Casas del Aguas

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Master of Interior Architecture and Retail Design

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Contents

Abstract

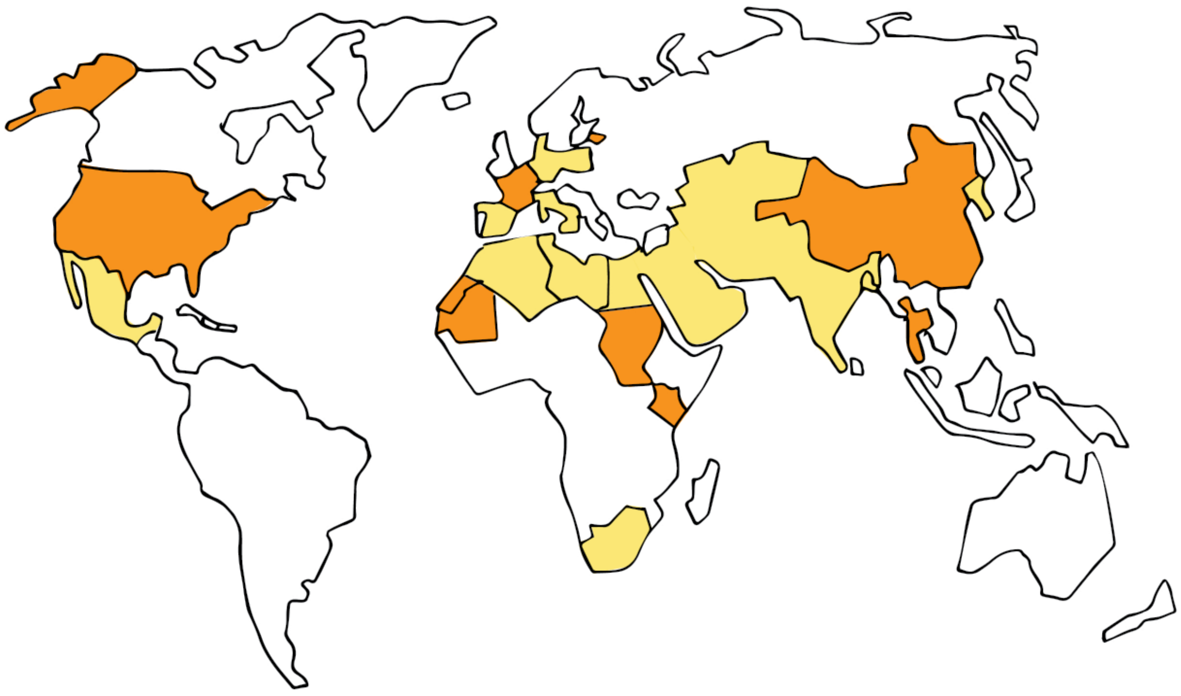
Addressing global water crisis my design project titled "Casas del Aguas" aims to deal with such catastrophic water case in Mexico City and its district Iztapalapa.

Iztapalapa, one of the poorest sections of the city, is suffering from domestic water scarcity. Here domestic water is always uncertain: sometimes it is unavailable and sometimes it is highly polluted with unknown substances. Local people are forced to search for fresh water outside the city or to buy bottled water. However, many poor families in the area cannot afford such expenses.

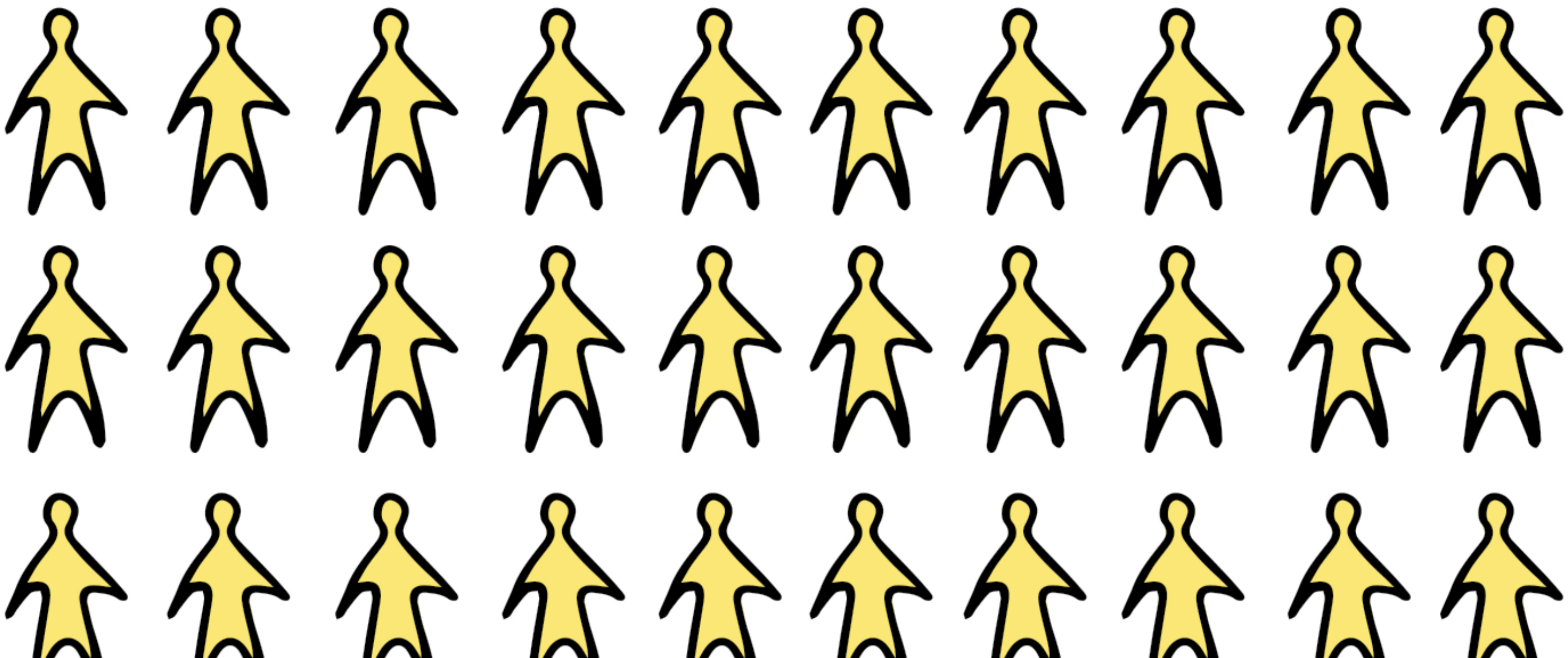
Trying to resolve such problem my design project looks at the Iztapalapa households' interior as a potential pure water generator and transformes it into a water laboratory where this precious natural resource has gained an important treatment.

Simultaneously within the context of water scarcity my design project suggests a new domestic interior model of the future.

Introduction



1. Global water crisis map



2. Water stress in 2050

Foreword

Water is the vital and existential element for a human in order to sustain a life on this planet.
However, today, this natural resource is facing a crisis and threatening many populations to suffer from scarcity of water and clean water for drinking.

One might wonder how that is possible - after all, 70 % of our planet is covered by water. However, we should notice that the largest amount of it is salty and only 3 percent is pure. Moreover, the most attention requiring fact, which determines water scarcity, is that only 1 percent of total pure water is accessible for humans.

This little amount of total pure water available on the earth today is running out. The reasons of this looming water disaster are multifarious, but still majority of them are due to insouciant human activities regarding their natural habitat and its natural water resources. Last mentioned water scarcity determining activities mainly are overexploitation of rivers and aquifers, water overconsumption and water contamination and pollution (Patrick, S., M., 2012).

Due to that "[...] 80 countries now have water shortages and 2 billion people lack access to clean water and [...] 1 billion people lack enough water to simply meet their basic needs." (Alois, P., 2007) (fig. 1.).

If we don't stop wasting and polluting pure water resources by 2050, as researchers claim, 75 percent of our planet will be under water stress conditions (Denee, 2015) (fig. 2.).

Addressing this global issue and the interior of the domestics, I would like to argue that human habits towards the water and the way we relate to this natural resource must change.

Therefore as such case study and my design context with my thesis work I am investigating Iztapalapa district in Mexico City, which faces a huge water crisis. In this area of large metropolis almost 2 million poor people are suffering pure domestic water deprivation and are in need of serious help. Due to that my research work focuses on this district's issues and tries to resolve methods of how pure water could be obtained and treated within the realm of area's household's domestics.

A final outcome of my exploration became a domestic aquatic scenario – a set of interior water treatment interventions dedicated to the poor Iztapalapa district. My final project titled "Casas del Aguas" introduces new methods of how extended interior space can be modified to accommodate water scarcity facing households with domestic fresh water and suggests a new domestic interior model of the future.

Motivation

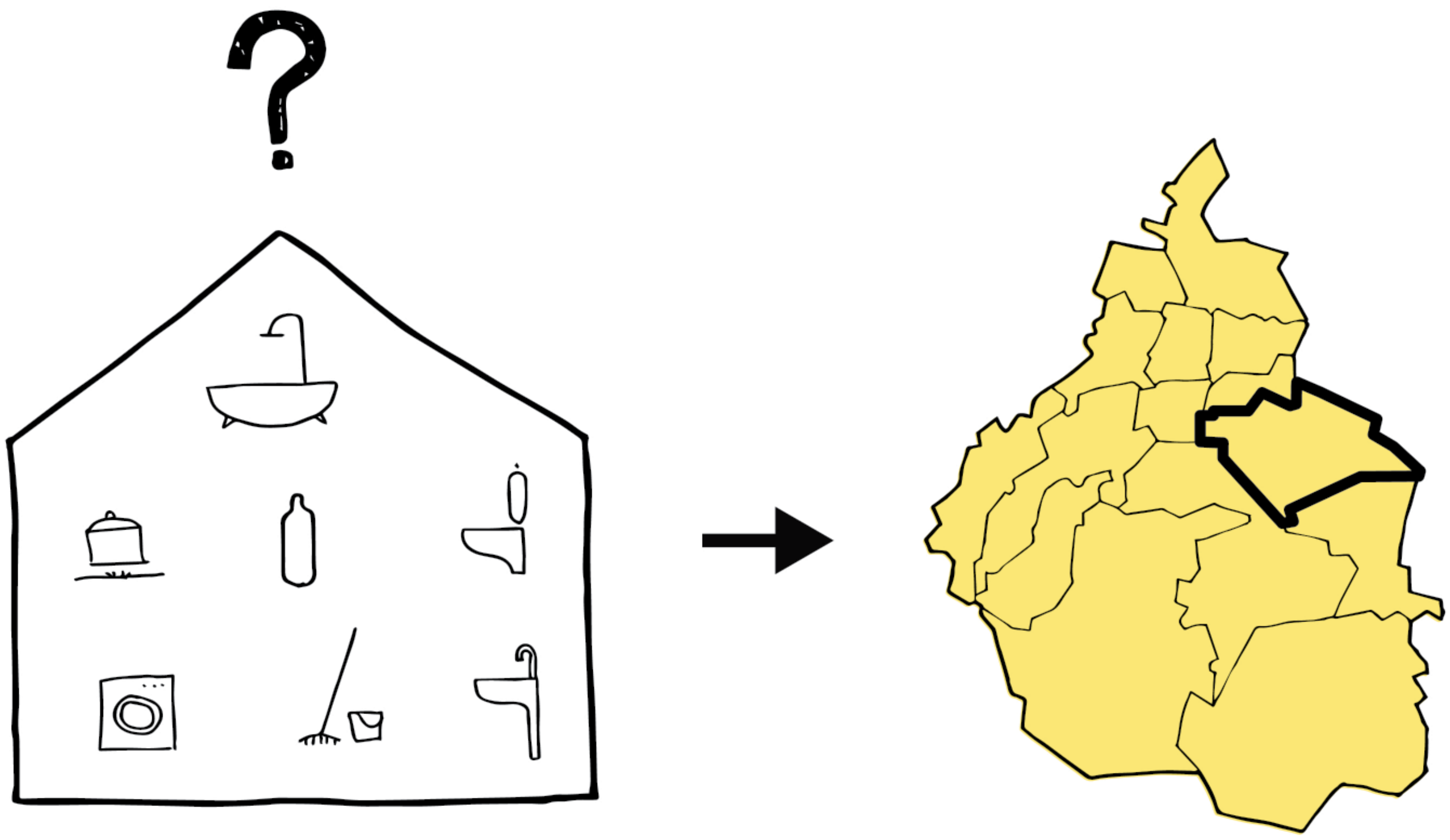
My research subject stems from my personal life "journey" and experiences that formed my specific emotional attitude. Such attitude of mind in the implicit or explicit ways echoes in all of my design work.

I was born in a province of Lithuania, where nature was my daily environment I lived within. When I relocated to study in a city, I encountered a different milieu and landscape. The differences were pleasing, challenging but at the same time scaring and bringing a sense of estrangement and alienation. Rivers, forests and meadows I exchanged with the spectacle of cars, waste and a range of architectural marvels. Metropolitan lifestyle, rapid global urbanization, fast growing economies leave the nature behind the scenes. Not only that, it uses its resources to sustain its presence and growth. In this context, a city could be critiqued as being a parasite and a danger for natural environment, its resources and imminent disasters.

Due to interest in the above described phenomena my thesis work aims to explore the natural resource of water, which has been exploited for centuries within the urban environment. This everlasting process led many areas in the world to face a huge water crisis.
Therefore, as mentioned in the introduction, my implemented investigation questions the age of pure water scarcity and searches for alternative survival domestic interior solutions in the era of a looming water disaster with the specific focus on the Iztapalapa district in Mexico City, , which suffers pure domestic water shortages.

My final design proposal titled "Casas del Aguas" suggests methods of a new water treatment and scenarios for interiors of this neighborhood, the domestic interior, in order to address situations of emergency due to water shortage.

This project too might be seen as a leitmotif for many water scarcity facing areas around the globe.



3. My main research question scheme

Research Question

samil Serageldin, the Vice President of the World Bank notes:

Many of the wars of the 20th century were about oil, but wars of the 21st century will be over water. (Morrissette and Borer, 2004)

Reading this quote and understanding already the global water crisis that I described in the introduction it becomes explicit that in future our planet will face huge shortages of pure water. Therefore my general research question is as follows: how to adapt to the new era of pure water scarcity and could the interior of domestics alter in order to adapt to an age of global water crisis? (fig. 3.)

As my thesis investigation centers on the specific case of the Iztapalapa district in Mexico City, which is suffering from safe domestic water deprivation, the following thesis questions stem from this context: How can fresh water become available within a neighborhood's domestic realm in order to meet the most basic sanitary needs: clean water for drinking, cleaning and bathing? What new methods of water treatment can be adopted in order to save and refine this natural resource? How can water related diseases be prevented? What actions must be taken that new water management method would be implemented within a low income society?
These questions raised and the quest of the answers eventually had determined my design methodology and the final design solution.

Methodology

Through the development of my thesis work I employed several design methodologies that influenced each other during the process.

The first one is the so called artistic research. Such practice, as Sarat Maharaj defines in one of the first European conferences on artistic research is: ""spasmodic, interdisciplinary probes, haphazard cognitive investigations, dissipating interaction, and imaginary archiving." Such investigation is aiming not at the "expert knowledge", but at the "experiential knowledge" (Slager, 2009, p.2). Therefore, one could say that artistic research is a "theory driven experimentation" devoted to enrich one's knowledge (Balkema and Slager, 2004, p.12).

My implemented artistic investigation on domestic water scarcity was driven by the experimentation and study of various factual and artistic references and their theoretical and historical background.
The whole exploration consists of three main parts: short review of water history with the quest of the roots of global water crisis phenomena, analysis of water crisis in the specific area of Mexico City and it's district Iztapalapa, and eventually a study of multiple artistic references in order to find a right strategy for design project in the context of Iztapalapa district in Mexico City.

Alongside to my artistic research I employed other research method – a hand drawing. While studying theory and references I simultaneously created a series of conceptual drawings speculating on possible systems and future scenarios. In general hand sketching became my main tool of analysis and finally my own peculiar representation and communication technique.

To sum up, my research methodology is based on the artistic experimentation fed by various creative and historical references that was continuously documented by hand drawing.

Chapter 1.

