

Supplementary material

Supplementary figures

In Mexico and Central America, the Mayans developed *RW* harvesting, and storage systems called "Chultuns," [2]. The figure A1 shows a Chultun example.

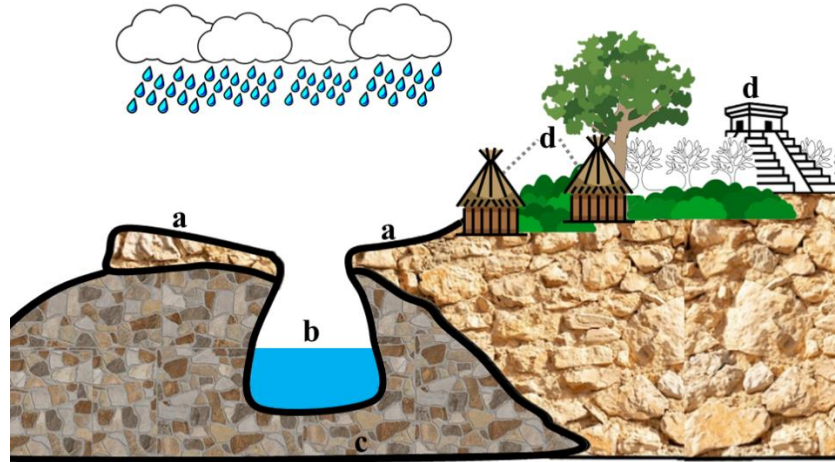


Figure S1. Mayan chultun design. (a) Rainwater runoff surface; (b) Chultun; (c) Basal surface; (d) Mayan buildings.

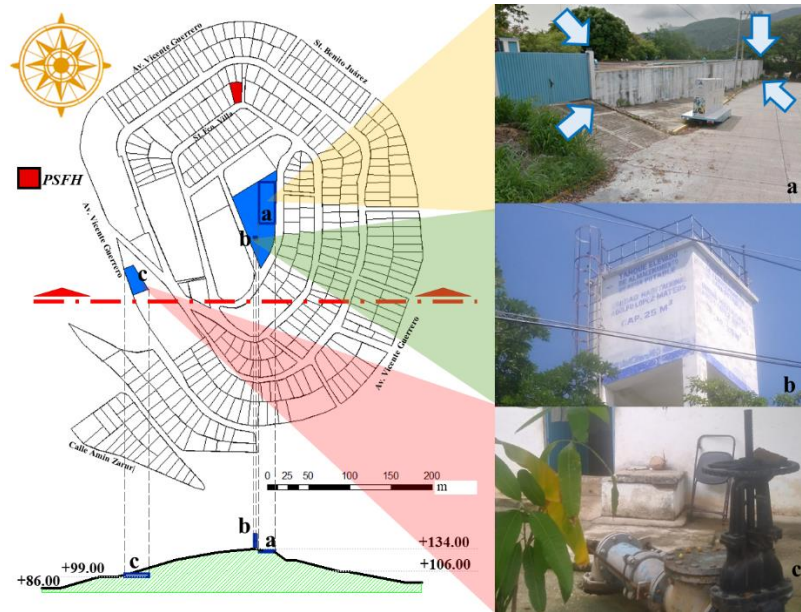


Figure S2. Location of BGA-2736 urban water and sanitary services equipment. (a) Hydraulic tank cap. 2,750 m³, (b) elevated hydraulic tank cap. 25 m³, and (c) sanitary overflow collector. PSFM= pattern single-family household. Elevations in meters above sea level.

Figure S3 shows the measuring rainfall device in this study. The plastic container was placed inside a glazed clay pot that served as a frame and prevented movement generated by air currents or other phenomena. The device was placed inside the *PSFH* in the backyard at open air. A graduated cylinder with a capacity of 1 L was used to measure the catchment volume.

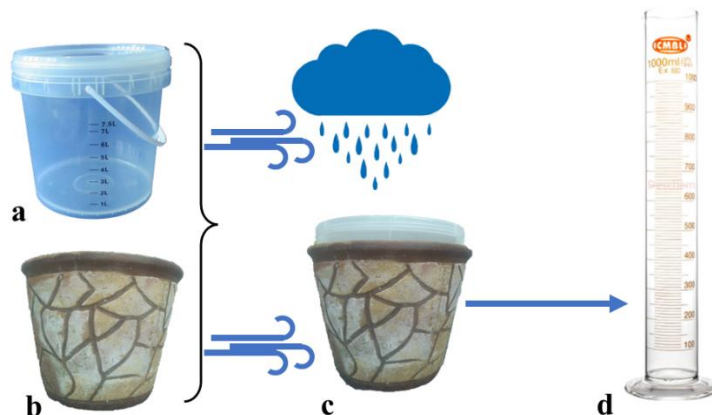


Figure S3. Measuring rainfall device. (a) Graduated container; (b) Earthenware pot; (c) Catchment device; (d) Graduated cylinder.

