

HOME WATER PROJECT

WATER CONSUMPTION



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I INTRODUCTION

During the preparation of a workshop on compost toilet and humanure production, I had the opportunity to look at a graph of the average water consumption in a family house and the percentage of water (potable and drinking water) we normally use at home. The average amount of water wasted for flushing per person every year is around 20'000 liters. This data make me feel bad and I started to think about it and I decide to make a design out of it to find solution for consuming less water.

The design framework I will follow for this project will be the **C.E.A.P.**

Collect

Evaluate

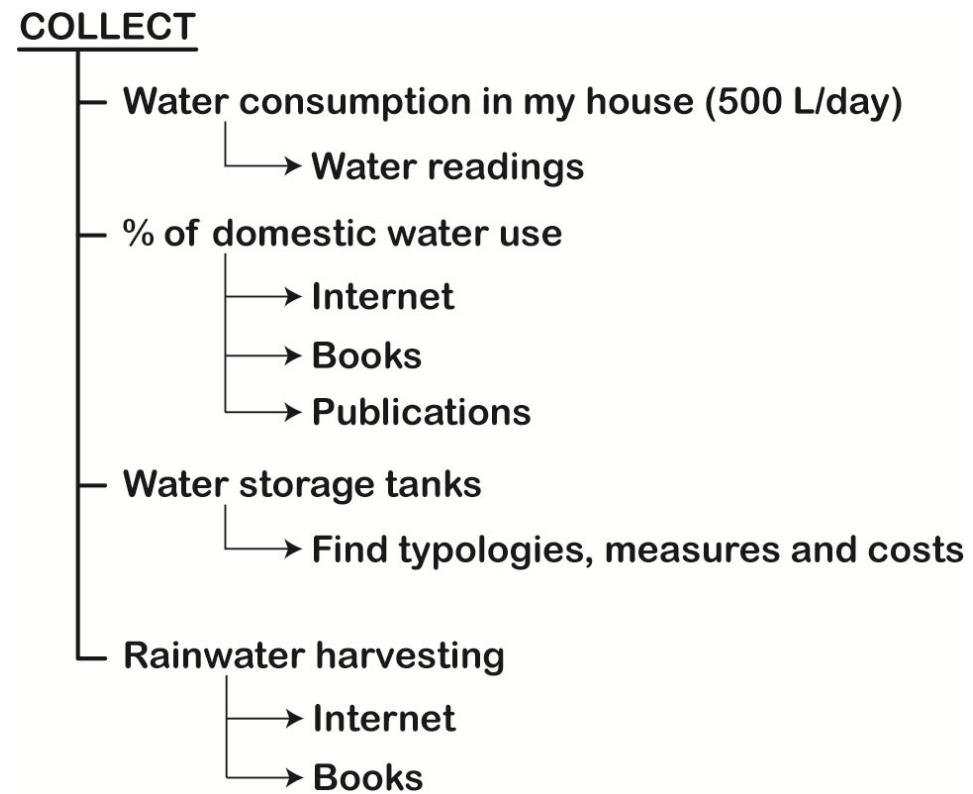
Apply

Plan

I.1 DESIGN TOOL

- Client interview
- Input-output analysis
- Flow diagram

II COLLECT



First step was to find out the real water use of my family (two adults and two children, 6 and 1 year). I have looked at all the past water readings and start to write down all the data since 2006, than I have made some graphs.

