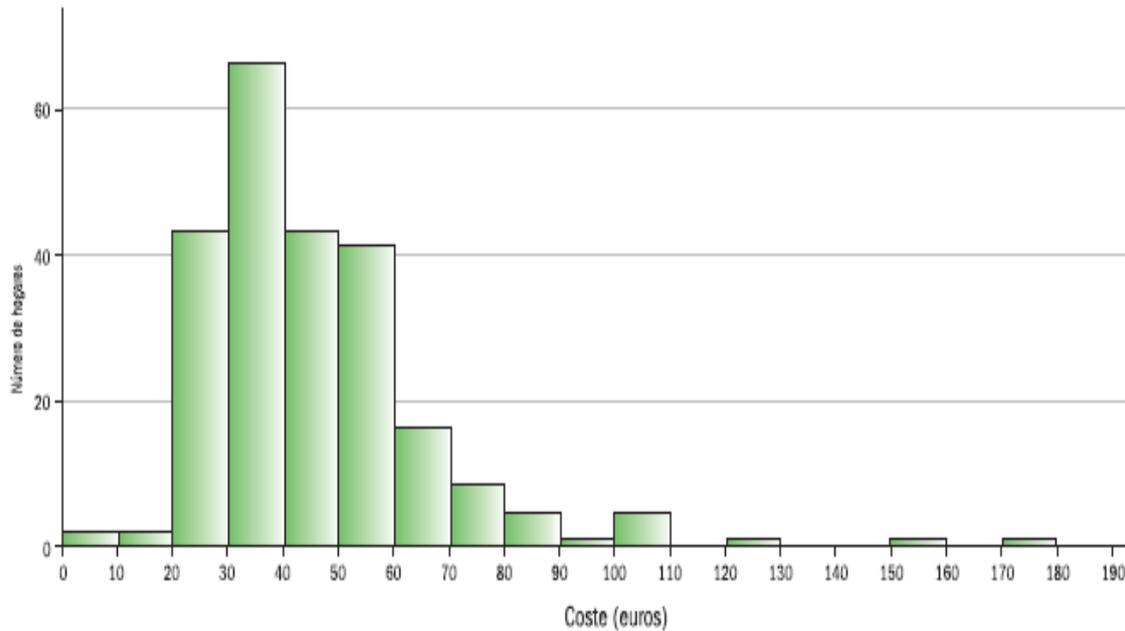
Bar chart No 2. Estimated consumption by household
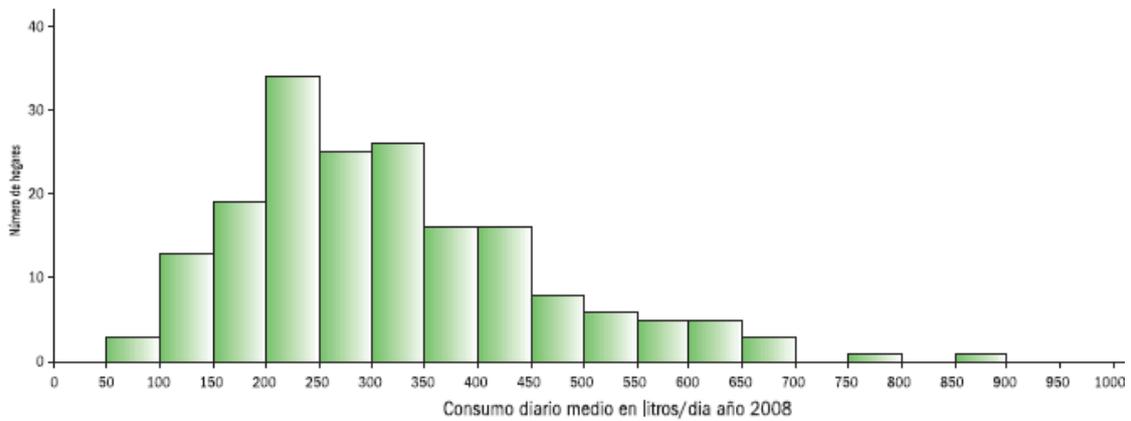
Bar chart No.3 Real consumption in households

Bar chart No.4 Water costs that families believe to bear every three months

Bar chart No 5. Real cost of water for household every three months

With reference to the degree of knowledge on the information received on good practices, the majority of the interviewees has declared that they already knew this information in full (52.5%) or partially (44.2%), with a scarce number of families who did not know nothing about it.

As far as the most effective practices to reduce water consumption is concerned, the three most chosen alternatives were an adequate turning off of the taps (44.2%), the installation of water saving devices (31.7%) and searching and repairing of water seepage in taps and closets (15.8%).