The alkalinity represents the capacity of water to avoid abrupt changes in pH. This buffering capacity is given by the presence of HCO_3^- and CO_3^{2-} ions in water [44]. In nature, the pH range of water tolerated by most macro and microorganisms is 6 to 9 as is shown in Figure S4. These values tend to vary naturally during the day, mainly due to ambient temperature variation.

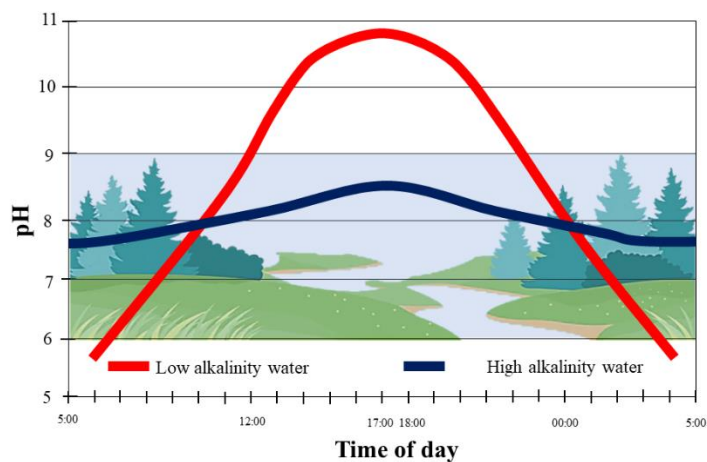


Figure S4. pH variation over 24 hours in low and high alkalinity water.

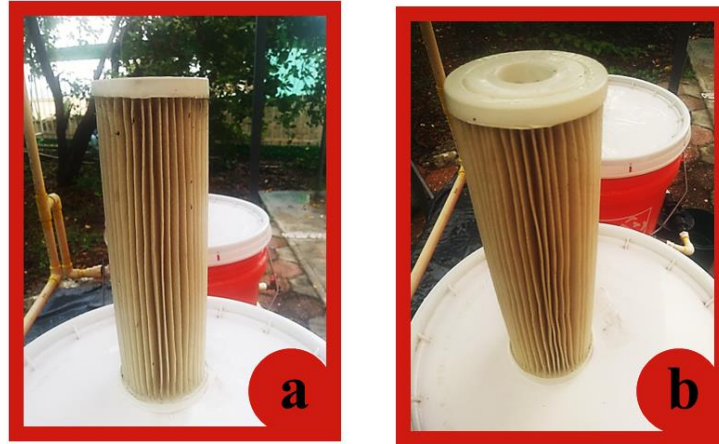


Figure S5. Commercial filters used in the prototype rainwater harvesting system. (a) condition of the filter at the end of the first 14-day rainfall period; (b) condition of the filter at the end of the second 14-day rainfall period.