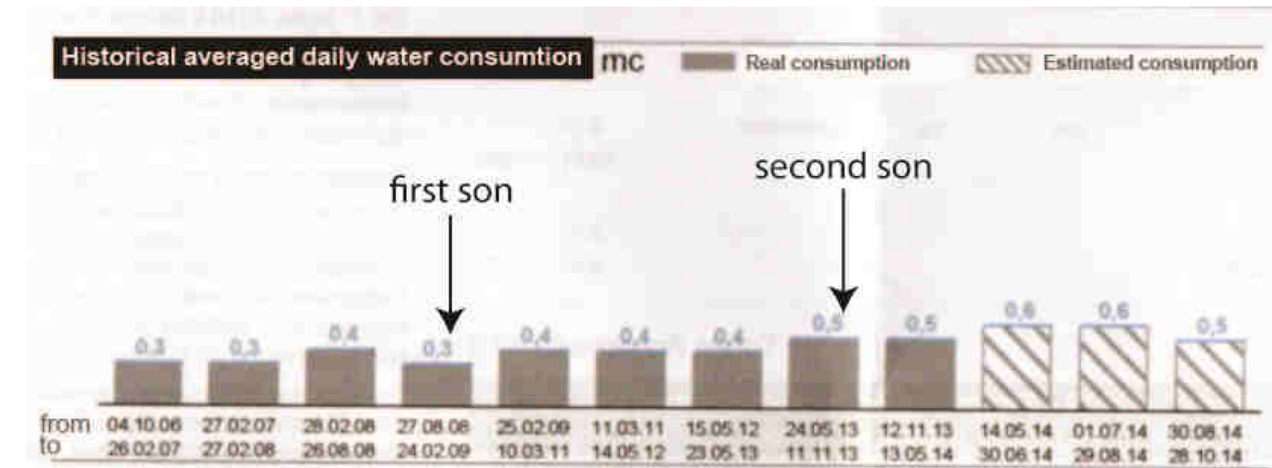
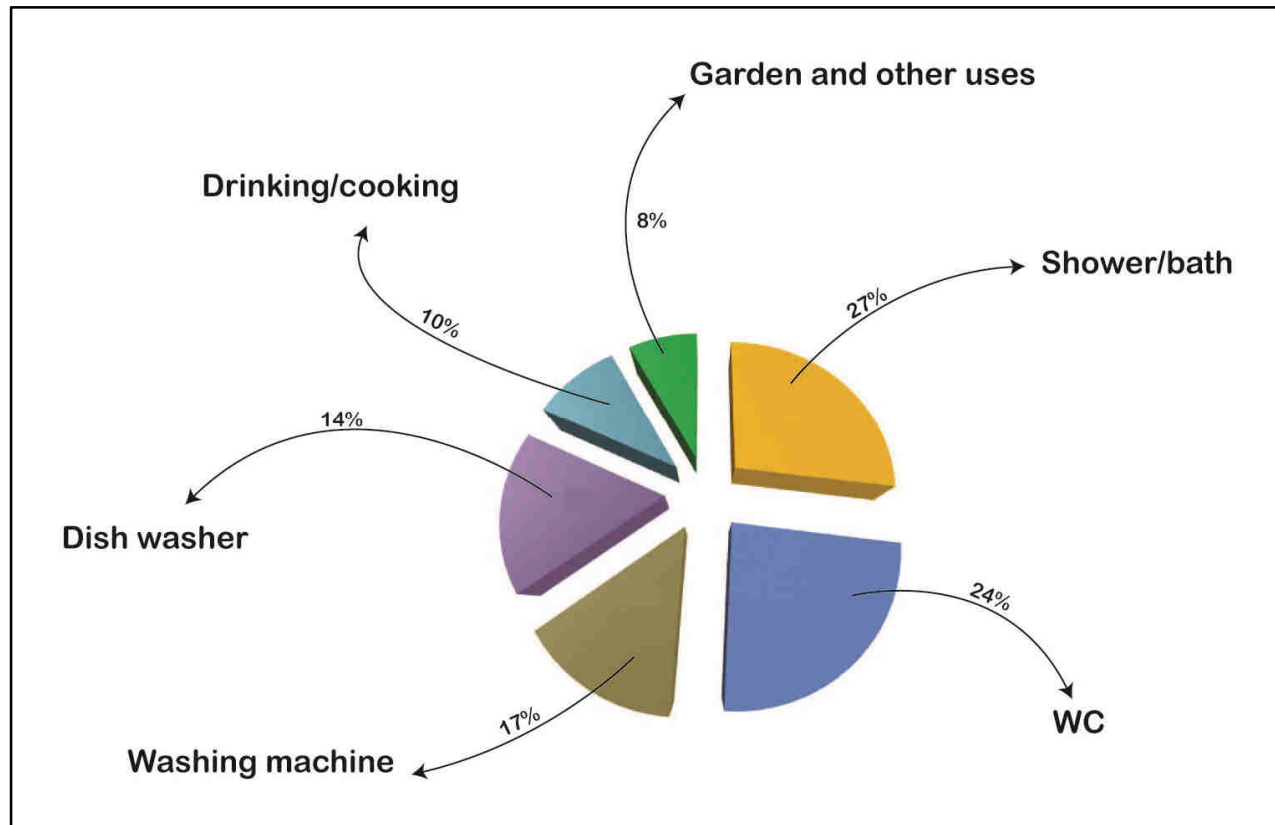