Theoretical Research

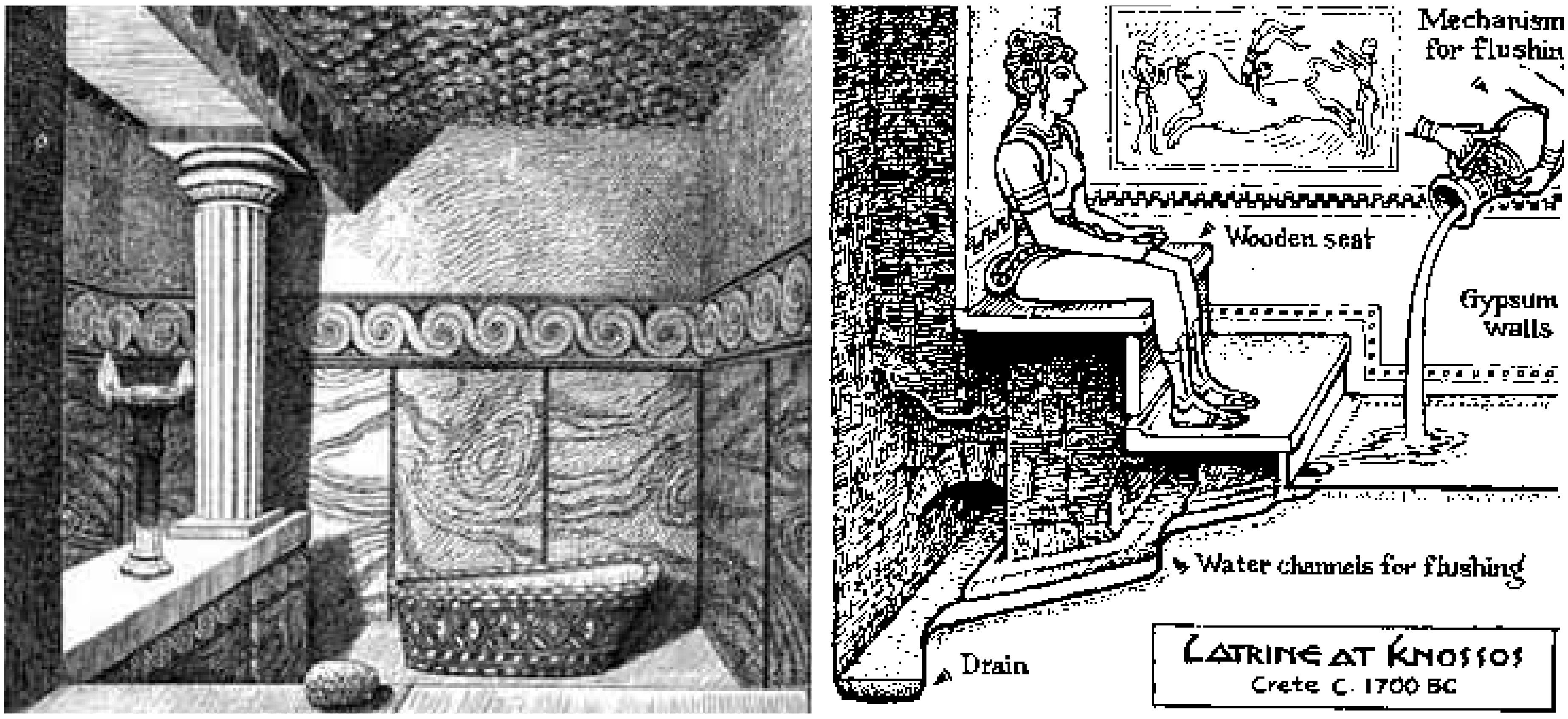
1.1 Global Water Crisis Roots and Impact

In order to understand global water crisis in essence and conceive its grounds with this initial chapter I will shortly introduce four main historical factors that, in my opinion, were a foundation-stone of today's water disaster. Later on, as a result, I will trace some historical and recent water related disasters showing its huge negative impact to the nature and the whole humankind.

First of all, I believe that one of the main factors that contributed to today's water catastrophe was simply a 'domestication' of this natural resource that resulted in the earliest environmental pollution in a form of black waters discharge into rivers.

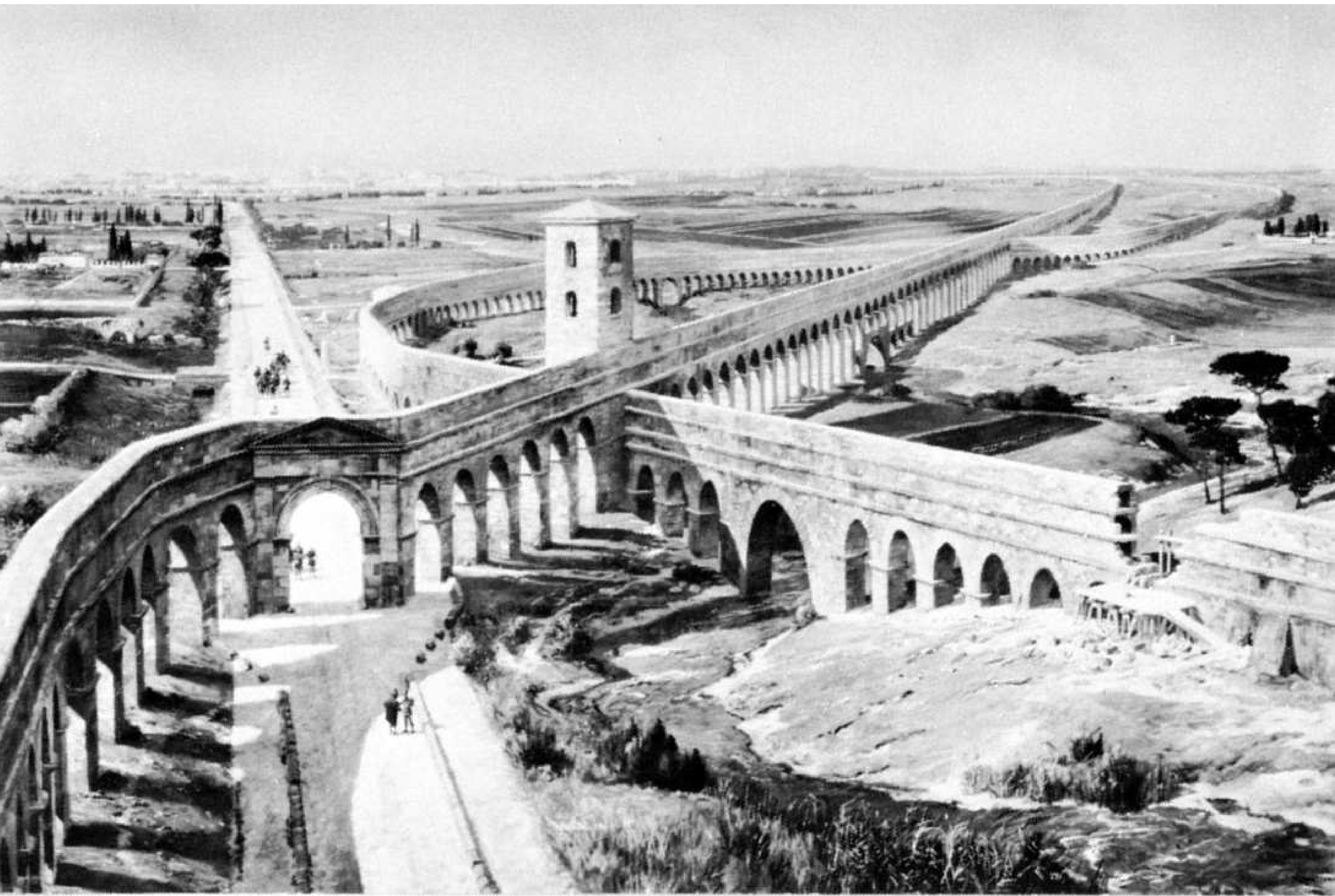
As an example of such my claim could be Knossos palace with its indoor drainage and sanitary systems build in 1700 BC. In the age when water used to be carried manually, the palace with its intricate water channeling system was a novelty. This system allowed fresh natural waters to be easily 'domesticated' or interiorized and as a result, for its better use and comfort, to emerge an earliest sanitary fixtures such as lavatories, sinks and bathtubs and eventually a separate room dedicated for ones self-cleaning – "A Queen's Bathroom" (fig.4.). I could say domestication of water made the palace a luxury habitation that eased humans' life bringing fresh water indoors, however, I dare to claim that palace's domestic drainage system and it's sanitary fixtures could mark the beginning of the contemporary water crisis of today, as besides bringing pure water into a house, palace's drainage system also served as a tool to discharge used grey and black waters into the nearby flowing river of Kairatos without any treat (Plumbing Supply, 1989) (fig. 9.). Therefore, due to such environment pollution, I can see this house as an earliest pioneer of a large environmental disaster that we are facing today.

Another factor that contributed to the emergence of a global water crisis, I think, was the beginning of excessive water overexploitation.
One of such examples could be roman aqueducts. Probably no one could disagree that the invention of these massive water infrastructures brought ancient Roman civilization to thrive since they were channeling a precious natural resource to roman cities from very far (Hansen, n.d., p.2) (fig. 5.).



4. Queen's Bathroom. Luxurious cleansing fixtures in Knossos palace. 1700 BC

5. Roman aqueducts. Painting by by Michael Zeno Diemer, 1900s

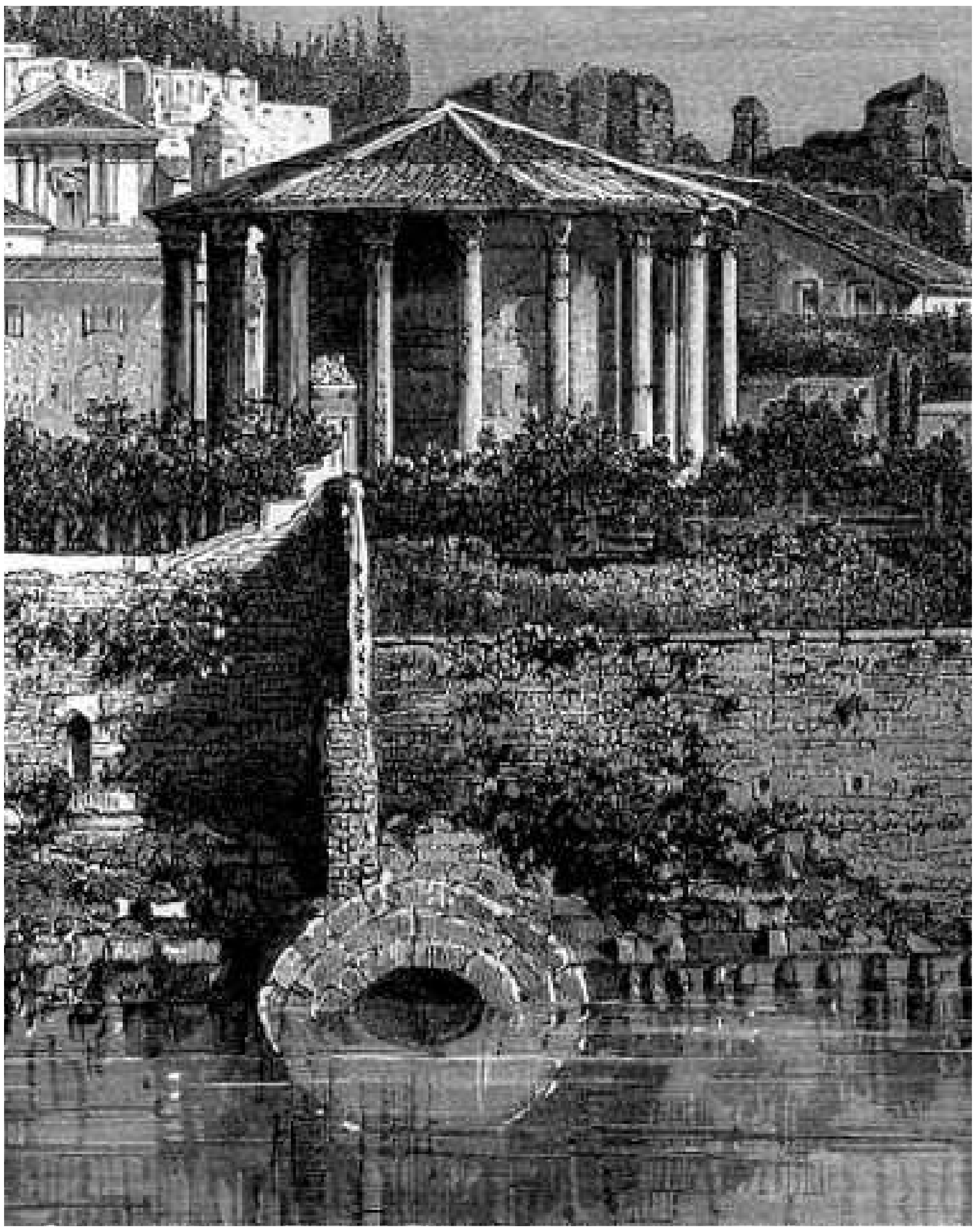


However, I can claim that these innovative architectural structures not only supplied human domiciles with pure water, but also became natural water resources sucking apparatus, begun the age of water overexploitation.

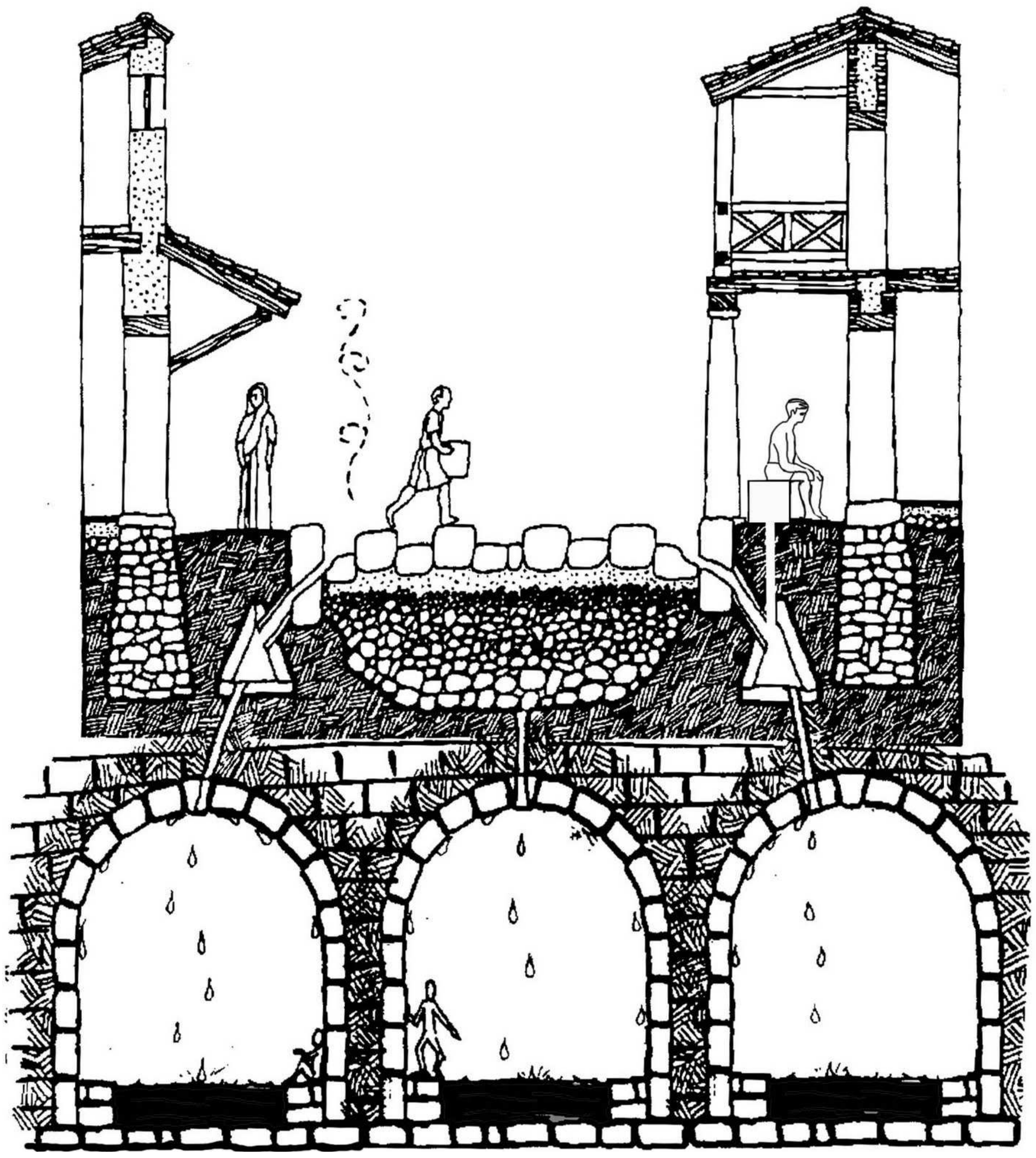
One more factor that, I believe, had influenced a global water crisis emergence of today was the birth of water consumption culture.