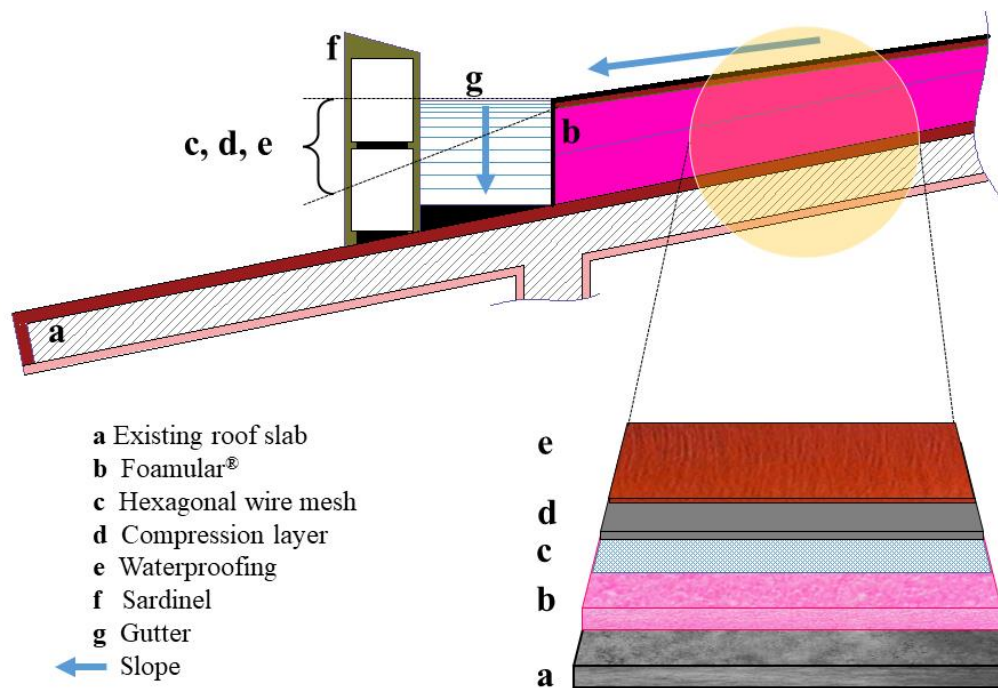


Figure S6. Roof slab retrofit using Foamular® to generate slopes and catchment gutter in the pattern single-family household.

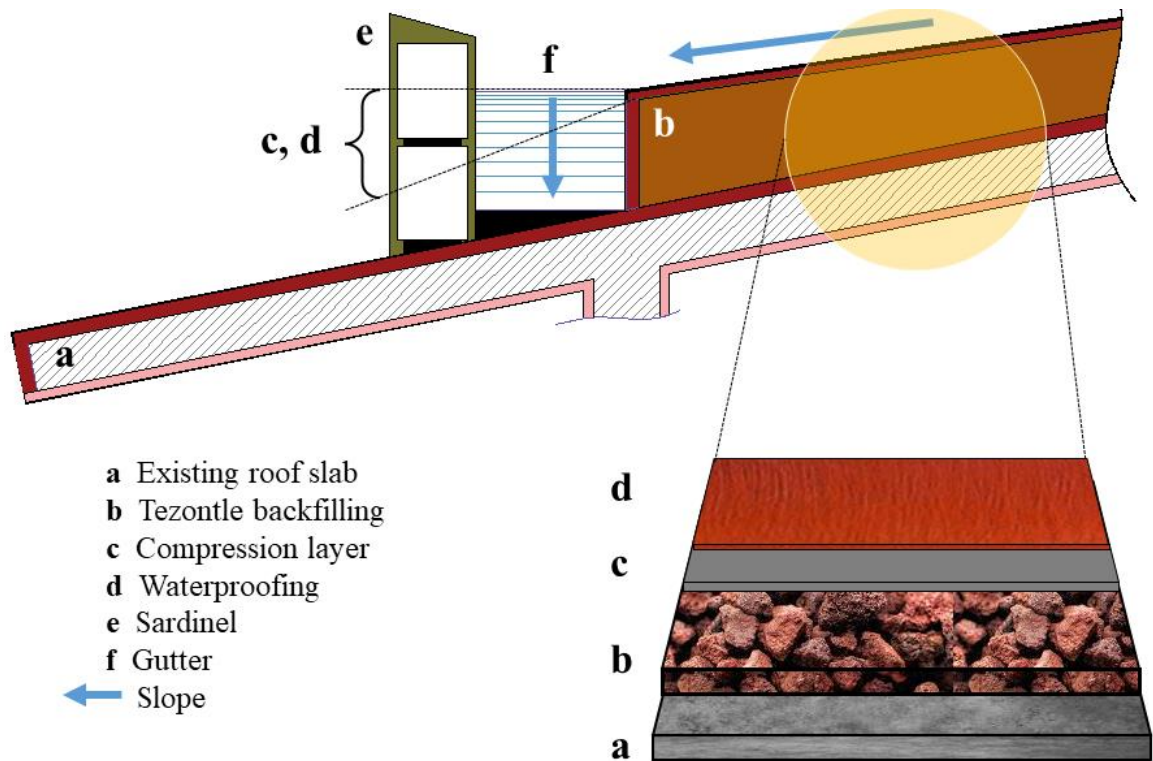


Figure S7. Roof slab retrofitting with tezontle to generate slopes and catchment gutter in the pattern single-family household.