Figure 1: November 2015 water readings (in grey are the past data) and estimated water readings (striped)

When I look at the data I felt very bad. Certainly the water consumption have increased since the arrival of my first son Pietro and the same happened with Luca, the second son, but what was very hard to accept was that we, as a family, use 500 liters of drinkable water EVERY DAY; it's really a lot of water!

Ok what can I do now that I know how much water we use? Let's check where and when we use all the domestic water. I started to collect data from the web and also from publications and finally I understood that the following are the average numbers I have to deal with:

- Personal Hygiene 27%
- WC 24%
- Washing machine 17%
- Dish washer 14%
- Water for drinking/cooking 10%
- Garden and other uses 8%



- 25 m³/year for dish washer
- 18 m³/year for drinking and cooking water
- 15 m³/year for garden and other uses

If we could reduce the use of water, say of a half, it could be possible to use the water harvested from the roof for everything.

Let's have a look at the rainwater harvesting. Where I live we have an average of 600mm of rainwater per year, distributed mainly in autumn, winter and spring time.

Moreover my house has a roof (collector of rain water) of 120 square meters; if we put the two numbers together the system can collect (and store) $120 \times 0.6 = 72 \text{ m}^3$ of water every year.

Moreover if we consume 0.5 m³ every day, at the end of the year in total we will consume more than 182 m³ of water distributed in the following way:

- 49 m³/year for Personal Hygiene
- 44 m³/year for WC flushes
- 31 m³/year for the washing machine

II.1 NEEDS

- Use less water
- Fertiliser for berries and veggies

II.2 WANTS

- Use rain water for the garden
- Use rainwater for washing machine
- Use rain water for drinking/cooking

III EVALUATE

III.1 PERSONAL HYGIENE (27%)

To reduce the use of water the only action we can carry out is to change our life style. When we brush our teeth, we wash our hands or when we take a shower we have to close the water while using the soap or toothpaste.

III.2 WC (24%)

The best way to reduce the water consumption in relation with pee and poo is to use a compost toilet; compost toilet doesn't need any water and creates compost (Humanure) to use in the garden. Use the pee directly in the garden beds to fertilize the veggies or the berries.

III.3 WASHING MACHINE (17%)

There is a possibility to harvest rain water in the inside garden, store it in a tank and use it for the washing machine; if we use the rain water we can also use a more ecological soap and the waste water coming out from the washing machine could be used to water the garden. The washing machine use almost 50 liters of water for every washing, so maybe in summer time the water harvested from the rain and stored in a tank will not be sufficient.

III.4 DISH WASHER (14%)

At the moment there is no possibility to connect the dish washer with the rain water tank, but I will see in the future what to do.

III.5 DRINKING/COOKING WATER (10%)

In the past we use to filter the water coming out from the tap (it is drinkable, but it smells and tastes too much of chlorine) but at the moment we buy mineral water in bottles and use the tap water for cooking. I would like to create a structure to harvest the rain water and filter it at least for cooking.

III.6 GARDEN AND OTHER USES (8%)

I have a small garden inside the house with some plants, flowers and small dwarf trees, and a bigger garden in front of the house with several plants and synergistic garden with three beds where I grow some veggies. During summer time the consumption of water is very high both for the inside garden and for the outside garden. For the garden inside the house, I would like to use some of the kitchen tap waste water to water part of the garden and to build a small vertical greenhouse to harvest rain water, to recover the plants in winter time and to hide the tank used to store the water.

For the outside garden I can use a big tank to store the rainwater harvested from the roof system and design a smart watering system to waste less water during the watering of my garden beds. I have also a small shallow well in the garden, but the water in summer could become salty. I could put the water from one drainpipe direct into the well in order to recharge the well with fresh rain water.

IV APPLY

IV.1 PERMACULTURE ETHICS

CARE OF THE EARTH

The adoption of a compost toilet in the house give me the possibility to have a great humanure to use in the garden and off course to waste less water that should be treated to become drinkable again and again.