To visualize my statement I could exemplify thermal baths culture in Roman Empire. Usually, these 'water temples' featured by enormous hot, cold and warm water swimming pools, steam rooms, showers and fountains and without any limits entertained thousands of romans at the same time (Giedion, 2013, p. 632) (fig. 6.). Therefore an excessive water consuming habits rooted in this age, I believe, is another reason of looming water disaster today.

6. On the right: Massive water consumption during Roman times. The Baths of Caracalla. Painting by Sir Lawrence Alma-Tadema, 1899.



7. The Great Rome's sewage channel "Cloaca Maxima" discharges all waste waters to Tiber River.



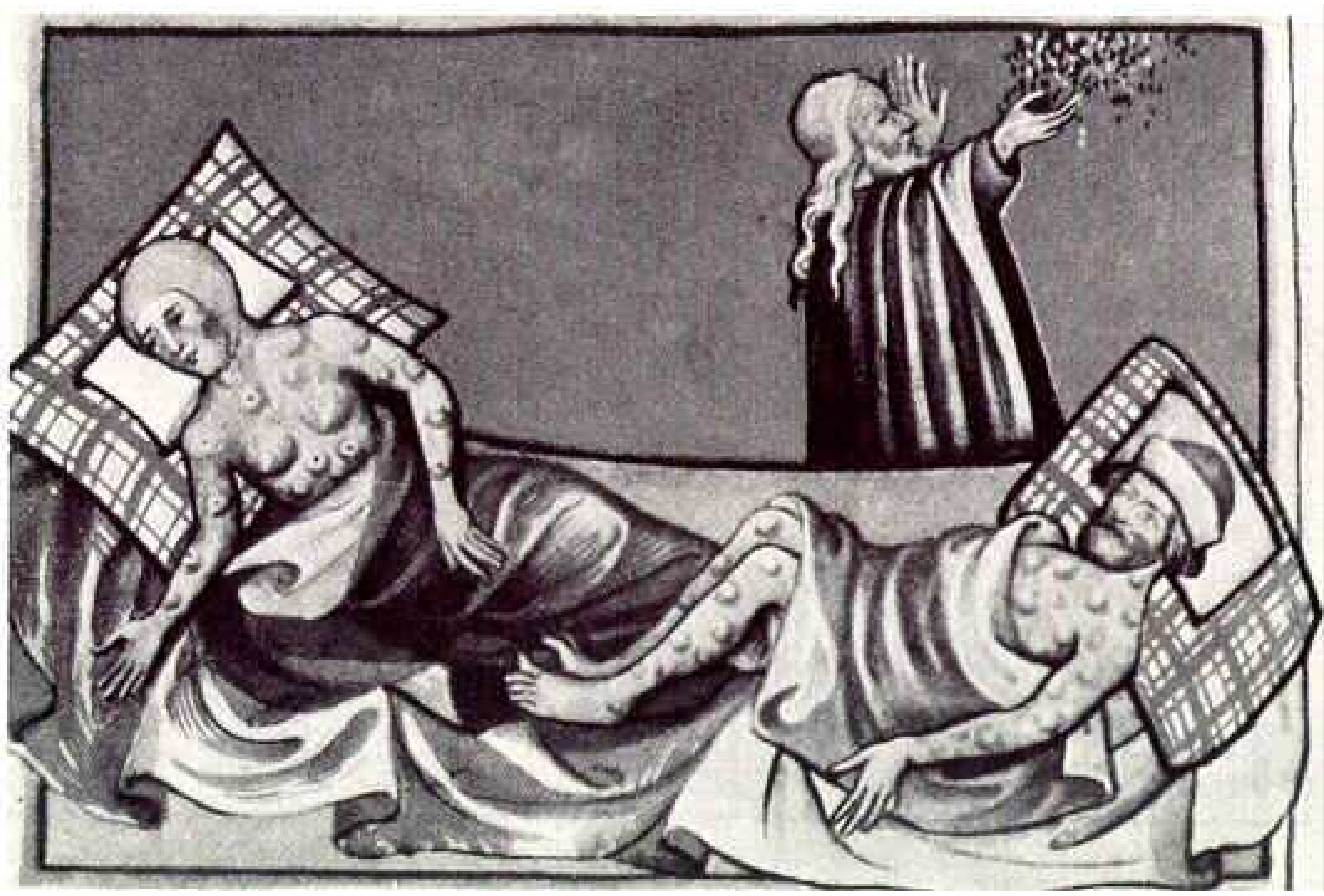
8. The Great Rome's drainage system. The waste was emptied into the openings on the sides of the streets connected with Roman Sewers. (Based on Macaulay, 1978 cited in Hansen, n.d.)

The last factor that, in my opinion, determined global water crisis is the emergence of waste water systems.

One of such examples, again, could be Roman Empire and its wastewater collection system Cloaca Maxima (fig. 7., 8.). This system, laid under the city of Rome, without any care or extra treatment was discharging all city's waste material into nearby existing Tiber River making it polluted (Hansen, n.d.). Therefore I dare to believe that such systems evolution without any doubt boosted the emergence of contemporary water crisis.

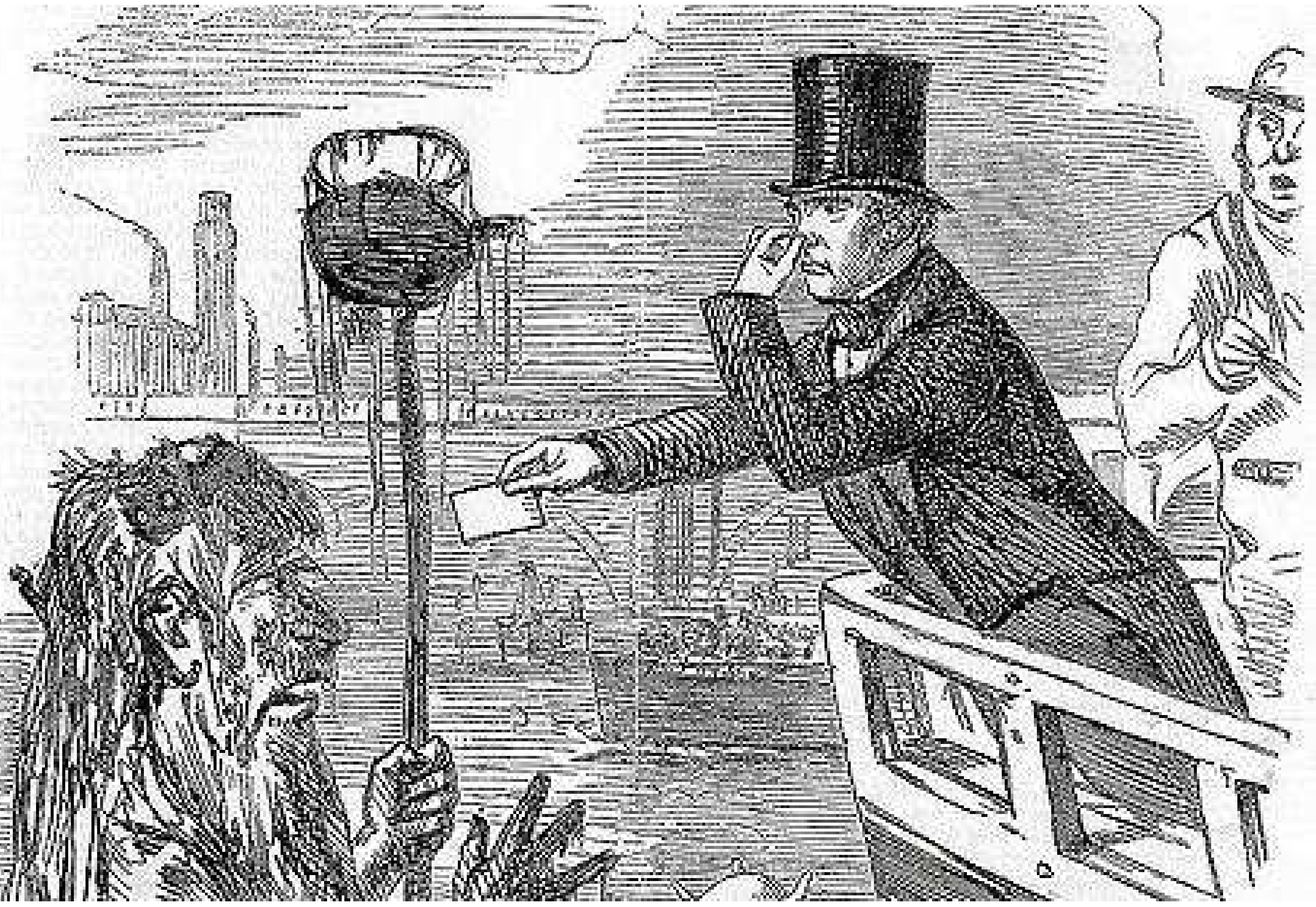
All these above mentioned historical factors, in my opinion, were the grounds of emerging water catastrophe, which at the same time had called many waterborne disasters throughout the planet and has mortified vast populations. The lead poisoning of water in the Roman Empire in 5th century (fig.9.), the Black Death plague in the 14th century (fig.10) and the Great London Stink in 19th century (fig.11) are just few historical examples that caused huge humankind-killing disasters due to water pollution and its miss-treatment.

10. The victims of the Black Death pandemic in 14th century Europe



9. Roman Empire aristocracy drinking wine from lead utensils.
Roman Banquet, Roman wall painting, from Herculaneum, 62-79 A.D., Archaeological Museum, Naples.

11. "Michael Faraday giving his card to father Themes" – a satiric image showing that the Themes water became a source of disease. A cartoon for satire magazine Punch, 1855.



However, such human misfortunes today don't end, contrary, they are increasing. But of what I can note that they have changed its form - from fatal accident (of unknown) they have turned into a (scientific and sometimes well-planed) environmental crime.

Such claim I could start to introduce with Rob Nixon's (2013) piece Slow Violence and the Environmentalism of the Poor and his concept of "Slow Violence" that stands for today's world environmental crises, environmental change and ignorance of the ones who suffers its tragic consequences.

In his book he aims to reveal an altered mode of environmental calamities that take place in 21st century and claims that today they are occurring due to political violence and economical phenomenon of neoliberalism. Contemporary capitalism driven transnational corporates often misevaluate vulnerable ecosystems and especially neglect human beings that are poor, powerless and silently suffer environmental noxiousness (Nixon, 2013).

I believe that all water related disasters that are happening in our era can be framed within Rob Nixon's term of "slow and political violence", as major contemporary water catastrophes are occurring due to negligent capitalism driven corporations' encounter with the environment. Today corporations' environmental crimes are resulting in pollution of rivers, lakes, oceans and ground waters.

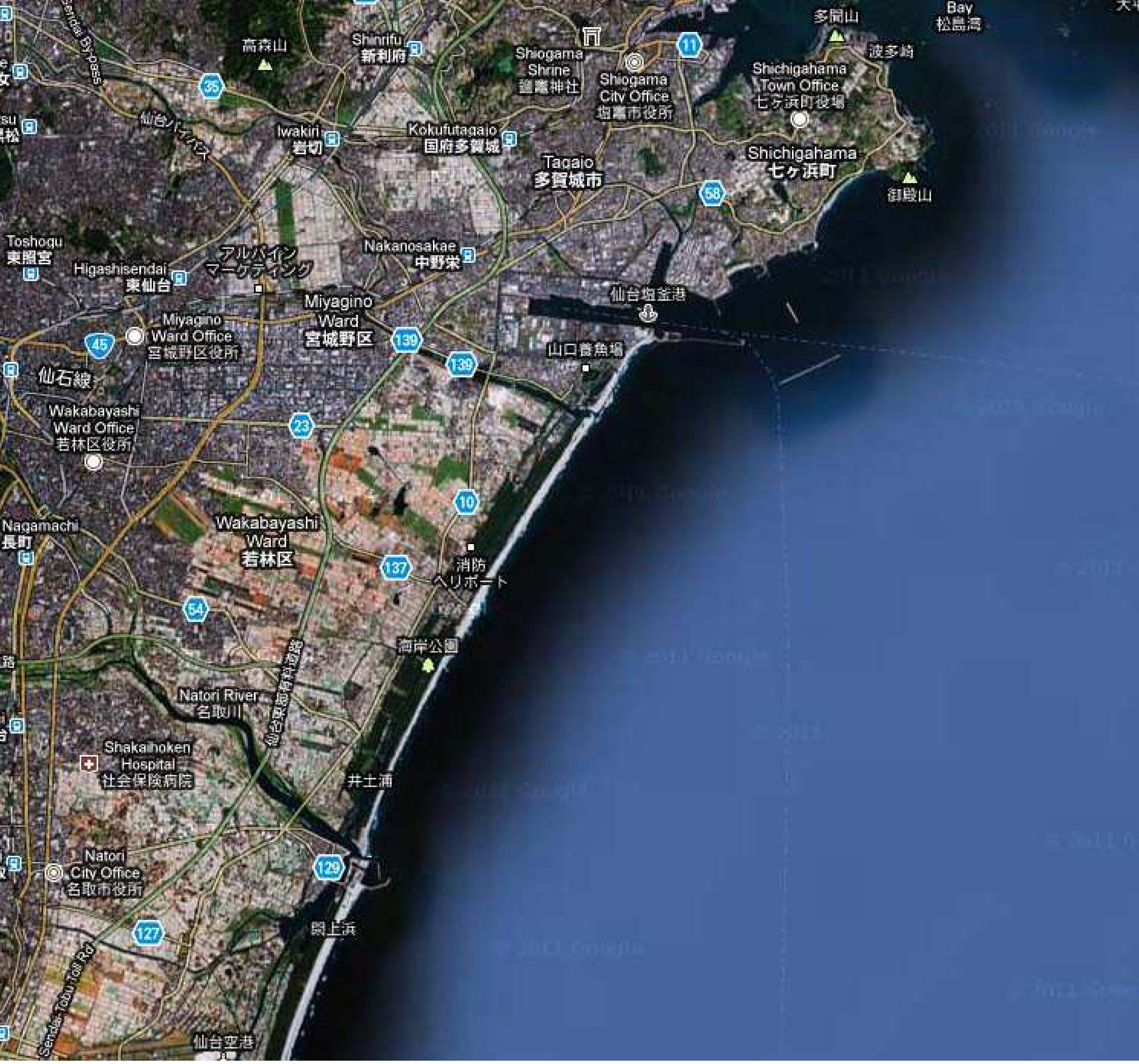
One of such example of my claim could be an environmental crime that has occurred in US in 2015 summer and has been committed by "The Gold King Mine" Corporation. Due to the spillage in the mine, The Animas and San Juan rivers waters in Navajo region has been highly contaminated with 3 million gallons of mine waste (Agrawal, 2015) (fig. 12.). This accident not only left the environment in toxic conditions for decades but also made a huge harm to poor farmers who used river waters for drinking and agriculture.

Similar spillages of chemical waste are hitting different parts of the world. For instance, in 2011, the spillage of chemical wastewater into rain sewer pipes completely polluted the Jianhe River in Luoyang in Henan province in China (fig. 13.) (Taylor, A., 2012). Romania also experienced such ecological disaster when a lake in Geamana, Rosia Montana has been contaminated by copper and gold mining waste residuals (fig. 14.). " [...] The village, church, houses and the cemetery of Geamana were totally flooded by toxic red water" (Palko, P., S., 2013). The village soon became abandoned (Amazing Places on Earth, 2015).