After the information received on the importance of a correct use of water and best practices for saving water, the changes that the interviewees think to implement have been grouped in five categories. The most used refer to the installation of devices for saving water (45.24%), saving and improvement of consumption (26.19%), and family awareness (11.90%). It can be said that the declarations of intent - apart from those related to saving devices- are not precise but indicate clearly the intention to change our behaviour in the use of water.

3. NUMBER AND CONDITION OF THE EQUIPMENTS RELATED TO THE USE OF WATER

3.1. Individual equipments

In relation to closets, it can be observed that the majority of households (88.1%) have two closets and there is not homes with three or more.

It was analysed the existence of water saving devices: double discharge, interruption of the discharge and reduction of the volume of water of the flushing cistern through the introduction of bottles and other containers. The discharge volume was also measured (in litres of water) and it was analysed the existence of water seepage or dripping. It was also observed a trend in reformed households to have more closets with double discharge devices (30.0% instead of a 6.8%), but also less closets with these devices (14.0% compared to 15,6%). And, of course, less closets without saving devices.

Referring to toilets, it is observed that the biggest part of the households (88.1%) have two toilets, and there is not dwellings with three or more. The majority of the tapes (93,70%) had a water saving device, and 83.86% have mixer taps.

Most of the households have a bidet (57.8%) or two (30.4%), and a 11.9% have not.

The majority of homes have two showers (65.2%) or one (34.1%). It was observed that most of them are mixer tap showers (91.56%), have not a water-saving device (88%) and are placed within the bathtub (76.44%).

3.2. Housework appliances

There is a kitchen sink in every household and the majority of taps (98.51%) have water-saving devices. Much of them are mixer taps (94.81%) and the majority of the kitchen sinks (85.92%) have a pool.

100% of the households of the survey have a washing machine, approximately 6.49 years old. Most of the washing machines we reached information about were A energy efficiency (79%), a very high level equivalent to an energy consumption under the average of 55%. Consumption oscillates around an average quantity of 53.51 litres. The average number of washings per week depends on the number of people living in every household -a 5.5- being observed that in the majority of cases (84.2%) there is less than 8 washings per week.

71.9% of the dwellings have a dishwasher with an average age of 7.38 years old. The majority of dishwashers we reached information about (72.7%) have an A energy efficiency, and consumption is around an average value of 17.14

litres. The distribution of the number of washings is clearly bimodal, with a main trend of 7 washings per weeks, and a secondary of 3 per week. It can be observed an increase of one washing per week for every member of the household.

4. EVOLUTION OF WATER CONSUMPTION FROM 2000 TO 2009

It was analysed the annual and quarterly evolution of average daily consumption of water, both by household and by person, in the dwellings of the survey, from 2000 to 2009. The data of this analysis correspond to the real consumption of water according to the results given every three months by the household meters for the City of Zaragoza by Aquagest.

Annual evolution is shown in the following table and consumption data are expressed in litres/day:

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Consumption by household	385.9	390.1	377.5	376.8	388.5	367.6	349.2	326.6	307.5	318.1
Consumption per capita	119.0	120.4	117.9	118.4	123.0	118.0	113.2	106.2	101.3	106.5

This work presents a tracking of the annual and quarterly evolution of consumption by household and per capita. A negative evolution can be observed, reaching the conclusion that the evolution of the trend is not homogeneous.

It is also studied the average daily consumption of water both at home and per capita, in households during 2008, being analysed also the influence of socio-economic characteristics in consumption.

4.1. Impact on the consumption level of the interventions for raising public awareness and replacement of devices in households.

The total number of dwellings analysed has been 360 (93.75% of the total of households of the survey), and the total number of available data 30,012, from which 8,689 (29%) belong to a period of time before the intervention date and 20,954 (a 69.8%) to the period after that date.

It was calculated the levels of average consumption of water before and after the intervention date in every household of the survey. Differences in average consumption by household before and after the intervention date (previous consumption – subsequent consumption) were 7.69% and 10.91 litres/day respectively.

Once analysed the existence of differences in daily water consumption before and after the intervention date, it was analysed dividing the sample of households in 3 groups according to the type of intervention:

A first group composed of 130 households was only visited to collect information on its characteristics. A second group was composed of 135 dwellings in which, apart from collecting information on its characteristics, water saving devices have been installed (sprayers) in taps or showers, and replacing those in bad condition. The third group, composed of 119 households, apart from collecting information on its characteristics, received information on good practices in the use of water and information on the importance of water saving.

The results obtained show that the most outstanding differences take place in households where information on good practices and public awareness on the importance of water saving was spread. The reduction of middle and average water consumption was fixed in 13.22 litres/day and 14.65 litres/day.