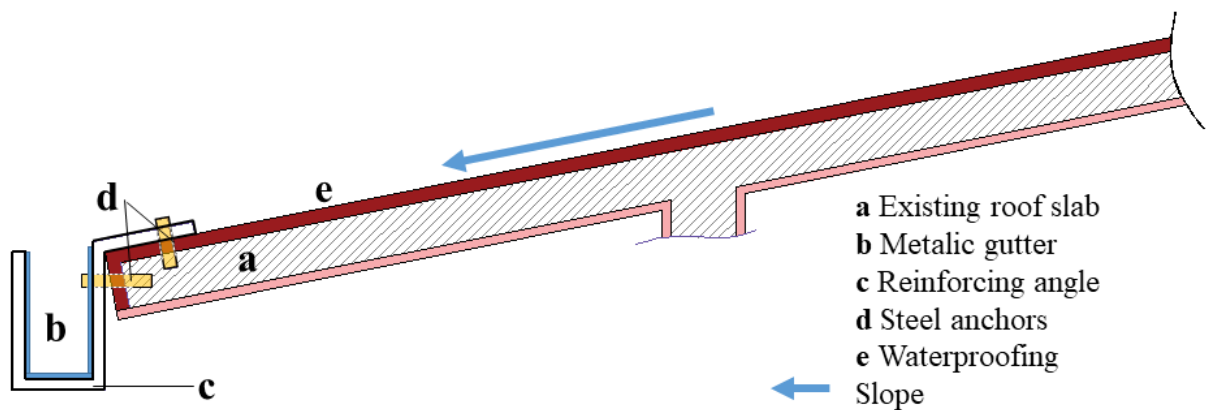


Figure S8. Roof slab retrofitting using a metal gutter without modifying the top slab in the pattern single-family household.