CARE OF THE PEOPLE

The main purpose of this project was to use less water; where I live the tap water is the result of several treatments (the water has taken from the river, than to the water treatment plan, than to the water service tube system and finally to the houses). It makes me feel happy to think that I will not use drinkable water to flush the poo and also to transform the poo in a great resource for the garden.

FAIR SHARE

An opportunity to learn something new and specific in order to share my knowledge to others.

IV.2 PERMACULTURE PRINCIPLES

The most evident principle applied in this project are:

Observe and Interact

I have observed the main water waste system in my family patterns and looked for a solution

Catch and store energy

I will collect the rain water from the roof and I will store it in a tank and in the well.

Obtain a yield

I will harvest the rain water and I will produce Humanure to use in the garden.

Use and value renewable resources and services

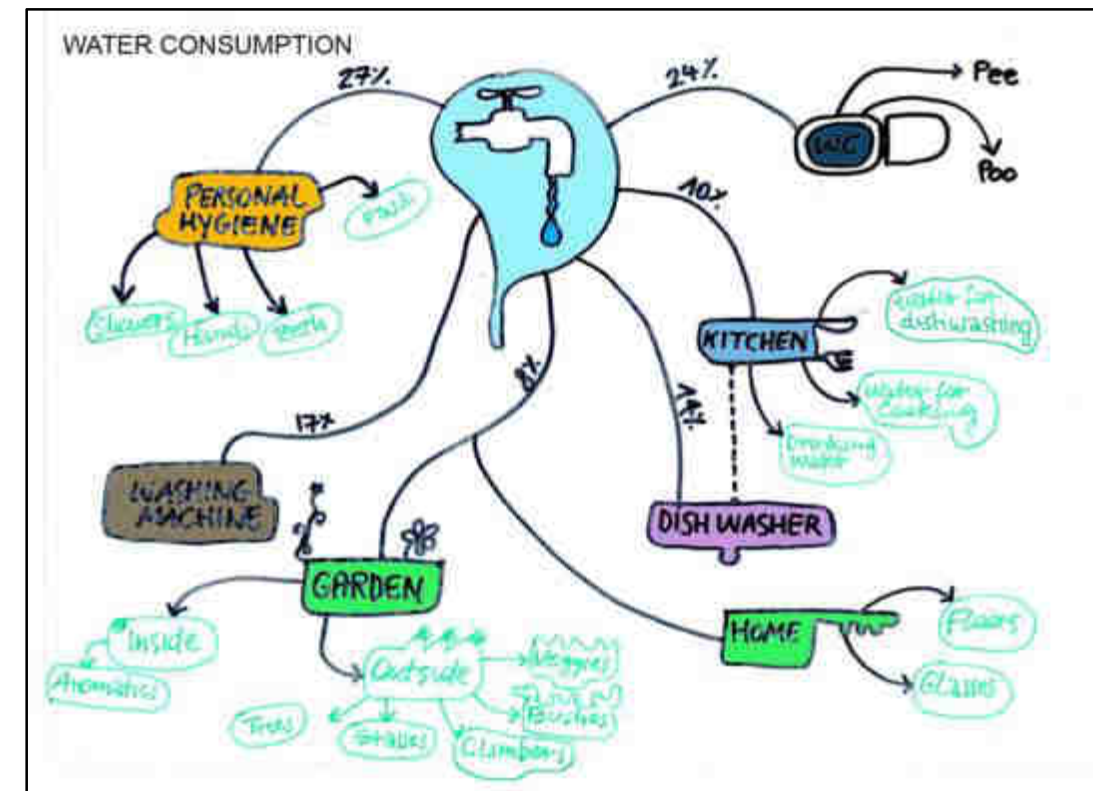
To pump out the water from the well I will install a pump and a solar panel.

Produce no waste

The compost toilet will produce compost instead of waste water.

Use small and slow solution

Collect water in a tank is a slow solution, cheap and effective. In particular if the tank has been recycled from an analytical laboratory.



V PLAN

The project started on the 25th of November 2014 with the first utilization of the Compost Toilet.