It is also observed a reduction on consumption in the group of households where new saving devices were placed in taps. The reduction of middle and average water consumption was estimated in 9.45 litres/day and 10.09 litres/day.

Finally, it can also be observed in the households of the control group a reduction of consumption of 0.89 litres/day and 8.49% litres/day in the middle and average consumption.

5. WATER CONSUMING ACTIVITIES IN HOUSEHOLDS

The survey analyses activities in the households implying the use of water and the influence of them on the global consumption level. The data in which this analysis is based have been obtained from the forms filled out by every household.

The number of times that every household member use water for his/her personal hygiene every day of the week is analysed in a numerical and graphic form. A big stability is observed during the week in the ways every element is used, being the closet and the toilet the most used, and the bathtub and the bidet the least. Only on Saturdays it can be observed a drop in the use of the closet, and on Saturdays and Sundays of the toilet, possibly due to the weekend effect with a change of habits with respect to the rest of the week, including some of people staying out of home.

It can be observed the existence of three trends clearly differentiated in the number of daily uses of the different water sources. One, in working days (Monday to Friday), another on Saturdays, and the last on Sundays. The difference of the two lasts with respect to the first is that a displacement of the time-stretch of personal hygiene activities takes place.

In reference to housework, it can be observed a great stability during the week in the number of uses for the different activities, with the existence of a slight

decrease in cooking and kitchen and dishes cleaning, and an increase in the use of the washing machine and other uses (floors, watering,…) on Saturdays and Sundays.

5.1. Distribution of water consumption by kinds of uses

As the following tables show, the research survey includes the percentage of daily water consumption and the litres/day attributed to every type of use.

Water uses	Consumption percentage
Closet	39.64-40.69
Toilet and bidet	20.69-21.24
Shower and bath	10.37-10.74
Sink	19.84-20.36
Washing-machine	5.54-7.42
Dishwasher	1.53-2.04
total	100

The following table presents the estimation of water consumption in an average household according to every use in every stretch of time.

Usos del agua	6 a 10	10 a 13	13 a 17	17 a 20	20 a 24	24 a 6	Total
Inodoro	25,83	20,06	28,96	23,43	26,78	11,10	136,17
Ducha + Bañera	7,93	5,66	4,47	6,67	8,39	0,92	34,04
Lavabo + Bidé	14,20	11,79	15,80	10,42	13,62	4,77	70,60
Fregadero	9,08	14,80	22,44	5,85	15,90	0,44	68,51
Lavadora	3,66	8,47	4,28	2,80	3,12	0,00	22,33
Lavavajillas	0,55	0,70	2,30	0,51	1,95	0,04	6,04
Consumo total	61,24	61,49	78,24	49,68	69,76	17,27	337,69

6. CONCLUSIONS

The aim of this work is to contribute to improve knowledge on consumption at home, in order to perfect management policies on the demand of water for the city. The survey has been made in Zaragoza´s Actur district and has been developed after selecting a representative sample of dwellings of that district.

The average profile of the households analysed is a family with 2-4 members composed of a couple with 0-2 children, which owned their home. 70% has made some type of reform affecting to water facilities or equipments, and having hot water through gas boiler.

The majority of the families surveyed think that it is necessary to save water since this is a limited resource that allows us to reduce costs and show solidarity with future generations.

They agree with the goals of Switch Project and think that the results to be obtained can be positive for them and for society.

The families surveyed seem to be well informed on the problems derived from the use of water and good practices at home.

Taking into account the facilities related to personal hygiene, the most used are the closet and the toilet. Shower is taken every two days. Related to housework, the most used are the kitchen sink both to cook and for cleaning the kitchen by hand.

In relation to the evolution of domestic consumption, both by household and per capita, it can be observed a significant reduction in consumption from 2005, coinciding with the deep reform launched by the City of Zaragoza in relation to water fees, and many initiatives for raising public awareness on the necessity to make a good use of water.

The average level of water consumption for family is around 307 litres per day, with a consumption per person of 101 litres/day. These are not homogeneous values, being the number of members of the family the most influential data (exploitation of economy of scale).

The biggest percentage of water consumption is produced by the closet (40%), followed by the toilet (21%) and the sink (20%).

As a consequence of the interventions carried out experimentally in the households of the sample during the development of the project, it has been checked the effectiveness of public awareness policies on problems derived from the use of water, information spreading, and the policy for the introduction or replacement of saving devices for taps.

These results contribute to improve the knowledge on factors affecting water consumption in households, and can be useful to design and implement management policies on water demand at home.