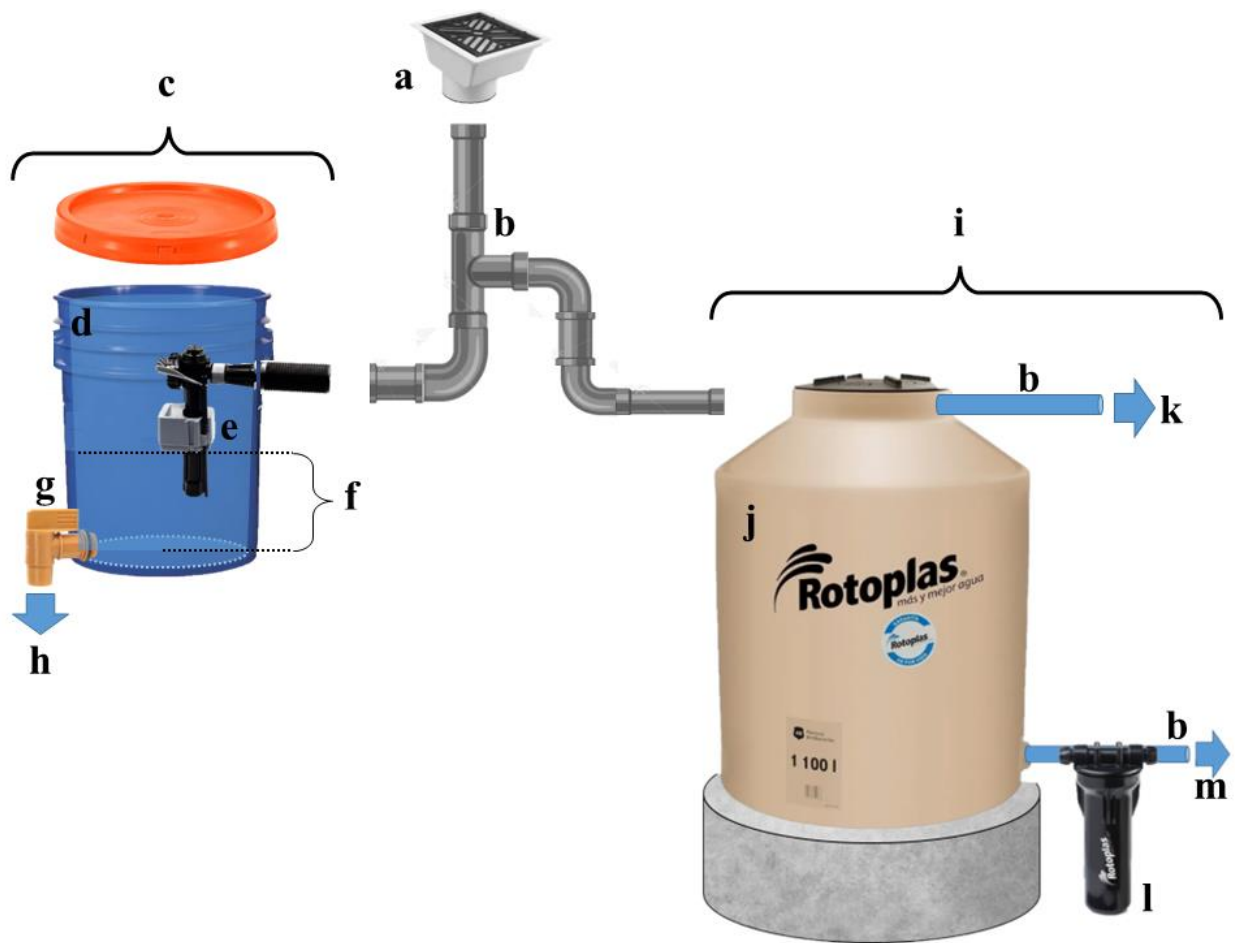


Figure S9. Rainwater harvesting system proposal. (a) Leaf filter, (b) Conveyance, (c) First rain separator, (d) Commercial container (20 L), (e) Float, (f) Water volume adjustment, (g) Untreated water release valve, (h) Untreated water outlet to permeable soil, (i) Rainwater storage, (j) Commercial container (1,100 L), (k) Surplus water outlet, (l) Filter, (m) Treated water outlet to domestic distribution

Supplementary tables

Table S1. Classification of rainfall type.

Catchment (mm=L/m ²)	Rainfall type
<25	Slight
25.1 - 50.0	Heavy
50.1 - 75.0	Very Heavy
75.1 - 150	Intense
150.1 - 250.0	Torrential
>250.1	Extraordinary

In 2020, Mexico experienced the most active tropical cyclone season in its history. During this period, 46 rainfall events occurred: 29 tropical storms and 17 hurricanes, of which nine were of great intensity [39]. Table S2. shows four of these phenomena that affected the state of Guerrero and represent a greater volume of water precipitation.

Table S2. Pluvial phenomena affecting Guerrero from May to November 2020, according to the National Meteorological Service of Mexico.

Rainfall Event	Category	Date	Precipitation (L/m ²)	
			Minimum	Maximum
Cristina	TS	July 06 th to 12 th	17	58
Genevieve	H4	August 16 th to 21 st	NR	NR
Hernán	TS	August 26 th to 28 th	38.5	334.6
Julio	TS	September 5 th to 7 th	18.2	52.4

TS= tropical storm; H4= category four hurricane; NR= not reported.

Table S3. Physicochemical properties of rainwater samples from the basic geostatistical area-2736 collected in the year 2021.

Week	Pluvial phenomena	Period	pH		Electrical conductivity ($\mu\text{S}/\text{cm}$)		Alkalinity (CaCO_3 mg/L)		TDS (mg/L)	
			FRS	ST	FRS	ST	FRS	ST	FRS	ST
1	1	1	6.28 \pm 0.13	6.30	221.10 \pm 98.85	630.30	31.58 \pm 8.71	58.20	111.51 \pm 50.71	178.70
2	2									
3	7	2	6.43 \pm 0.06	6.54 \pm 0.07	54.24 \pm 20.27	54.69 \pm 27.08	9.79 \pm 2.74	10.42 \pm 3.62	27.31 \pm 10.29	27.41 \pm 13.71
4	6									
5	3	3	6.28 \pm 0.08	6.23 \pm 0.10	32.78 \pm 7.49	13.89 \pm 2.38	6.32 \pm 1.09	4.60 \pm 0.33	16.36 \pm 3.66	6.56 \pm 1.07
6	3									
7	2	4	6.36 \pm 0.07	6.27 \pm 0.06	28.78 \pm 10.16	24.49 \pm 8.94	5.87 \pm 0.75	5.42 \pm 0.60	14.05 \pm 5.00	11.89 \pm 4.43
8	4									
9	2	5	6.17 \pm 0.04	6.03 \pm 0.08	31.41 \pm 9.97	21.95 \pm 5.95	4.42 \pm 1.60	4.42 \pm 0.34	15.12 \pm 4.94	10.16 \pm 2.73
10	2									
11	3	6	6.26 \pm 0.10	6.13 \pm 0.07	28.39 \pm 13.27	7.95 \pm 3.33	6.79 \pm 0.00	4.98 \pm 0.45	13.08 \pm 6.33	3.32 \pm 1.58
12	0									
13	1	7	6.48 \pm 0.09	6.38 \pm 0.05	72.02 \pm 35.43	26.43 \pm 12.91	9.17 \pm 2.56	5.09 \pm 1.60	34.07 \pm 17.03	12.15 \pm 6.17
14	3									
15	1	8	6.40	6.43	30.22	21.30	8.15	6.80	14.48	10.40
16	2									
17	3	9	6.62 \pm 0.12	6.57 \pm 0.01	9.82 \pm 0.88	3.58 \pm 1.43	3.40 \pm 0.68	3.40 \pm 0.68	4.69 \pm 0.52	1.82 \pm 0.68
18	0									
19	2	10	6.28 \pm 0.07	6.18 \pm 0.03	48.58 \pm 12.16	12.85 \pm 0.13	8.60 \pm 2.75	4.75 \pm 0.68	24.17 \pm 5.82	6.86 \pm 0.32
20	1									
21	3	11	6.46 \pm 0.08	6.66 \pm 0.11	31.36 \pm 10.94	20.68 \pm 1.06	7.70 \pm 1.97	5.89 \pm 0.45	15.59 \pm 5.07	9.48 \pm 1.26
22	2									
23	2	12	6.74 \pm 0.05	6.77 \pm 0.09	33.22 \pm 16.95	16.44 \pm 7.66	6.11 \pm 0.68	6.79 \pm 1.36	16.46 \pm 8.50	8.27 \pm 3.68
24	0									