12. The Animas and San Juan rivers in Navajo region, US are suffering a natural disaster after the spill of 3 million gallons of mine waste in 2015

13. A journalist takes a sample of polluted red water from the Jianhe River in Luoyang, Henan province, China, 2011. (Taylor, A., 2012)

14. Lake contaminated by copper and gold mining waste residuals. Geamana, Rosia Montana, Romania has been



15. Large amounts of sewage unveiled after the great tsunami in Japan in 2011

Environmental violence perpetrated by huge corporations is not only polluting rivers and lakes but are also invisibly impoverishing global oceans. Such patterns of environmental crime were revealed on the Pacific Ocean shore bounding Japan. After it's devastation of huge 9.0 scale earthquake, followed by a tsunami in 2011, large amounts of strange black waters were detected (fig. 15.). As researchers claim, the black water color indicates a putrefying sewage that was accumulated on the ocean floors by humans for many years (Green Systems, 2012).

1.2 Water Crisis in Mexico City and its District Iztapalapa

With this chapter I would like to introduce my design context in Mexico City and its district Iztapalapa that I believe as well could be framed within lately mentioned Rob Nixon's term of "Slow Violence", as its indigent inhabitants are suffering from pure water deprivations due to multiple water related corporates' activities.

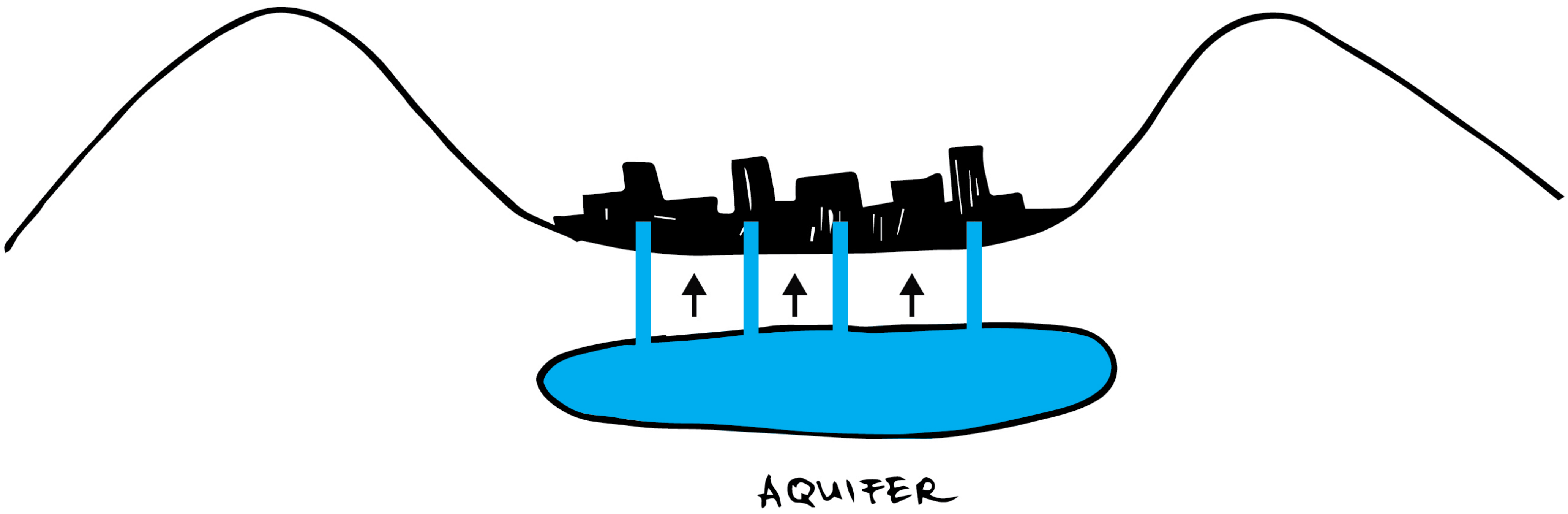
The objective of this investigation is to trace and understand the reasons and consequences of water scarcity in the area in order to develop a strategic design solution that can reduce or completely eliminate prevailing water shortages. My main research question here is: how pure and safe water can become socially available within the domestics of the ones who are suffering its scarcity?

So firstly, I am going to overview water crisis in Mexico City in general. Later, I will focus on its district Iztapalapa, that suffers the most of this crisis, and discuss its main water crisis issues and its consequences. Then, I will try to investigate the methods and initiatives of how local people are attempting to deal with such situation. Lastly, I will approach my design area - a neighborhood of Santa Cruz Meyehualco – and shortly describe its architectural condition.

Overexploited Aquifer and Sinking City

First of all, the aquifer, that lies below the city and that is used as a main water source to nourish city's population, is overexploited.

When City emerged on the Lake Texcoco in 1325 (fig. 16.), for its population survival, it was using spring water from nearby mountains. Later, in 1846, there were discovered pure water sources deep underground. Since that time hunted out underground aquifer became a main water target. Many deep water extracting wells were drilled to obtain this precious natural resource (fig. 17). As a result, from the 1930s, due to intensive drilling and massive water extraction ground waters started to shrink (Dumars et al.,1995).



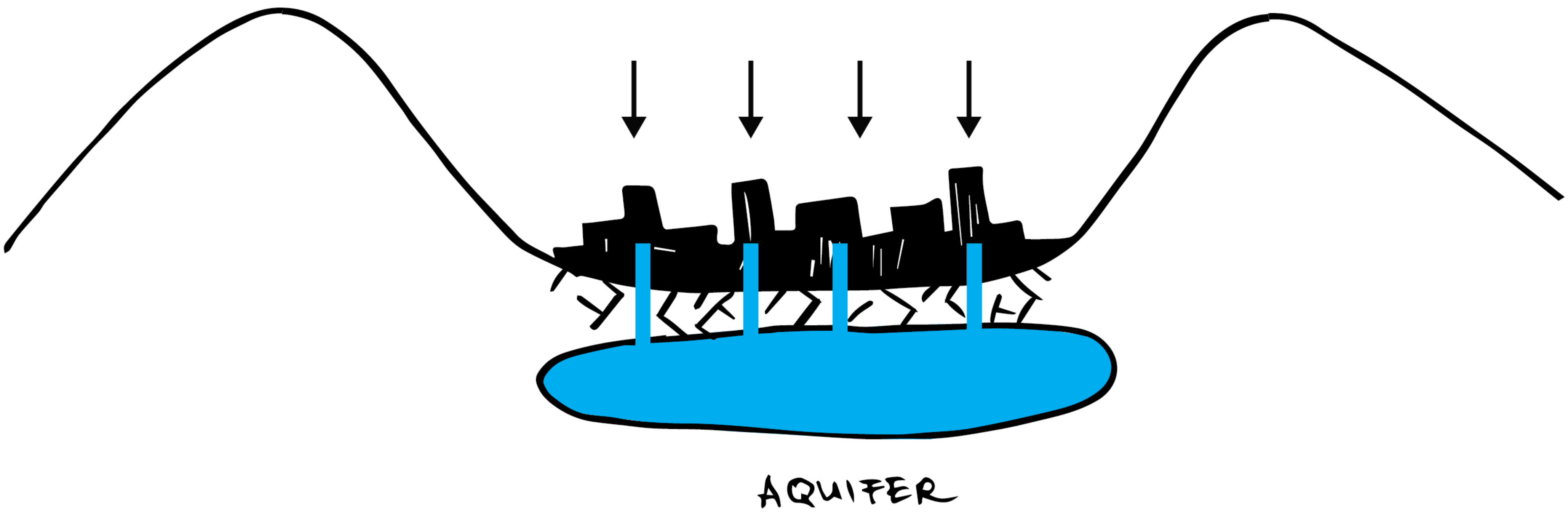
16. Aquifer in Mexico City

17. The ancient Mexico City Tenochtitlán and on the Lake Texcoco. Mural made by Diego Rivera

Today such excessive ground waters extraction from city's aquifers not only threatens population to remain without a drop of pure water but is also causing a city to sink (fig. 18.). Brooks Hays (2014) in his article claims: "As Mexico City continues to pull water from the aquifer below, its ground is sinking". He also adds that "some areas of the city are sinking as much as one inch per month".

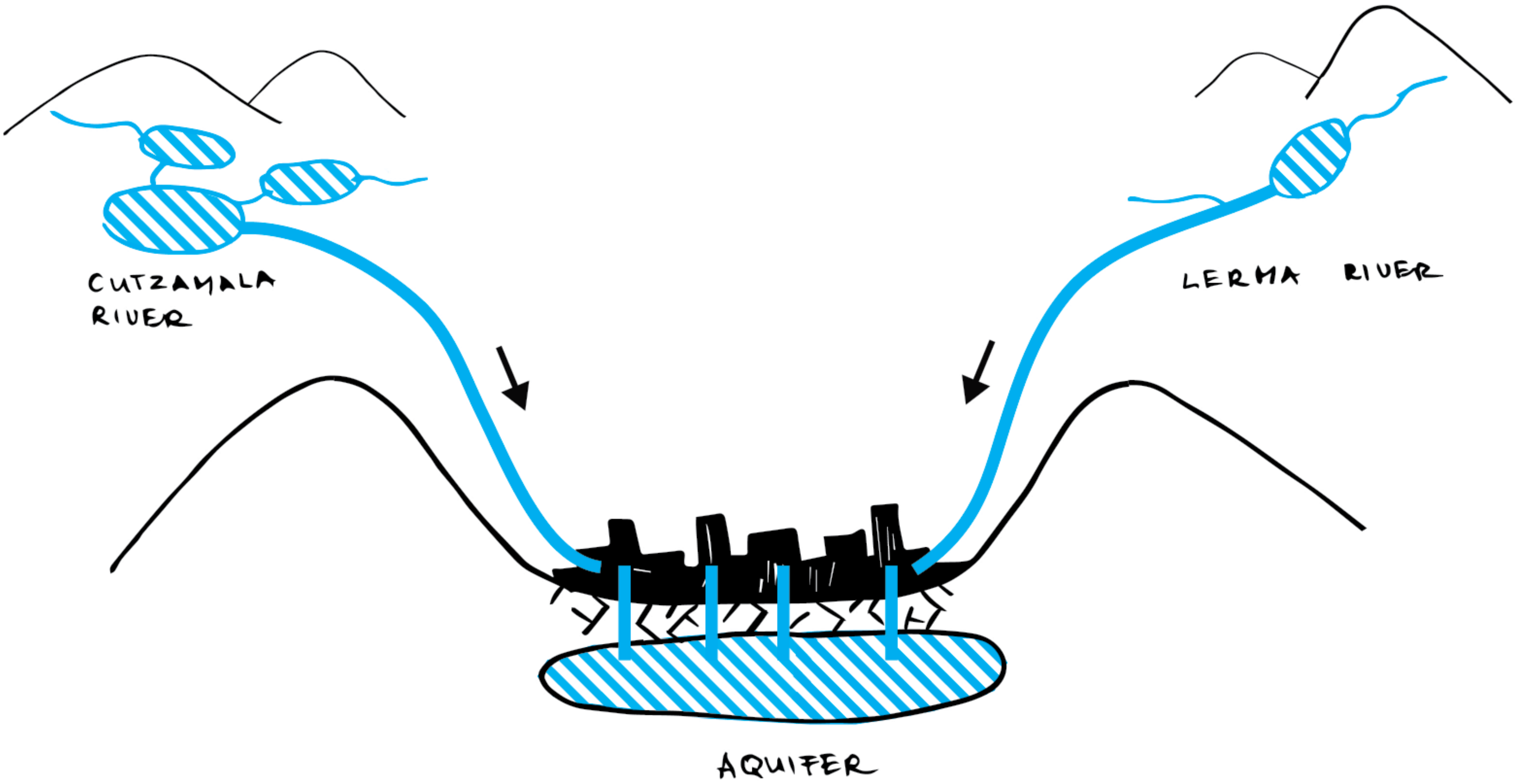
Moreover, sinking earth is causing land cracks. Such cases of cracking land were already registered in many places in Mexico and Mexico City. For instance, in 2011 the 1500 meters long crack was registered in Santa Maria Huejoculco in Chalco, State Mexico (fig. 19.) (Excelsior, 2011). Such cracks within a city not only put a risk on human's heath but also damage buildings and infrastructure (especially roads and water pipes) (Geo Mexico, 2011).

In conclusion overexploitation of aquifers in Mexico City is a serious issue complementing to water scarcity. It leads city to sink causing frequent earth-cracks and destroying water infrastructures.