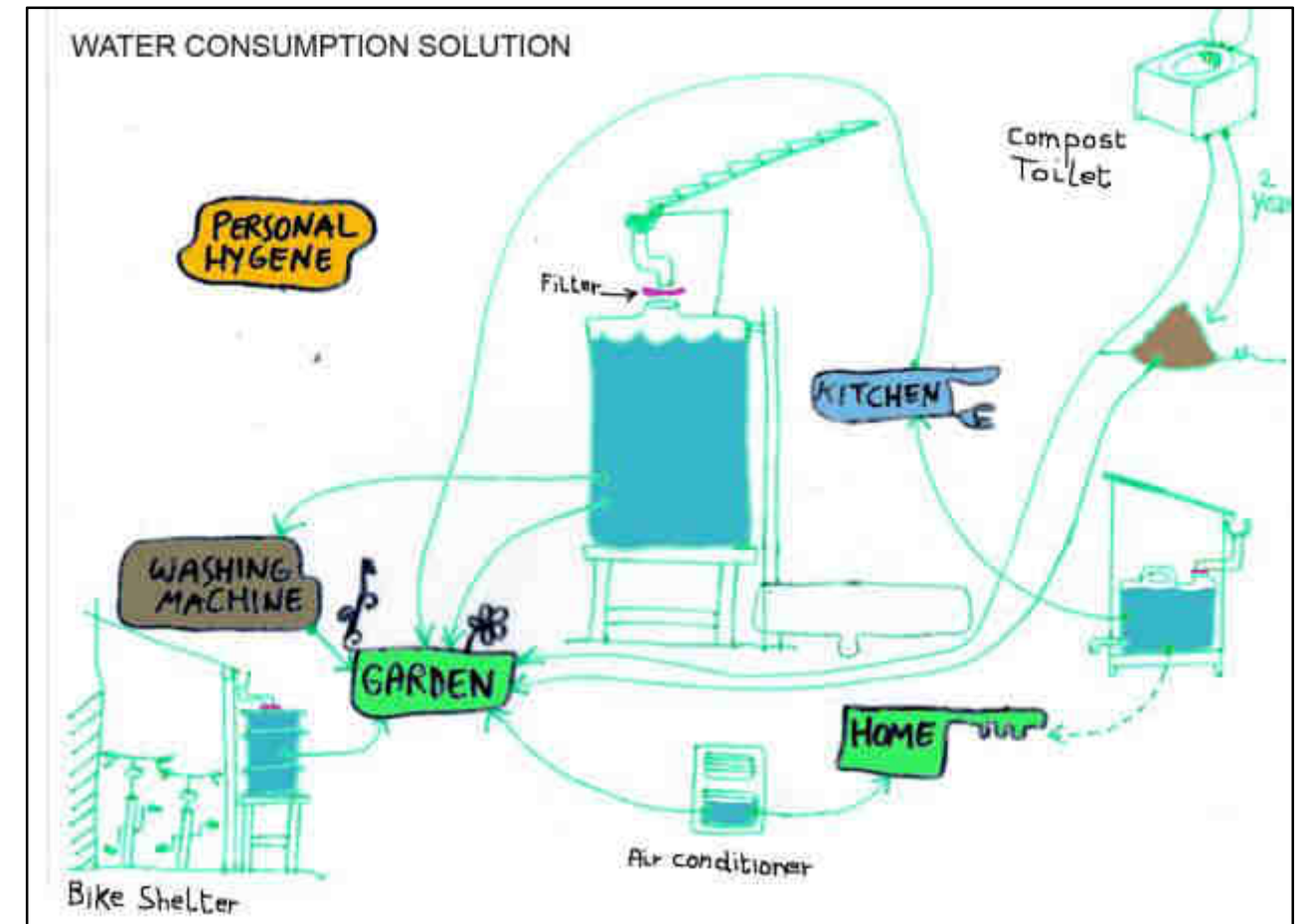
Figure 2: My domestic compost toilet.

The compost toilet I use is made of two main parts:

- There is a small container with the seat
- A bin with lid to contain pee, poo and organic material

Next step will be:

- filling the Poo Diary every day for at least 100 days
- water reading every month for a year.
- I plan to make a design and to realize a system for the rain water harvesting both for the inside garden and for the outside garden before the late spring 2015, let's say before June 2015. I also plan to design and realize a system to use the waste water from the kitchen tap to the inside garden bed.