Data are presented as the average \pm standard error, where n= depends on the number of rainfall events recorded per period, except in periods 1 and 8 where n=1 because only one sample was collected from the ST, whereas in period 8 only one sample was collected from FRS and ST. FRS=First rain separator; ST=Storage tank; TDS=Total dissolved solids.

Table S4 shows an acid rain classification. Acid rain is increasingly frequent in industrial cities and is mainly attributed to the natural interaction between *RW* and sulfur (SO_2) and nitrogen (NO_2) oxides involved in the chemistry of the atmosphere and its equilibrium [42].

Table S4. Acid rain classification.

Acid rain classification	pH
Non-acidic rain	> 5.6
Slightly acid rain	4.7 - 5.6
Moderately acid rain	4.3 - 4.7
Strongly acid rain	≤ 4.3

Table S5. Materials required for the installation of the rainwater storage device in the pattern single-family household priced in 2021.

Element	Material	Amount (USD\$)
Storage tank	1,100 L Rotoplas tank with accessories: filling valve, multi-connector with ball valve and union nut, float, air jug and standard filter.	116.77
	<i>CPVC pipe</i>	5.11
Conveyance	90°x½" CPVC Elbow	0.39
	½" CPVC tee	0.58
	Plumbing sandpaper	0.73
Fasteners	<i>CPVC glue</i>	4.14
	½" Teflon tape	1.17
Total (USD\$)		128.89

CPVC= chlorinated polyvinyl chloride.

Supplementary perception instruments

Perception instrument S1. Survey for inhabitants of the basic geostatistical area -2736. Focused on the current state of the hydrosanitary installations in the homes, water consumption and management practices, and the willingness to adopt domestic hydraulic ecotechnologies.

Hydro-social survey

1. How many people live in your household?

- a) 1-2
- b) 3-4
- c) 5 or more

2. How much do you pay for water per month?

- a) Less than 100 pesos
- b) From 100 to 200 pesos
- c) From 201 to 300 pesos
- d) From 301 to 500 pesos
- e) More than 500 pesos

3. Rate from 1 to 6 the following activities by water consumption in your household (6 for the most consumed, 1 for the least consumed)

- _____ a) Personal hygiene
- _____ b) Washing clothes
- _____ c) Washing dishes and cooking
- _____ d) Flushing toilets
- _____ e) House cleaning
- _____ f) Outdoor uses gardens, patios automobile

4. Where do you get your drinking water from in your home?

- a) Tap water (filter, chlorination or boiling)
- b) Bottled water (jugs, bottles, etc...)
- c) Other (specify)

5. In the case of consuming tap water, what treatment do you use for its purification?

- a) I filter it
- b) I boil it
- c) I treat it with chlorine
- d) I combine methods