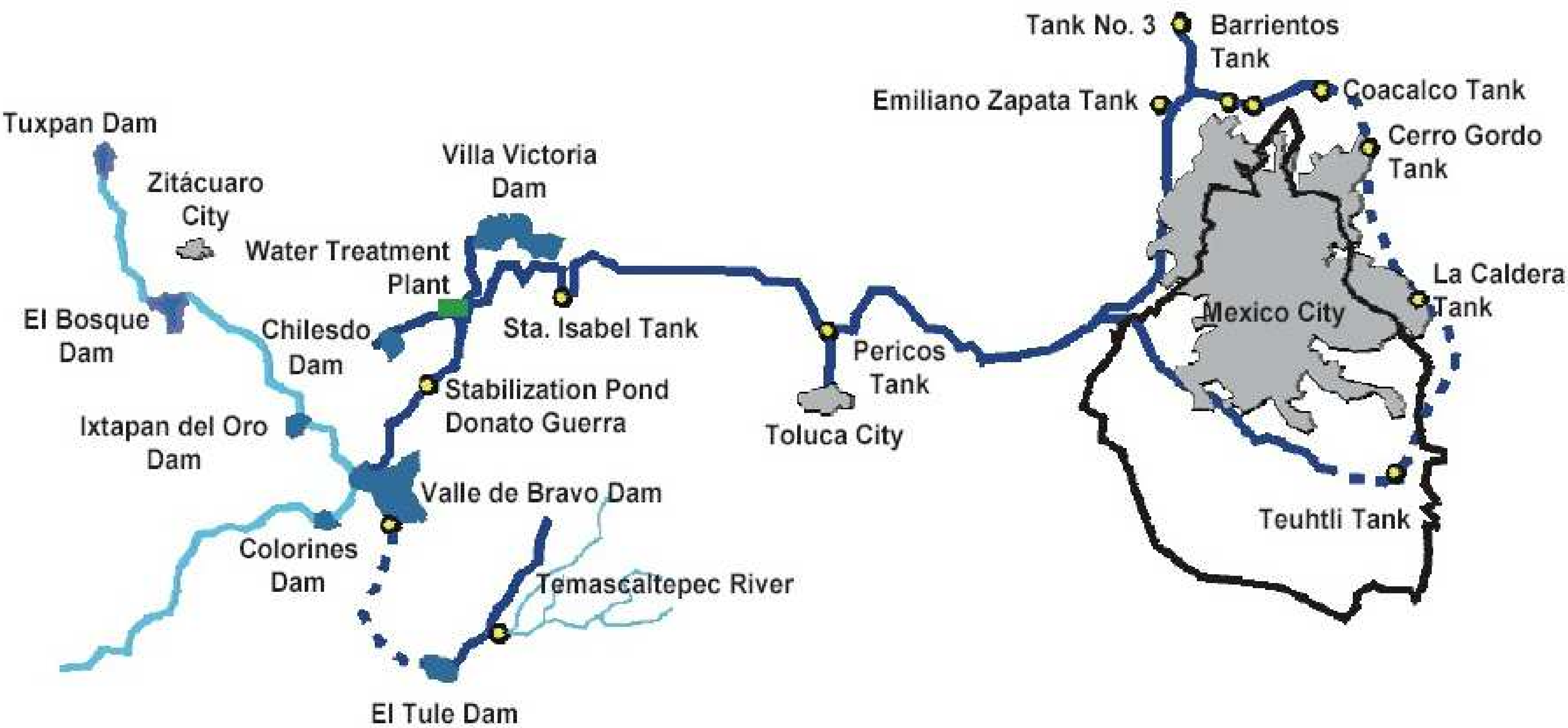
18. Cracking land in Mexico City

19. A huge land crack appeared in Santa Maria Huejoculco in Chalco, State Mexico in 2011



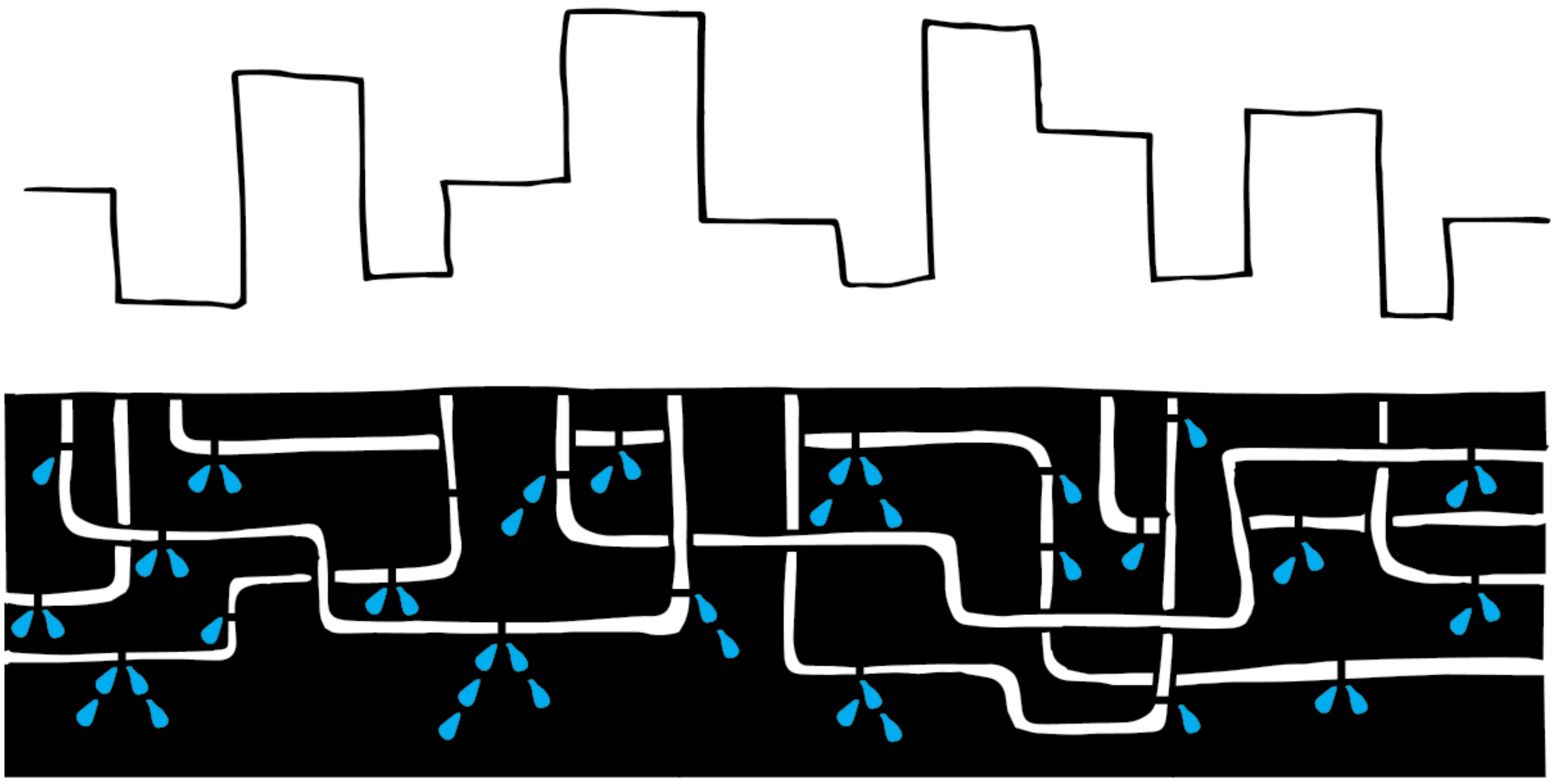
20. Mexico City's Cutzamala and Lerma Systems

21. Mexico City is transporting fresh rivers and dams waters situated on its western part



Mexico City's Cutzamala and Lerma Systems Cirsis

Due to overexploitation of the aquifer and still increasing demand of fresh water, new sources of this natural resource were needed. Such water targets became rivers and dams situated on the western part of Mexican Valley. Therefore two water transporting systems were devised to transport fresh water to the metropolis (fig. 20.): "Lerma system" completed in the middle of the 20th century started to transport from Lerma river and Cutzamala System, completed 30 years later , Started to bring waters from Cutzamala River (Barkin, 2014).
As a result, due to excessive these natural waters use, these systems today became also overexploited (Casey, 2009) (fig. 21). Therefore these water transportation systems responsible to nourish certain parts of a city are threatening people to thirst.



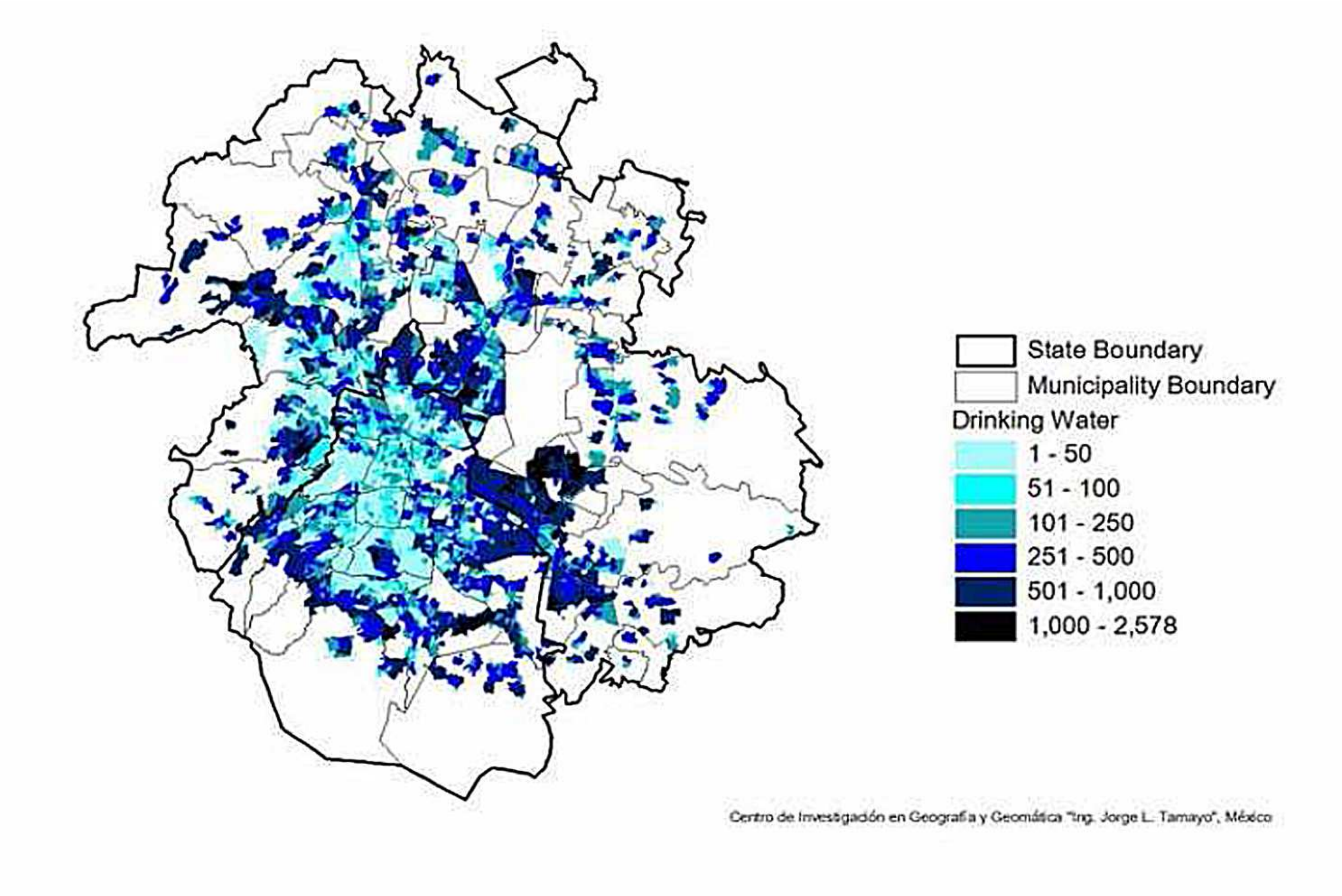
22. Leaks in Mexico City's Hydraulic System

23. Around 40 percent of pure water in Mexico City is lost through aging hydraulic infrastructure leaks

Mexico City's Hydraulic System's Crisis

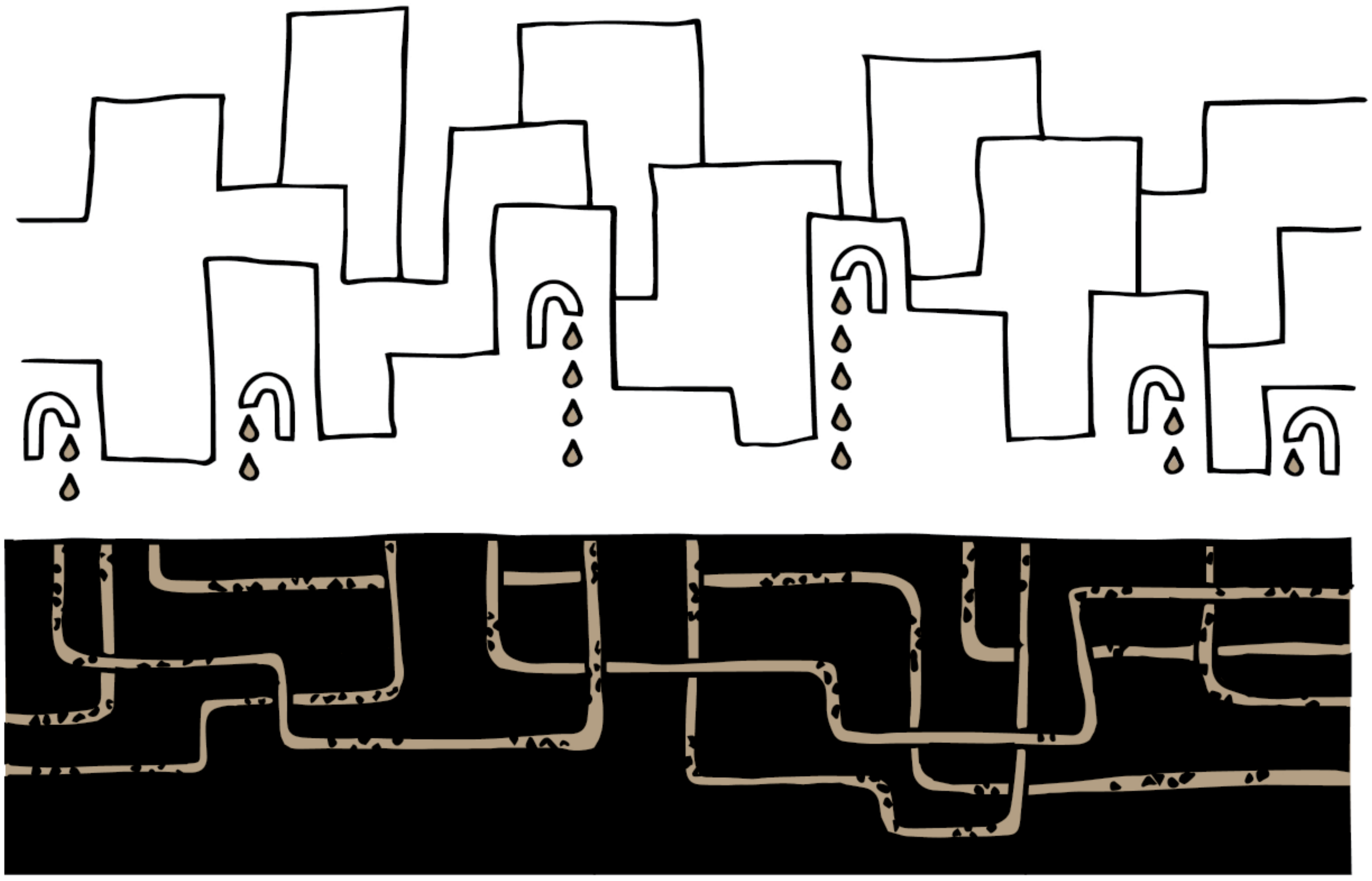
Another important factor determining water scarcity and its crisis in Mexico City is its hydraulic system which is in a disastrous state.

This system is more than 50 years old. That means that pipe systems are outdated and cause leakages (fig. 22.). Around 40 percent of pure water available for people is lost through hydraulic infrastructure which already completed its life cycle (fig. 23.) (Robles, 2011).



25. Diagram showing a number of houses which doesn't have domestic water supply

24. Rapidly growing Mexico City Metropolitan Area. Mexico City, waves of humanity, photograph taken by Pablo Lopez Luz



26. Pure water contamination in city's "aging water mains"

Additionally, it is important to note, that the population in Mexico City metropolitan area during the last 50 years has grown for around 6 times. From almost 3 million people in 1950 population boosted to almost 20 million in 2010. (fig. 24.) Therefore the hydraulic system, designed 50 years ago, cannot anymore accommodate properly expanding populations and their dwellings – many of the households don't even have running tap water inside (fig. 25) (Tortajada, 2006, p.8).

Moreover, getting back to the aging water infrastructure, the old pipes also contribute to pure water pollution that is running through them. Jesús Rebollo, a community activist of Mexico's district Iztapalapa, confirms that lately the effort has been put to improve the water systems establishing new water purifying plants, however he notes that despite this situation in fact doesn't get better. The pure water gets again contaminated in the city's "aging water mains" (Malkin, 2012) (fig. 26).

In conclusion Mexico City' hydraulic system crisis is a serious issue reducing pure water availability and increasing water shortages in the city.

Mexico City's Sewage System's Crisis

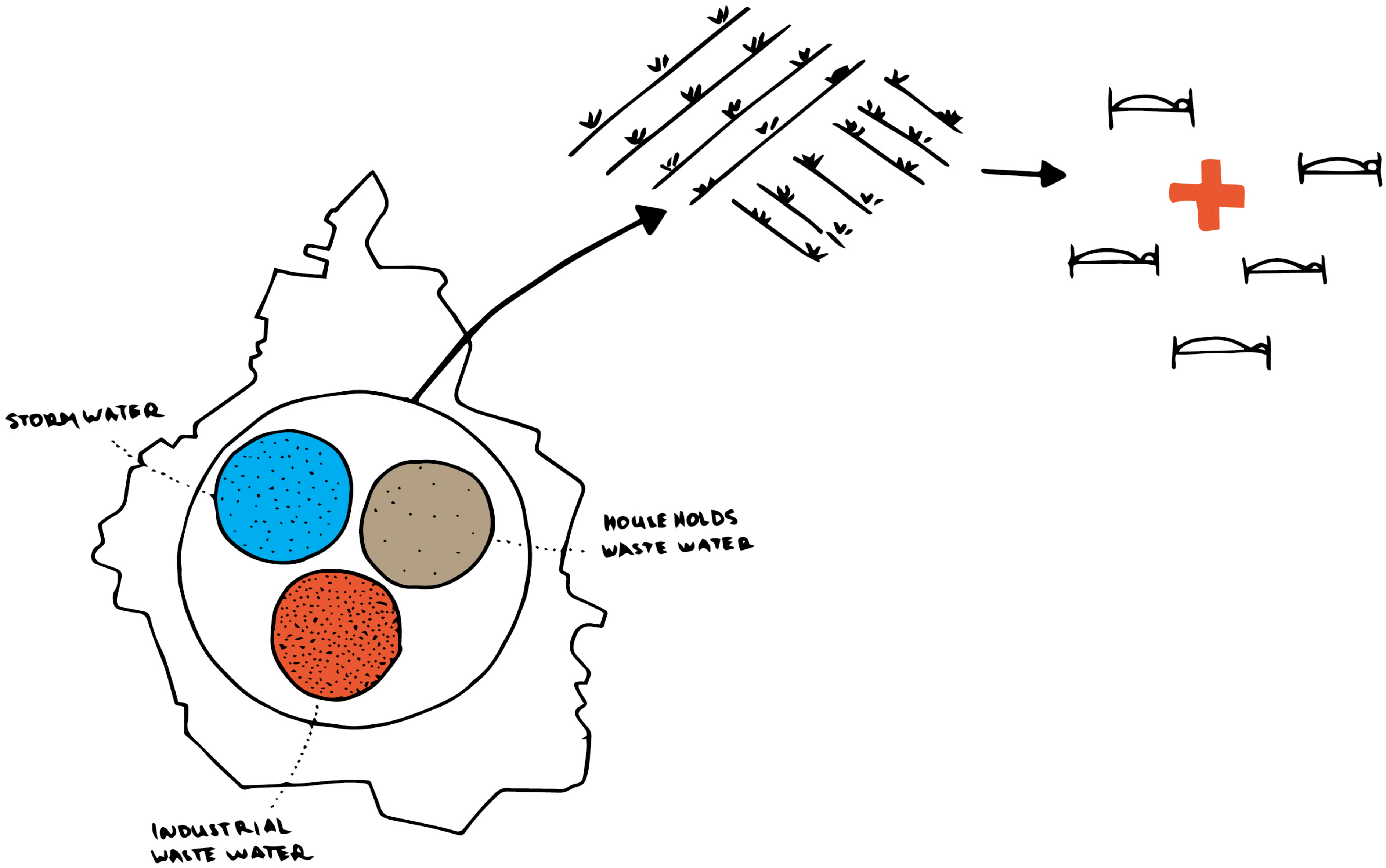
Another aspect that contributes to the water crisis in Mexico City is its sewage system.