1st of december 2014

First poo bin evacuation. As a source of Carbon I am using the rice chaff, this is something cheap that I can find easily. I know that the best source of Carbon for the Compost Toilet is the sawdust but here in Ravenna is not very easy to find one without chemical additives. There was a lot of pee in the bottom of the bin and for this reason there was a bad smell, an acid smell, the rice chaff has not absorbed all the pee, so I will try to use some straw in the bottom.

5th of december 2014

Second poo bin evacuation. There is still some pee in the bottom and the smell is still there. The straw did not work properly. A friend suggest me to use the wood ash, I will ask the local pizzeria to keep the ash for me. I am also looking for a good sawdust.

1st of January 2015

It is time to plan the water supply for the external garden.

31st January 2015

The humanure heap is full, now I need to stop using the compost toilet for a while, move the composted manure away and re start using the compost toilet.

26th of February 2015

The water harvesting system for the inside garden has been realised and tested.

15th May 2015

I move the humanure from the heap to the ground. No bad smell.

I started to use the compost toilet again using the sawdust. With the sawdust the smell is reduced but not eliminated. I still keep the humanure heap in the garden outside and bring it in the compost toilet when as needed.



1st June 2015

The following are the data and graphs of the home water consumption:

	DATE	READING (CubicMeter)	CONSUMPTION/MONTH	CONS/DAY
1	18-nov-14	2269	11.6	0.39
2	18-dic-14	2280.6	9.88	0.32
3	18-gen-15	2290.48	10.52	0.34
4	18-feb-15	2301	10	0.36
5	18-mar-15	2311	12	0.39
6	18-apr-15	2323	14	0.47
7	18-mag-15	2337	11	0.85

Table 1: Water reading

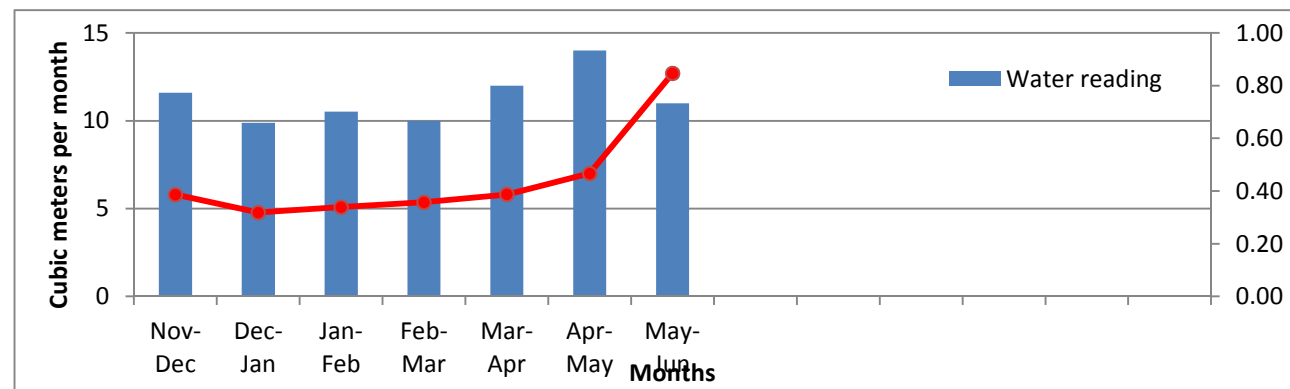


Figure 3: Water consumption graph.

VI EVALUATION

To understand and evaluate if the project will be successful I have decided to act as follow:

- Carrying out the water reading every month (first reading on the 18th November 2014).
- Keeping a Poo diary to calculate how many poo are necessary to fill a basket and to fill the composter (the 25th of November 2014 has been the first compost toilet day).

What I have learnt and what I will learn from this project:

- Become more conscious about domestic water consumptions
- I am using a compost toilet and I will be aware of its strengths and limitations
- I will learn how to produce, control and manage my humanure
- How to catch and store energy in my house
- How to make the rain water potable.