6. How many liters of drinking water do you regularly consume in your household per day?

- a) 0-2
- b) 3-6
- c) 7-10
- d) More than 10 liters

7. Do you consider that there is a water shortage in Acapulco?

- a) Yes
- b) No

8. Do you consider that water scarcity is a problem in your neighborhood?

- a) Yes
- b) No

9. What do you do to make sure you have enough water? (You can check more than one)

- a) I buy water pipes
- b) I avoid washing the car with a hosepipe
- c) When soaping the dishes, I keep the faucet turned off
- d) I use water-saving faucets and bathroom fixtures
- e) I avoid sweeping the sidewalks with a hose jet
- f) I flush toilets with water that has already been used
- g) I water gardens or wash patios and sidewalks with water that has already been used
- h) I take short showers
- i) While washing my hands, teeth, face and bathing I turn off the faucet while soaping myself
- j) I brush my teeth with a glass of water instead of the faucet
- k) I try to wash my clothes in full loads and as infrequently as possible
- l) I try to take care of leaks in faucets, water tanks and furniture promptly
- m) I use rainwater
- n) I use cisterns and additional storage tanks

10. From the following list, check the ecotechnologies you have heard about (You can check more than one). (Ecotechnologies are technological devices that solve problems in a sustainable way, preserving the environment)

- a) Water-saving toilets and showers, dry toilets and urinals
- b) Rainwater harvesting systems to capture and use rainwater and reduce the amount of water that runs off the streets when it rains
- c) Recirculation systems to reuse wastewater and reduce the amount of wastewater generated
- d) Others that treat wastewater and urine to produce clean water and energy
- e) I have never heard of water sanitation eco-technologies (to treat drinking water or sewage water)

11. Would you be willing to implement eco-hydro-sanitation technologies? If so, which benefit(s) are you interested in? (You can check more than one)

- a) Saving water
- b) Recovering water from human urine
- c) Producing electricity from wastewater
- d) Reducing the amount of wastewater generated by my home
- e) To reduce urban runoff
- f) Reduce pollution of watercourses, rivers and seas
- g) I am not willing to implement eco-technologies in my home

12. Which of the ecotechnologies do you find most interesting? (You can check more than one)

- a) Water-saving toilets and showers, dry toilets and urinals
- b) Rainwater harvesting systems to capture and use rainwater and reduce the amount of water that runs off the streets when it rains.
- c) Recirculation systems to reuse wastewater and reduce the amount of wastewater generated.
- d) Others that treat wastewater and urine to produce water and clean energy.
- g) I am not interested in the subject.

13. Would you be willing to use rainwater in your home?

- a) Yes
- b) No

14. If so, what uses would you be willing to give to the rainwater that has been filtered? (You can check more than one)

- a) Irrigation of green areas and gardens
- b) Washing the car
- c) Flushing toilets
- d) Cleaning floors and walls
- e) Cleaning kitchen (floors, walls, countertops, counters, counters, etc.)
- f) Washing dishes
- g) Washing clothes
- h) Pet bathing
- i) Swimming pools (chlorinated)
- j) Bathing
- k) Cooking
- l) Drinking

15. Do you have any other source of water supply inside your home besides the household tap?

- Yes
- No

16. If you have another source of water supply (besides the municipal tap), please check which one:

- a) My neighbor passes water to me
- b) I have a well, a spring, a stream, a spring, a spring, a stream, a spring, or a spring.
- c) I buy water pipes
- d) I do not have a household tap

17. How often do you maintain your house?

- a) Before the rainy season
- b) For the Christmas holidays
- c) When the house requires it
- d) Two or more of the above
- e) I have never given maintenance to my house

18. Does your home currently require any type of plumbing maintenance?

- a) Yes

b) No

19. Check which of the following signs of deterioration in your home, if any (You may check more than one)

- a) Dampness in walls or roof slabs (leaks)
- b) Drinking water leakage
- c) Sewage water leakage
- d) Clogged pipes
- e) Bad smells from bathroom or kitchen drains
- f) Badly maintained tanks or tanks without floats
- g) Exposed rods
- h) Malfunctioning bathroom and kitchen fixtures (plumbing is often clogged, faucets are not working, wastewater backs up, fixtures are not well fixed, etc.).
- i) My house has none

20. Given the current conditions of your home, how high a priority do you think it would be to maintain your plumbing installations (change pipes, bathroom and kitchen furniture, change sinks, install water tanks or cisterns, change registers, etc.)?

- a) It is urgent a hydrosanitary maintenance
- b) It is necessary, maintenance is required
- b) It is not necessary
- c) It is not necessary, they work optimally.

21. How often do you maintain your plumbing installations (washing tanks and water tanks, preventing leaks, changing bathroom and kitchen furniture, etc.)?

- a) Twice a year
- b) Every year
- c) When the house shows signs of needing plumbing maintenance.
- d) I never give maintenance to the installations

22. In relation to the payment of your CAPAMA bill, how do you consider the charge for the water supply?

- a) The charge is fair
- b) The charge is excessive
- c) The charge is cheap.