Mexico City's sewage system is combined: it collects storm water, industrial and household's wastewater together. However, only 15 percent of this water is treated through waste water treatment plants. The rest 85 percent is mixed with each other and through the pipes and open canals discharged in the northern area in Mexico City (Zimring and Rathje, 2012, p. 537). This black water is used to irrigate agricultural lands and nurture the corps (fig. 27).

Indeed nutrients in the sewage "keep crop yields high" (Ibidem). However, enormous amount of untreated industrial and biological waste contained in sewage makes this water hazardous and puts at a risk everyone's health (fig. 28.). The documentary research *Aguas Negras* (translated to English: *Black Waters)* by visual journalist Janet Jerman (2010) perfectly illustrates this phenomenon. Here are portrayed a number of channels and rivers in the outskirts of Mexico that filled with human waste, various plastics and contaminating liquids.

Such virulent water used for crops irrigation is dangerous for plants, animals and humans, who consume these waters and yields fruits. As recent survey investigating children's health in an irrigation district of the Mezquital Valle in Mexico executed by Giovana Palacios (2000) showed that "children from households irrigating with untreated wastewater [...] had a 33% higher risk of diarrhoeal diseases [...] compared to children from the areas farming with rainfall."

Therefore improper sewage system in Mexico City is causing many health problems for individuals who are using its waters to irrigate fields.



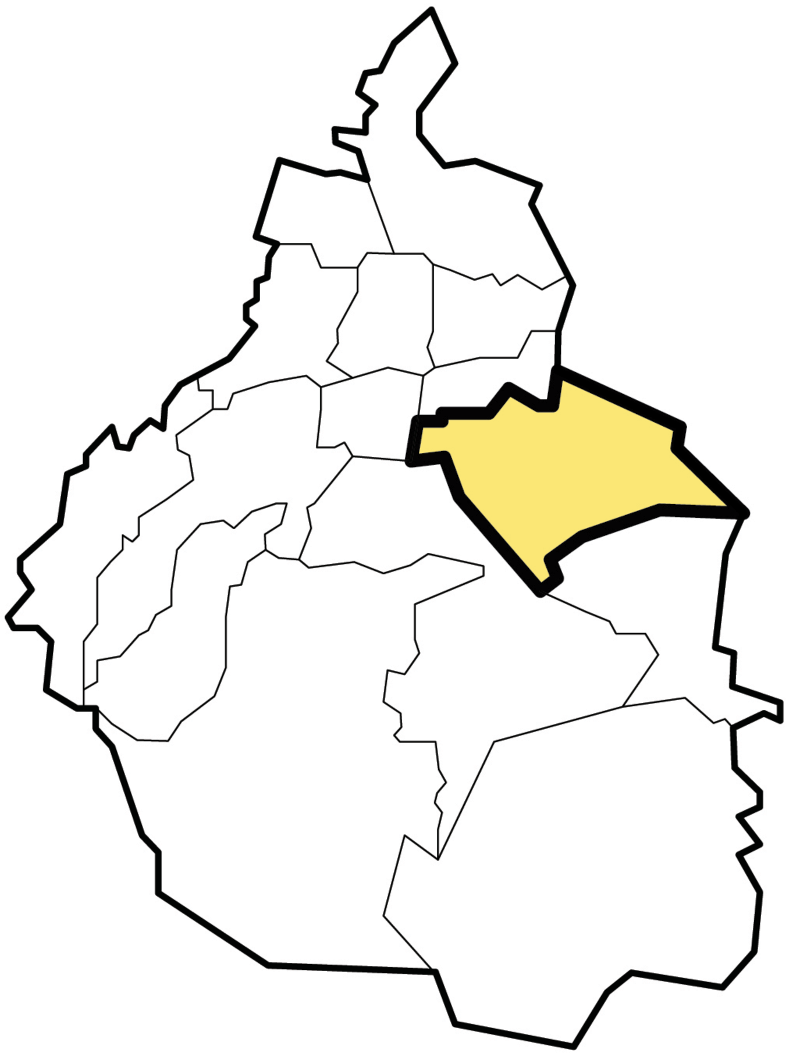
27. Mexico City's Sewage System's Crisis scheme

28. Mexico City's black waters discharge

Water Disaster in Iztapalapa District

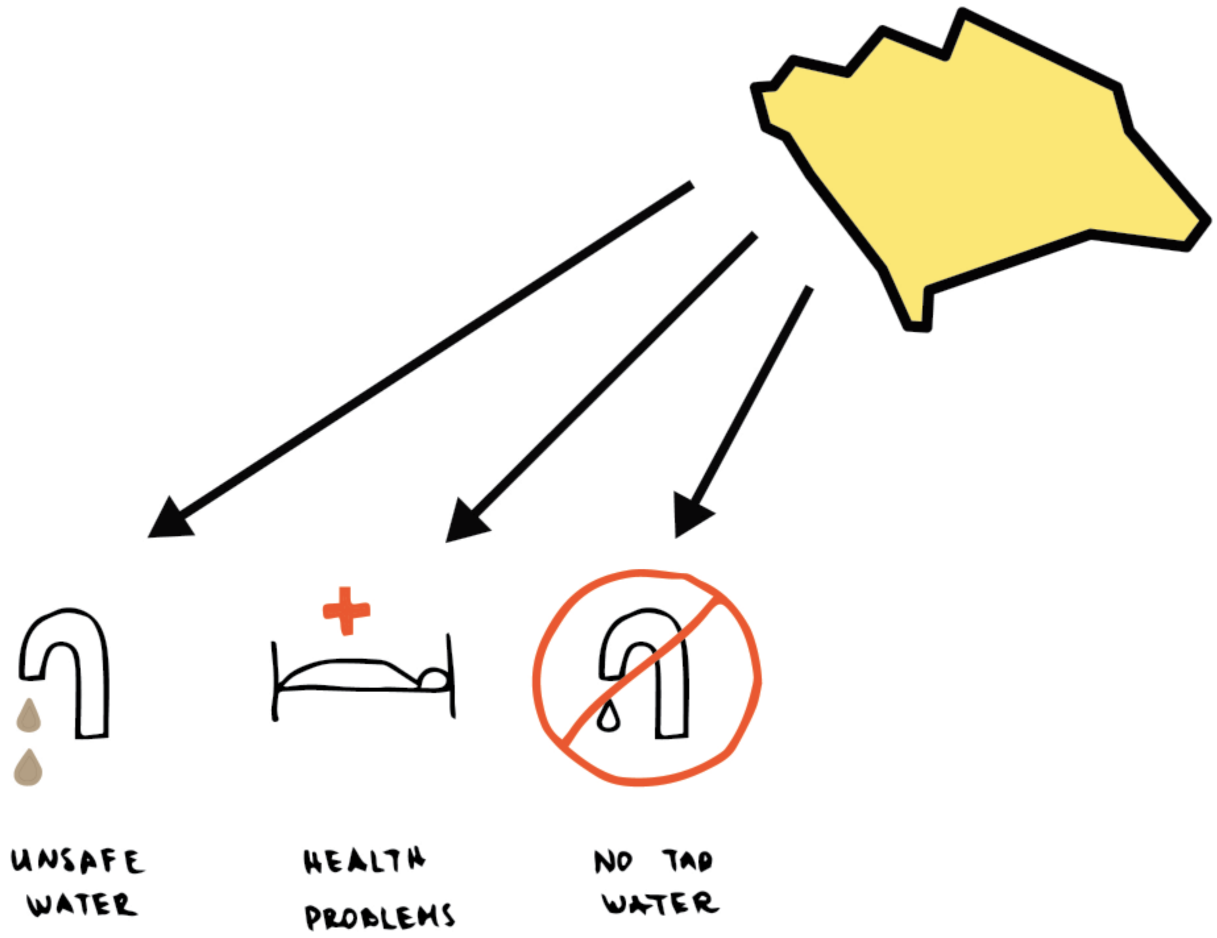
With the following I will discuss main water scarcity issues and its consequences of a more specific area of Mexico City - Iztapalapa , that suffers the most of this crisis (fig. 29).

Iztapalapa is the eastern area in Mexico City containing 1.8 million inhabitants. It is one of the poorest and most densely populated sections of the city that suffers from water crisis and its consequences in multiple ways (fig. 30).



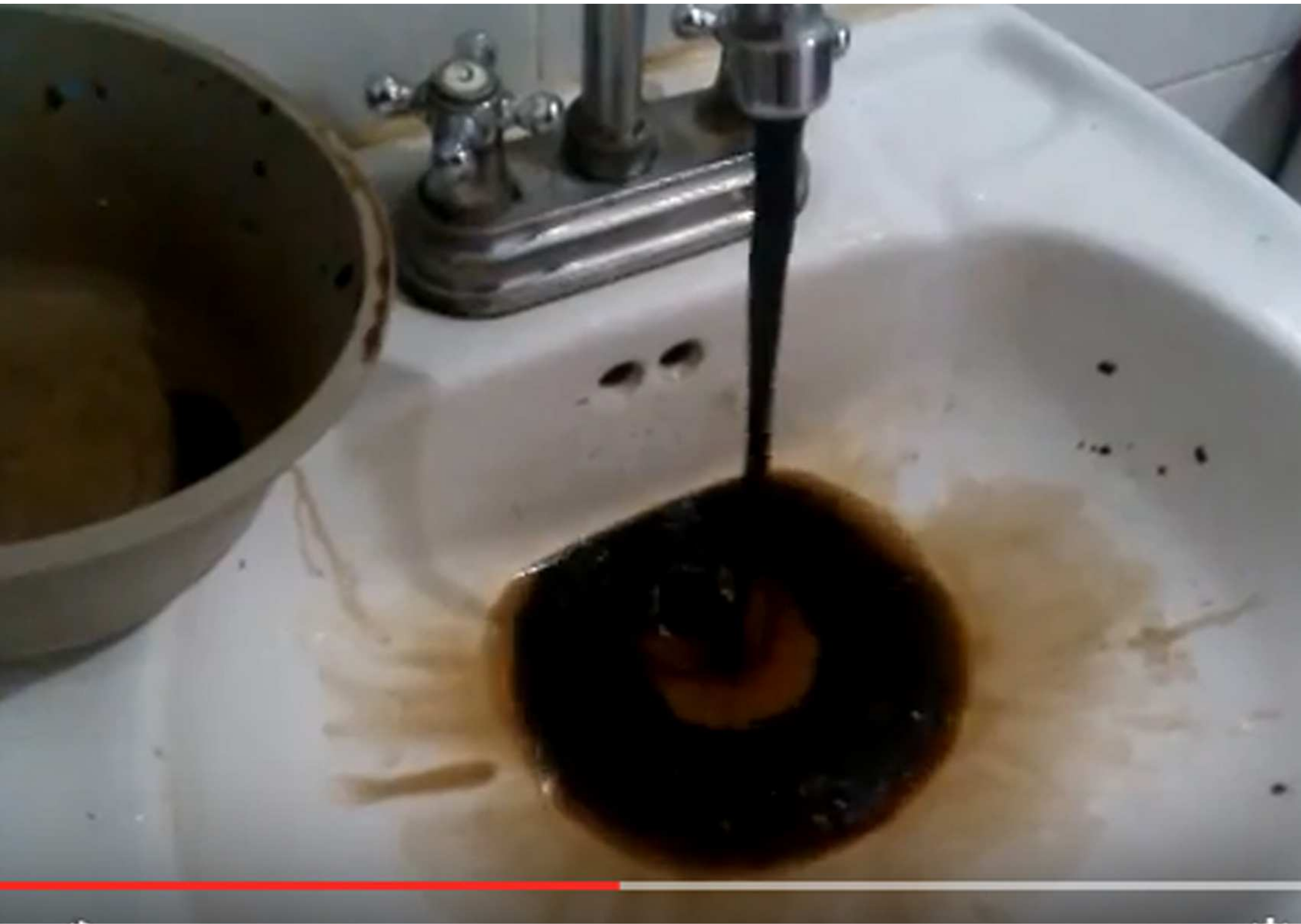
29. Mexico City and it's district Iztapalapa

30. Iztapalapa district, Metropolitan Mexico City Area



32. Iztapalapa and it's water problems scheme

31. A domestic horror in Iztapalapa: black color water is running from drinking water taps



However, such human misfortunes today don't end, contrary, they are increasing. But of what I can note that they have changed its form - from fatal accident (of unknown) they have turned into a (scientific and sometimes well-planed) environmental crime.

Firstly, domestic tap water is always discursive. Due to improper hydraulic systems "in Iztapalapa [...], talk of tap water is a constant — whether there is any, how it smells, what color it is, or whether it carries sand, mud or unspecified insect life" (Malkin, 2012). The domiciles of the district are more frequently encountering unsafe water running from their taps. The video named *Aguan Sucia Iztapalapa* (translated in English: *Dirty Waters in Iztapalapa*) presented in Youtube by its member "affray" (2014) clearly shows this phenomenon (fig. 31.). Here is portrayed a domestic horror: black color water is running from the drinking water taps. Additionally to this, water supply gets often shut leaving people without any water (Geo Mexico, 2015). Due to such accidents the quality of tap water and its availability is always uncertain. That increase community's lack of confidence on water supplies.

The use of such uncertain water might cause intestinal diseases, leading many people to die. As Fabiola S. Sosa-Rodriguez (2012) in her scholarly work states, "In 2007, the Ministry of Health in Mexico City registered 280 deaths due to intestinal infectious diseases", such as diarrhea, gastroenteritis and others. Due to already discussed poor water quality events, probably it is not surprising that Fabiola through her research notes that "the largest number of deaths cause by intestinal infectious diseases occurred southeast of the city, and the borough most affected by these diseases was Iztapalapa".

Besides, tap water absence events or its contamination affecting peoples' health, another factor that contributes to water shortage in Iztapalapa is the overall lack of piped water at human domiciles. As the blog Geo Mexico (2015) reports, "72 000 residents in Iztapalapa lack piped water supply to their homes" (fig. 32).

Being overpopulated and indigent this part of area gets least attention to such causes. Here people are forced to slowly suffer the consequences of the water crisis that embraced the city. Due to that, again, I can title this phenomenon with a term of a "Slow Violence" that was already introduced in chapter 2.1. As well, such condition I could compare to the case of arsenic poisoning in Bangladesh that Peter J. Atkins and others (2006) in his research paper framed with the term of the "Toxic Torts". Such insensible poison found in tubwells drilled for the poor in order to obtain pure water slowly killed vast populations in Bangladesh. I really believe that such discursive water condition in Iztapalapa is a legal tort.