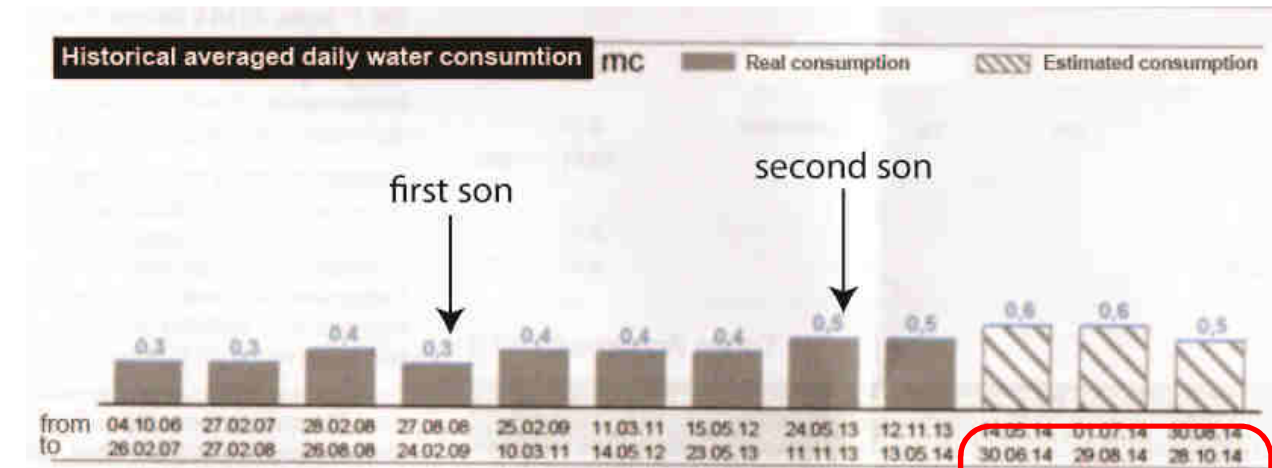


Figure 4: November 2015 water readings (in grey are the past data) and estimated water readings (striped)

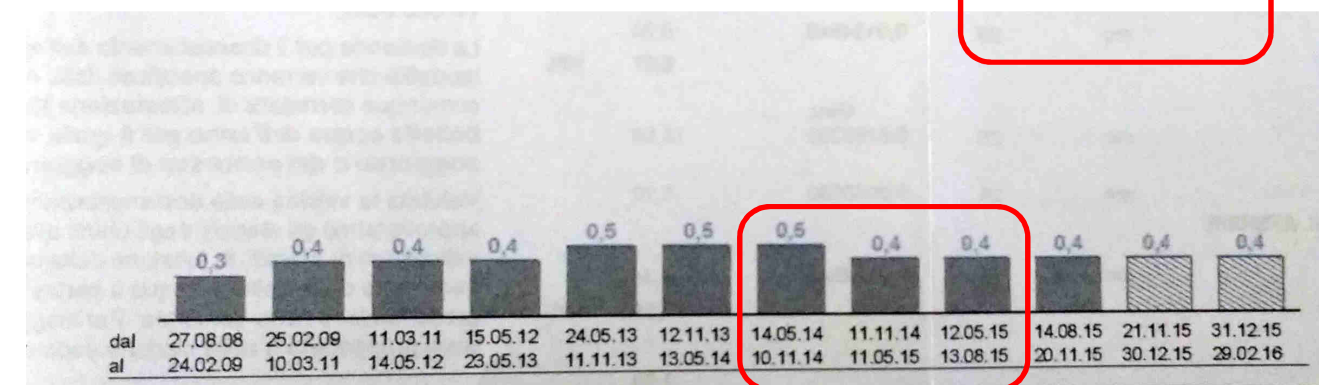


Figure 5: March 2016 2015 water readings (in grey are the past data) and estimated water readings (striped)

From the confrontation between the two figures it is clear to understand that the practical solutions applied during this year were effective. In November 2014 Hera (which is the waste, gas and water utility management in Ravenna where I live) estimated a consumption of 0,6 cubic meters for the period 14.05.2014 – 29.08.2014 and 0,5 for the period 30.08.2014-28.10.2014. The real water consumption is 0,4 cubic meters.

We pass from 28 cubic meters in 61 days which means 450 liters per day to 25 cubic meters in 61 days which means 410 liters per day. We save 40 liters per day only with small and slow solutions!

VII REFLECTION

This is a small design but it has been very useful. It made me and my family more aware of the use of drinking water and also on how to reduce its use. I have used the CEAP framework and I find it easy to follow and sufficient for this kind of design.