23. How often does water arrive at your home?

- a) Every day
- b) More than twice a week
- c) 1 or 2 times a week
- d) Once or twice a month
- e) Less than once a month

24. How sufficient do you consider the distribution of drinking water in your neighborhood?

- a) More than enough
- b) Sufficient

c) Insufficient

25. What is the quality of the water delivered by CAPAMA?

- a) Poor
- b) Regular
- c) Good

26. which of the following problems are present in your neighborhood? (You can check more than one)

- a) Drinking water leaks
- b) Drainage leaks
- c) Streets and/or sidewalks open due to pipe repairs
- d) Lack of water
- e) Lack of distribution pressure (water does not come up to your water tank)
- g) Accidents when it rains due to the dragging of water in the streets.
- h) Uncovered sewers
- i) Clogged or clogged sewers
- j) Bad odors in the streets coming from sewers
- k) They do not come to take water meter readings
- l) Unfinished pothole repairs left unfinished
- m) Collapsed drains
- n) Infrastructure with deficient capacity

27. Do you know where rainwater goes?

- a) To the sea
- b) Gully
- c) Treatment plant
- d) Rainwater courses
- e) I don't know

28. Which of the following actions do you consider to be responsibilities of citizens in relation to water?

- a) Report drinking water and sewage leaks
- b) Pay the water bill
- c) Use water rationally
- d) To give constant maintenance to the facilities of the houses
- e) Denounce clandestine water connections
- f) Implement water saving systems
- g) Participate in courses and workshops related to water whenever possible
- h) Encourage the family to take care of water
- i) Preserve areas with vegetation and land without concrete inside your house
- j) Defend the green areas of the city and the ecological reserve zones
- k) Other (specify)

29. Which of the following actions do you carry out for the collective care of water?

- a) I report drinking water and sewage leaks

- b) I pay my water bill punctually
- c) I use water rationally
- d) I give constant maintenance to the installations in my house
- e) I report clandestine water connections
- f) I implement water saving systems
- g) I participate in courses and workshops related to water whenever possible
- h) I encourage my family to take care of water and I watch out for it
- i) I conserve areas with vegetation and land without concrete around my house
- j) I defend the green areas of the city and the ecological reserve zones
- k) Other (specify)

My home is located at:

Street: _____ Number: _____

Thank you for answering this survey

Perception instrument S2. Semi-structured interview for housewives living in basic geostatistical area -2736.

Categories	Concepts	Question	Indicators
Nature based solutios	Technology	What do you think about technological advances to improve water management? Do you apply any technological advances related to water or sanitation? Why?	Solution to problems
	Application	What applications do you consider a priority for the best use of water and why? How do you store water in the dwelling, how much do you store and why?	Collection and treatment
	Natural Resources	What is your opinion about water as an environmental problem?	Nature-based solutions
	Efficiency	What constraints would you place on the adoption of technology in your home?	Cost/benefit
Water management	Management	Where does the water you use in your home come from? What do you think you can do to improve the quality and quantity of water available to you?	Collection
	Use	What can you tell me about the quantity of water available to you at home? What about the quality?	Food, hygiene, cleanliness, number of uses
	Consumption	What uses do you make of the water in your homeWhat uses do you consider the most important and the least important? In which uses do you consume the most water?	Recirculation Reuse
	Social integrality	Are there any cases in which you have had to ask your neighbors for help directly related to water or in which they have asked you for help? Have there been any occasions when you as neighbors or community have met to address any water issues?	Rel. with social problem
Plans and policies	Planning	What can you tell me about government action on the water issue in your neighborhood? What are the municipal strategies on water and drainage?	Future management

	Implementation	<p>What do you do when water stops being supplied? How many days has it been scarce? Tell me about a time when water has gone out and what you did.</p> <p>How is sewage management carried out in the municipality? What can you tell me about the drainage system in your neighborhood?</p> <p>What happens when it rains?</p> <p>Can you tell me about any experience with drainage in your neighborhood?</p> <p>What do you think about the drainage system?</p> <p>What about the distribution network?</p> <p>Management of wastewater in the home Problems and solutions</p>	Solution to problems
	Evaluation	How do you see the water supply in Acapulco? How would you rate the public sewage sanitation system?	Evaluation mechanisms and tools
	Synergies	What do you think is the participation of the common citizen in the management of municipal agreements?	Agreements
	Resistances	Do you or someone you know suffer from any sanitation or water distribution problem? if so, can you tell me what it consists of?	Conflicts