Current Attempts to Resolve Water Crisis in Iztapalapa

With the following, I will investigate initiatives and methods of how locals are attempting to deal with the disastrous water situation that was just described previously.

By doing so, I am expecting to get a better understanding of what people really need and get a hint of how these needs could be fulfilled with my design project.

Firstly, unenviable water conditions are forcing masses to search for the water outside the city. For instance, David Montero, a resident of Iztapalapa is driving three hours every week from his apartment to the village where he was born to fill five five-gallon jugs with clean water (Lazaro, 2014).

Others, who can't escape the city, are forced to buy bottled water (fig. 33.). Some families sometimes are compelled to spend more than 10 percent of their incomes on water. For many poor people that is a way too big expense (Lazaro, 2014). Here I would like to add that, huge corporate companies such as "Nestle" and "Coca-Cola" are taking the advantage of such situations of the poor and are trying to flourish their business selling water and other bottled drinks. As a result, for instance today, "Mexico is the number one consumer of Coca-Cola in the world" (SMI Group, 2008).

The great 'helping hand' for an area, suffering from polluted water events, is water trucks, provided by city's government that every day distributes pure water to people in Iztapalapa (fig. 34.). However, they cannot provide water to everybody and as some people report, they are often too late. . Moreover, such water supply system is quite expensive (Lazaro, 2014).

In Iztapalapa district, people, searching for pure water, sometimes approach some "inventive" methods, such as constructing their own water purifying plants. For instance, a resident of Iztapalapa - Maximiliano Santiago - has established his own water purification business. As it seems, he had built a quite primitive filter, which consists of carbon, gravel and sand (Malkin, 2012).

Mr. Khush, a water manager in Mexico, who had noticed Maximiliano Santiago's effort to purify water, gives an important note:

What's fascinating to me is that this is the solution that local businesses have come up with. [...]This is what people want, and I think we should learn from them.
(citted in Malkin, 2012)

Besides local people efforts, there are some professionals who try to deal with the situation. One of them is a young industrial designer, engineer and entrepreneur Enrique Lomnitz, who claims that a great method to provide area with pure water is rain water harvesting:

I think if all of the buildings were harvesting rainwater, I think we'd be talking about at least something like 30 percent of the city's water needs could be coming from rainwater harvesting.

This part of the city gets very high rainfall. It gets up to 1,500 millimeters. So a house [...] which [...] has 240 meters of roof [...] is about enough for two low-income families to go all year.
(Lomnitz, E. citted in Lazaro, 2014)

Following his thoughts, E. Lomnitz launched his own business that installs rainwater collection and storage systems. However, his systems priced 1000 dollars per installation are just not affordable for many low-income families (Ibidem).

Besides high cost of his systems, what I I found fascinating about E. Lomnitz activity, is not that he only suggests rain harvesting systems to locals, but also that he makes an effort to educate society. He is organizing community's gatherings and training people to install these systems by themselves in order to become primitive water engineers (Cohen, 2013).

Another method to deal with water crisis, which was suggested by city's officeholders, is reducing water consumption. For instance Mexico City's mayor Marcelo Ebrard went on television and encouraged everyone to limit showers to four minutes (Casey, 2009). Other officer, Ramón Aguirre Díaz, declared that a successful way to undergo the crisis could be reducing water consumption by 30 percent (Geo Mexico, 2013).

33.. Right above: Bottled water consumption in Iztapalapa

34. Right bottom: IIztapalapa residents refilling their water tanks with free portable water provided by water trucks


NCOS VAZQUEZ
ALQUILADORA
SILLAS
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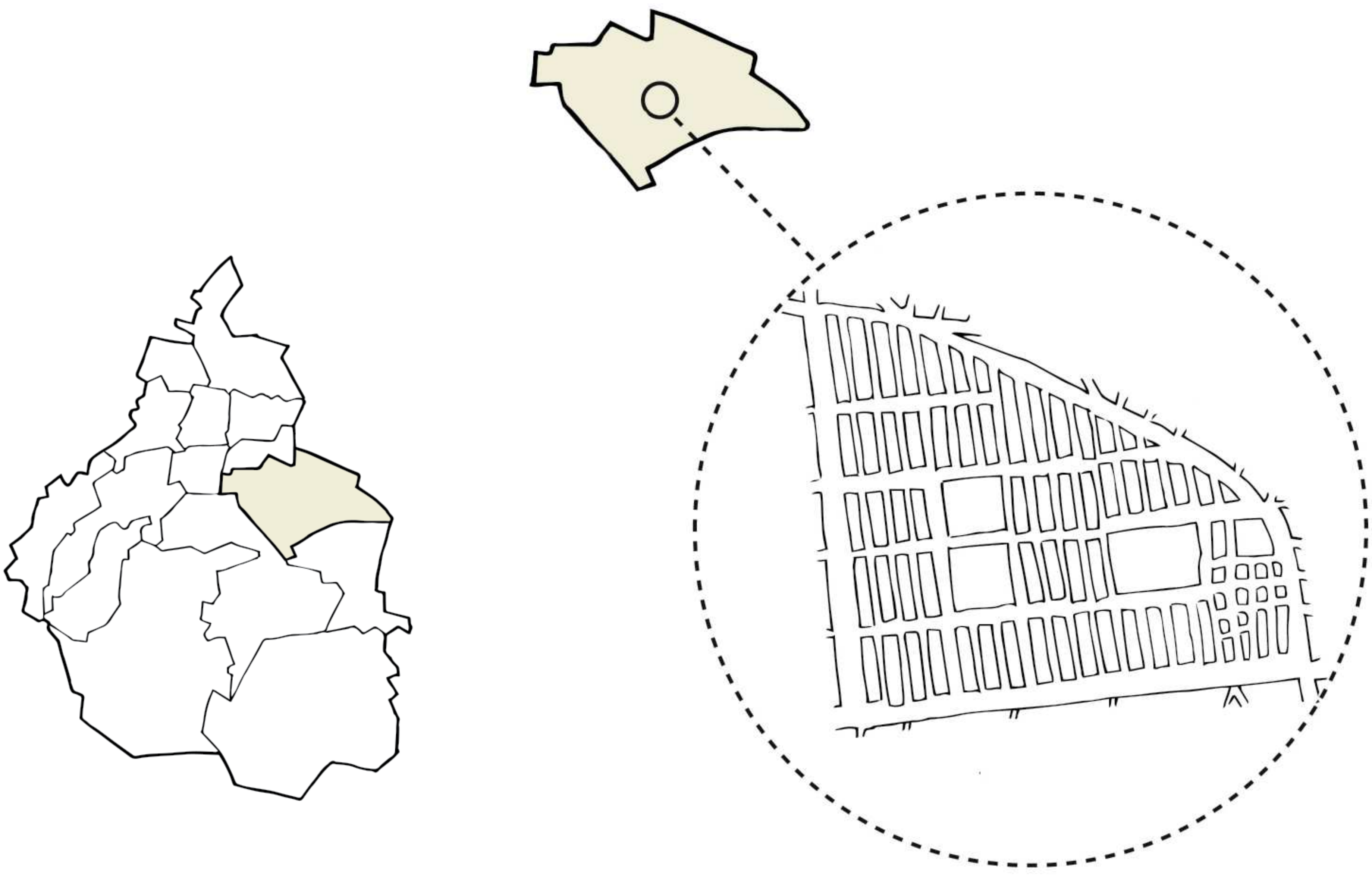
LONAS


AGUA POTABLE GRATUITA

Design Location –a neighborhood of Santa Cruz Meyehualco

In order implement my humanitarian design project, I have chosen a specific location - a neighborhood of Santa Cruz Meyehualco – situated in Iztapalapa district (fig. 35). So, with the following, I am going shortly describe the area and its architectural condition.

A small residential 'village' Santa Cruz Meyehualco, to the locals known as 'Unidad Habitacional Santa Cruz Meyehualco', was designed and completed in 1963 by two Mexican architects Gilberto Valenzuela y Jorge Rojas. The aim of this project was to provide individual family housing for rapidly growing Mexico City's populations at that time. It consisted of a number of identical and repetitive and housing blocks that contained single family dwellings (fig. 36.).

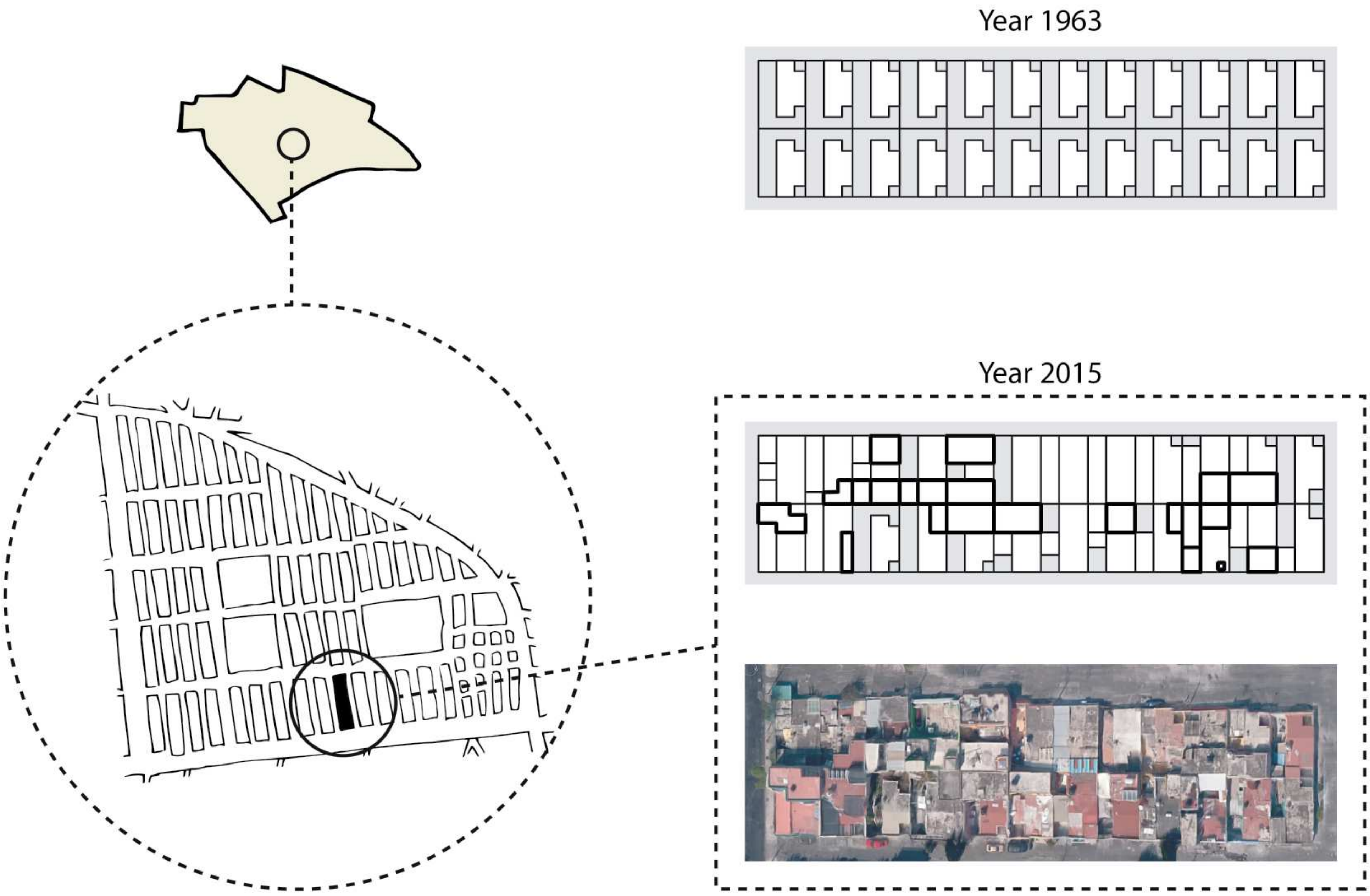


35. Santa Cruz Meyehualco , Iztapalapa

36. "Unidad Habitacional Santa Cruz Meyehualco" in 1963

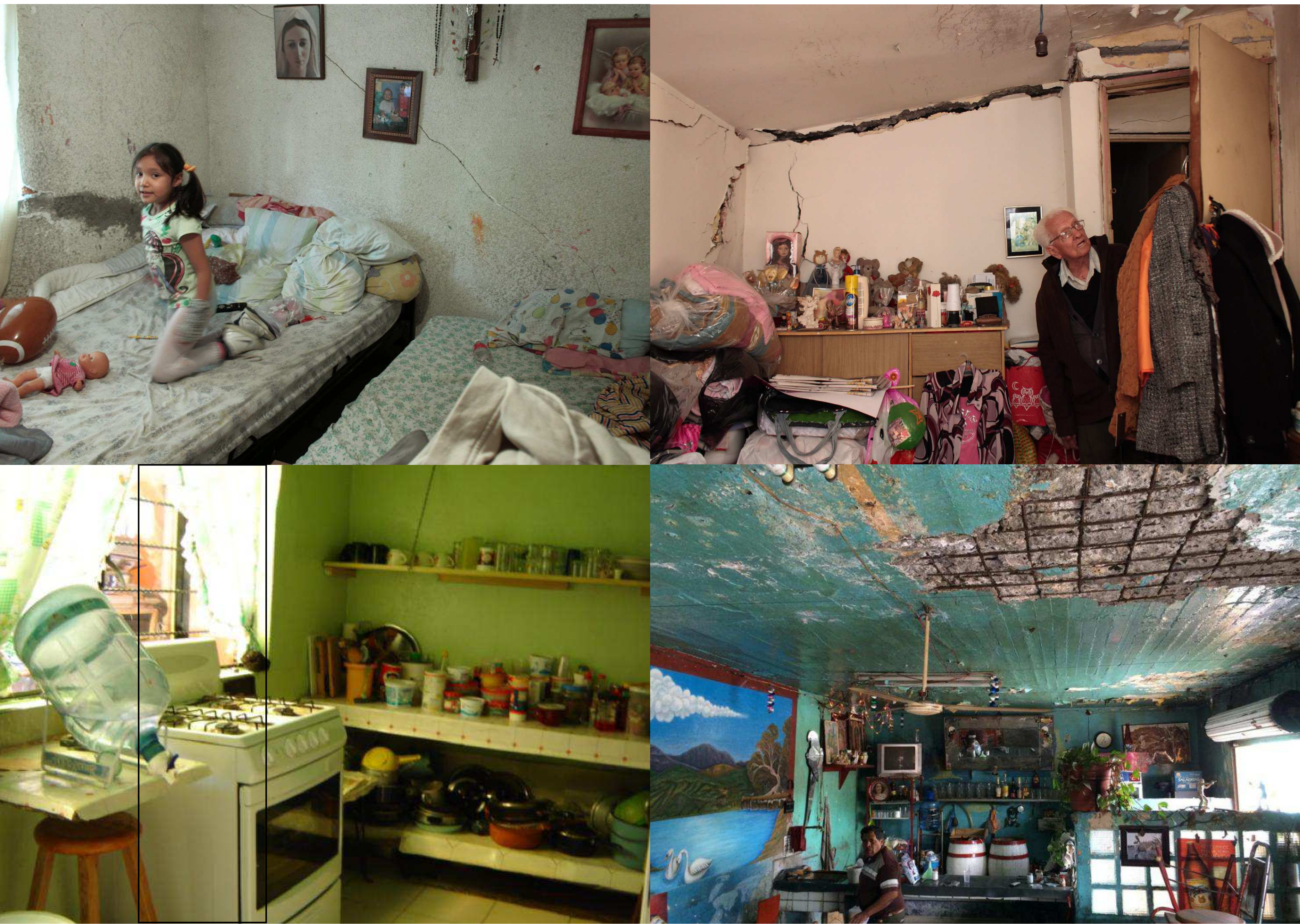
However, today the picture of this area is dramatically different. Continuing to grow Mexican populations exceeded the amount of available houses. Therefore, local people started to extend their inhabitable space bulling over existing dwellings (fig. 37.),. My comparative analysis of a same block in past and today shows that its structure with a time has altered significantly (fig. 38.). I can assume that the inhabitable area in every dwelling of Santa Cruz Meyehualco since the year1963 has been doubled. Such pragmatic development in the area resulted into irrational though practical and playful picture of the neighborhood that today inhabits one of the poorest parts of the city (fig. 39).