I focused the design on the COLLECT phase which, for this design, means understanding the water use in a normal house for a family while the evaluation phase was mainly focused on the collected data. The collection of data went well, I used the internet to find out information on domestic water consumption. I found different sources of data with different data relating the percentages of water used in the different categories and also found some lacks in categories. For example in my case, I have a small garden where I grow vegetables and during summer I need to water veggies almost every day. This is normally not considered or at least underestimated. Therefore it is necessary to carry on water measurement using water reading for at least one year to have enough data (for example differences between summer and winter use). A precious source of data are the past bills of the utility Company. I have used these sources to produce monthly water reading by myself and for many years.

At home, I started to collect data using the water reading in a random time period and I think I should have asked HERA (the Company) their reading date in order to be the same, but at the end the important information were the water consumed in a month so it was not so important the exact date.

In the evaluation phase, 6 categories of impact came out, so I had to focus on each of them to find a specific and real solution. It has been easy for me and my family to apply some easy and practical solutions like to close the water while using the soap or toothpaste, while for some others (like using the compost toilet) it was a bit more difficult.

Closing the water while using the soap or toothpaste proved to be a great system to save water. Relating to compost toilet on the other hand, I discovered that it is not an easy system to develop and use. My wife for example did not accept to use the compost toilet and nor to keep the pee and poo container inside the house, therefore I have to bring the composting bin inside the house from the garden and put it in the compost toilet before using it. My older son at the beginning was excited to use it but after a while he was not interested in it anymore. So compost toilet is a great solution but still with many limitations.

Another restriction in using it is that the composting bin stinks; poo, pee and carbon material mixed in the bin has a bad odor, to solve this problem I try several things:

- Straw: don't absorb the pee;
- Wood sawdust: good in adsorbing the pee but not enough good in reducing odor;
- Wood sawdust mixed with stove ash: I thought ash would have disinfected the mix of poo, pee and carbon material and therefore reduced the bad odor but I did not find significant differences with the previous method;
- Now I am trying to spray some lactobacillus to eliminate the odor and it seems to me that it is working better than the previous methods, let's see and experiment;
- I have also designed a solution to move pee out of the bin but if using wood sawdust a small amount of liquid is needed therefore I stop by using this solution.

Sawdust may be too dry and may need to be left exposed outside in the rain to rehydrate or may need dampened with water.

After a week of use of the compost toilet I need to move the produced material from the compost bin to the compost heap outside in the garden. The poo and pee management in the composting process on the other hand was quite easy and it surprised me for not creating bad smells or any related problems, even with neighbors. After 6 months I

needed to empty the compost heap and I had to take all the material out finding that the process was going on very well.

Building up system to catch and store rain water (like tanks) are great solutions, but a good and accurate calculation of water needed is mandatory. It is also very useful to record precipitation events in order to understand in which season the water is plenty available and those in which it isn't. For example at these latitudes we experience dry summer months with very low precipitation events, in these months the garden need a lot of water. A good solution is to have enough space to put in place a phytoremediation basin to recycle the water from bathrooms and kitchen or to use small solution to diverge some draining system (by moving pipes) from the drainage system to the garden by adding some basic sources of filtration and by using natural soaps. In my home I can put in place this solution only in the kitchen sink. My concerns are related to the boiling and salted water used for the pasta. Find solutions for this could be a matter for a new design or for an implementation of this.

I can harvest a lot of rain water from the roof but I don't have enough space to store it because I live in an old house in the city of Ravenna with several restrictions (for example I can't put solar panels on the roof or build sheds in front of the house) but I have an old well and I will try to redirect the pipe coming from the roof to the well in order to fill it and use the water stored for the garden using a pump (for the house we use electricity from a company that certified it as 100% from renewable sources, mainly hydroelectric).

LONG TERM VISION AND GOALS

- To reduce the water consumption even more
- To make some researches about filtering rain water and use it for cooking and for drinking.

- To start a collaboration project with the University to study the water table movements in the center of Ravenna using continuous water table reading probes.

NEXT ACHIEVABLE STEPS

- To connect the drain pipes from the roof to the well in order to harvest and store a lot of rain and to use it in the garden.
- To find a solution for diverting the kitchen sink pipes from the drainage system to the garden system, dealing with salty and boiling water.