37. Santa Cruz Meyehualco .Arial view



38. Scheme showing pragmatic urban growth Santa Cruz Meyehualco, Iztapalapa

39. Interiors at Santa Cruz Meyehualco households



40. Housing block plans in Santa Cruz Meyehualco, Iztapalapa. Ground and first floor

Chapter 2.

Design Research

With the following, I am going to present my design research with which I am aiming to develop a pure water generation system inside the dwellings of a poor residential neighborhood of Santa Cruz Meyehualco. Additionally, I am aiming to develop a set of new "water treatment gadgets" and a new "bathroom" typology that would help people to treat and maintain pure water resources in previously described catastrophic situation.

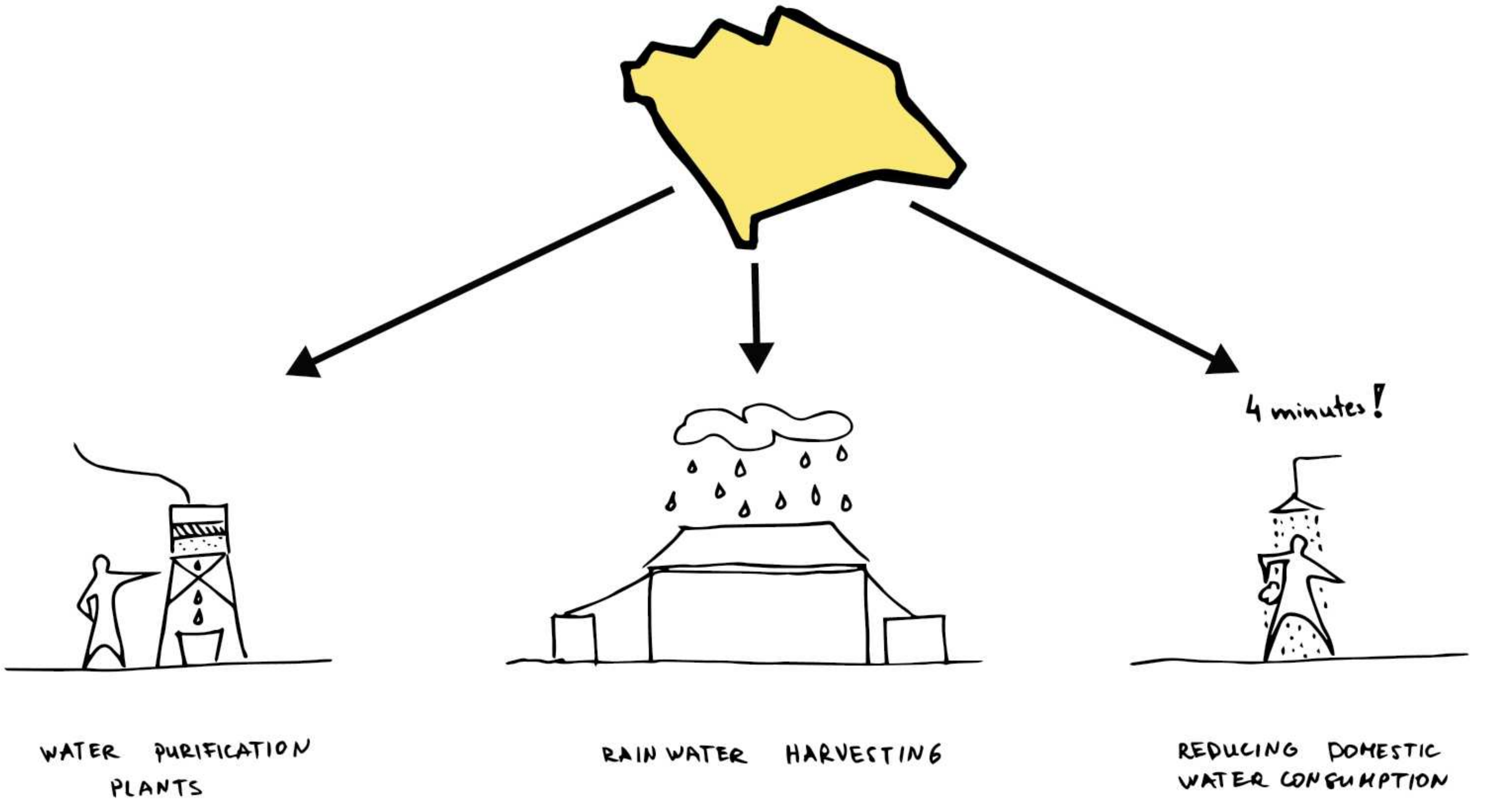
Therefore, to achieve this, as a starting point I took in consideration tree techniques, discovered in a previous chapter, that I think could be developed further in order to obtain and maintain pure water resources within an area. These techniques, that local people of the neighborhood are initiating or are urged to do, are as follows: construction of individual water purifying plants, development rain water harvesting systems and reduction of domestic water consumption (fig. 41).

Following such logic, I have drawn a simple scheme that illustrates my design goal (fig.42). First part of it shows the aim to develop a pure water generation system purifying and harvesting rain water. The second part is aiming to re-think domestic water treatment methods and re-solve water related appliances in order to reduce domestic water consumption and foster its re-use.

As my project is dedicated for poor families with low-income, one of the main criteria of investigation is a research of simple, in-expensive techniques that people could afford to buy or do themselves.

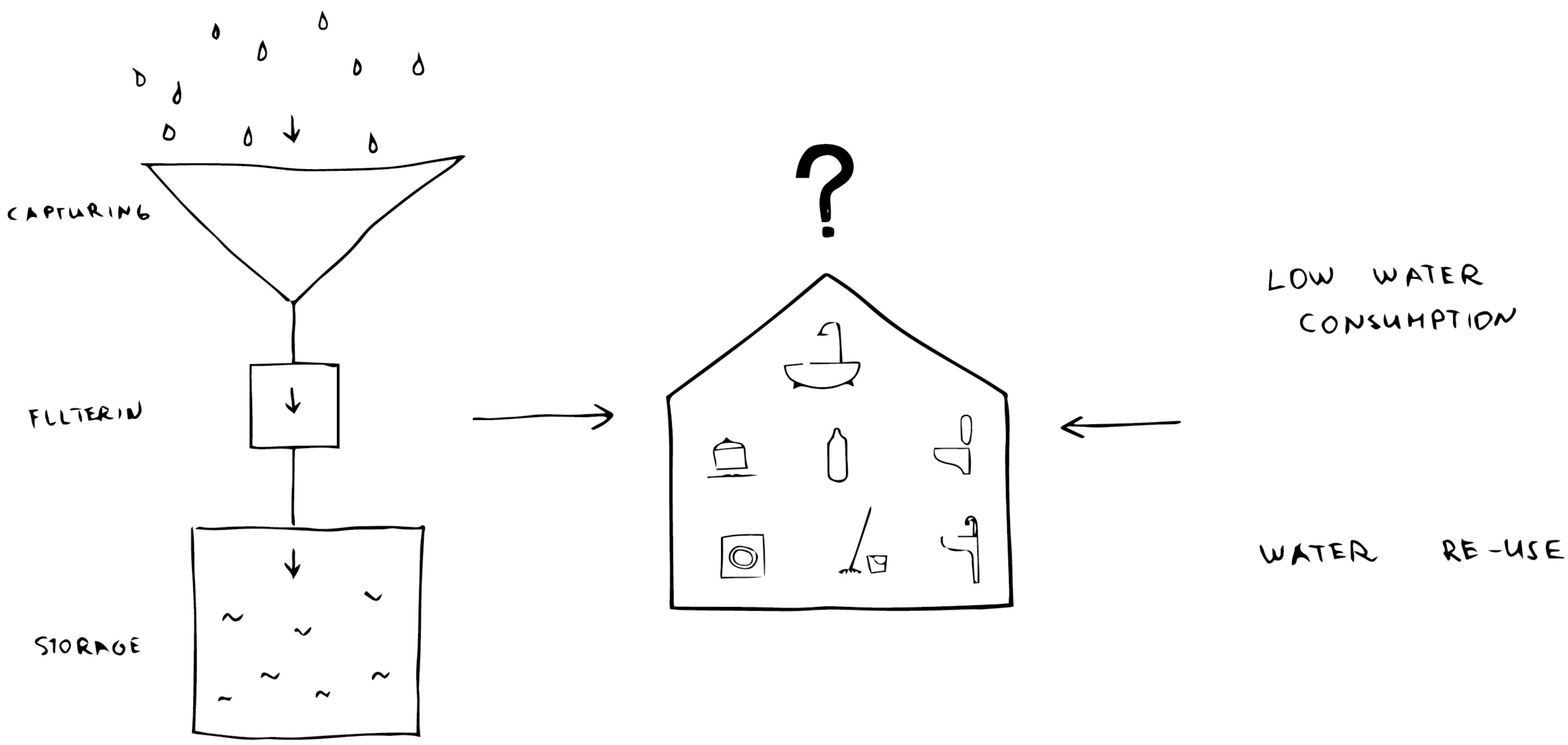
So following my scheme in the first part of this chapter I will aim to discover how to create a rainwater harvesting system. In order to do so, I will investigate ingenious methods and techniques of how rain water could be captured, stored and purified.

In the second part of this chapter I will examine various domestic water related appliances and try to research simple methods and techniques how they can use less or re-use the water.



41. Locals' innitiatives to deal with water crisis in Santa Cruz Meyehualco, Iztapalapa

42. Design goal scheme



2.1 Rain Water Capturing Methods

Rainwater Capturing with Gutters

One of the most well-known ways to obtain rain water is to capture it from buildings roofs by applying water channeling tubes, called gutters, which directs it to water storage tanks. Considering that, I was looking for simple homemade techniques to design such channels.

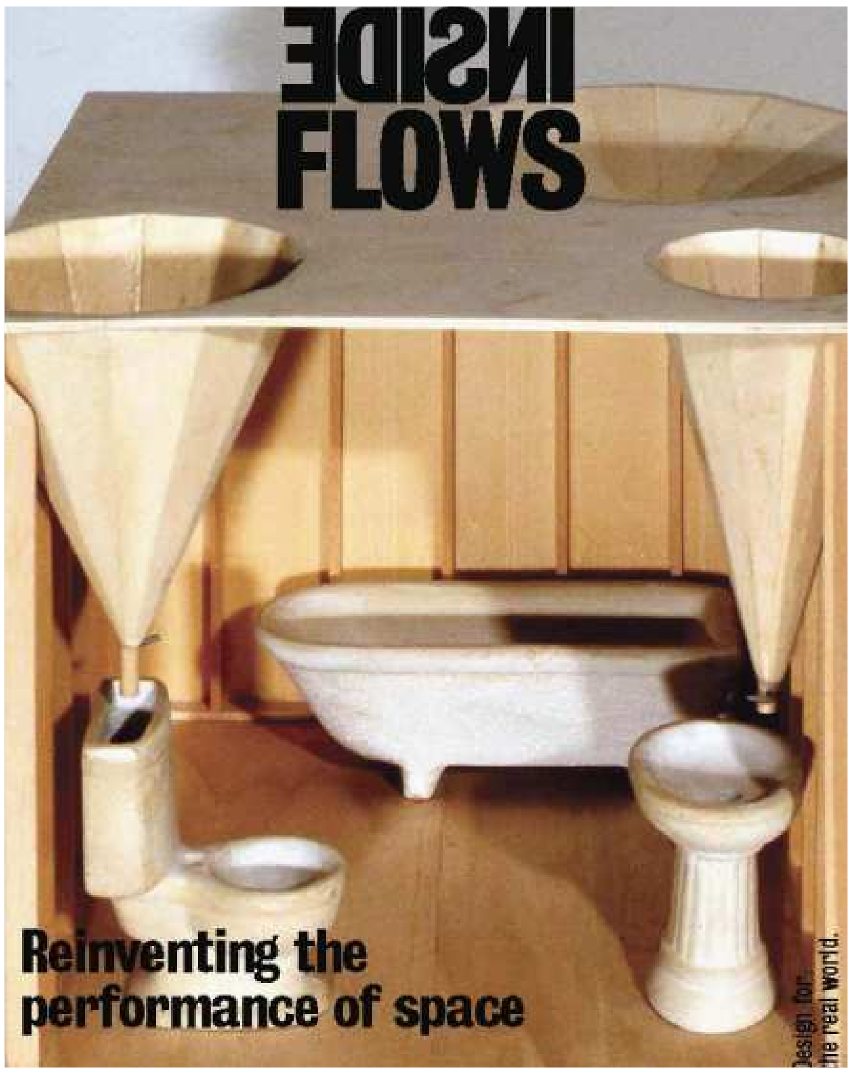
Considering that, I was looking for simple homemade techniques to design water channeling gutters. One of the projects that use in-expensive materials to design water channels is "Rainwater Catchment system for thatched roof huts in Uganda" designed by the senior project group "Rainwater Catchment in Uganda" (fig. 43)). Such gutter system is simply destined of 2 liter plastic bottles that are cut and connected together. Such bottles are largely available within the are therefore it make it easy for people to build such systems themselves (Rainwater Catchment in Lukodi, 2013).

Other project that attracted my attention is an art installation by Allan Wexler called "Aqueduct", designed in 1994 (fig 44.) (Allan Wexler Studio, 1994). This Installation is a sensitive and fragile rain water collector. It shows how rain water dripping from the roof could be ingeniously captured through in intricate portable gutter system and safely stored in the bucket inside the house. Gutter system consists of many separate and of different height water channels that could be assembled in to a peculiar water way system directing a water stream. What fascinate me most about this design are a take-away gutter assemblage and its simplicity. It seems that such primitive system could be easily constructed with simple materials and adopted by everyone.

In conclusion, these two presented projects demonstrated simple and in-expensive techniques of how to design rainwater gutters for survival.

43. Right above: Rainwater Catchment System for thatched roof huts in Uganda made of locally available plastic bottles

44. Right at the bottom: "Aqueduct" (left), "Community Fountain" (middle) and "Backyard Rain Catcher"(right). Art instalation by Allan Wexler, 1994



47. "Building for Water Collection with Bathroom" by Allan Wexler, 1994

45. Simple rainwater collection apparatus with textile in refugee camp at Jamam, Sudan. Photograph by Alun McDonald

Rainwater Capturing with Waterproof Textiles

Previously discussed gutter systems are simple to apply for gabled roofs. However in Santa Cruz Meyehualco not all the roofs of households are inclined. Many roofs there, due to pragmatic neighborhood development, are poor quality and often flat. Therefore I am considering the other method to obtain rainwater that is water capturing with waterproof textiles and plastic sheets. Such technique as well in inexpensive easy made.

As an example of such method could be a simple rainwater capturing set made in a refugee camp in Jamam in South Sudan (fig. 45,46.). Here the waterproof textile is mounted on four wooden sticks forming a tarp for water collection. In the middle of the sheet there is a hole through which water drains into a plastic bucket situated below (Primal Survivor, 2015).

Other project that has some parallels with just presented pragmatic water harvesting solution is a 'Building for Water Collection with Bathroom' by Allan Wexler (1994) (fig. 47.). This design is a scale model depicting a bathroom. The interesting part of this room is a roof. Conventional roof structure here is altered by applying large rainwater collecting funnel-shaped structures that directs rain water flow straight into bathtub, sink and toilet (Seward, 1995). This project explicitly demonstrates how previously discussed rainwater capturing with textiles could be interiorized and by doing so domesticate collected rain water.

I believe that just described technique of water capturing with textile is a really easy and inexpensive method that could be applied within my design location.

46. Textile rainwater collector

2.2. Rainwater Purifying Methods

With the following I am going to discuss, simple and ingenious techniques of how captured rain water could be purified.

Earthy Water Filters

The simplest method to purify rainwater is to use homemade filters.

One of such example is "Grass-Gravel-Charcoal Water Filter" described in Primal Survivor blog by Jacob Hunter (2015) (fig. 49.). This handmade filter comprises of a wooden tripod-shape holder that supports three textile bags containing different filtering materials in each that are grass, gravel/sand, and charcoal. Once water is poured on the top of the filter it starts flowing through all purifying layers. Grass and sand removes big pieces of dirt, while charcoal absorbs the harmful bacteria and viruses.

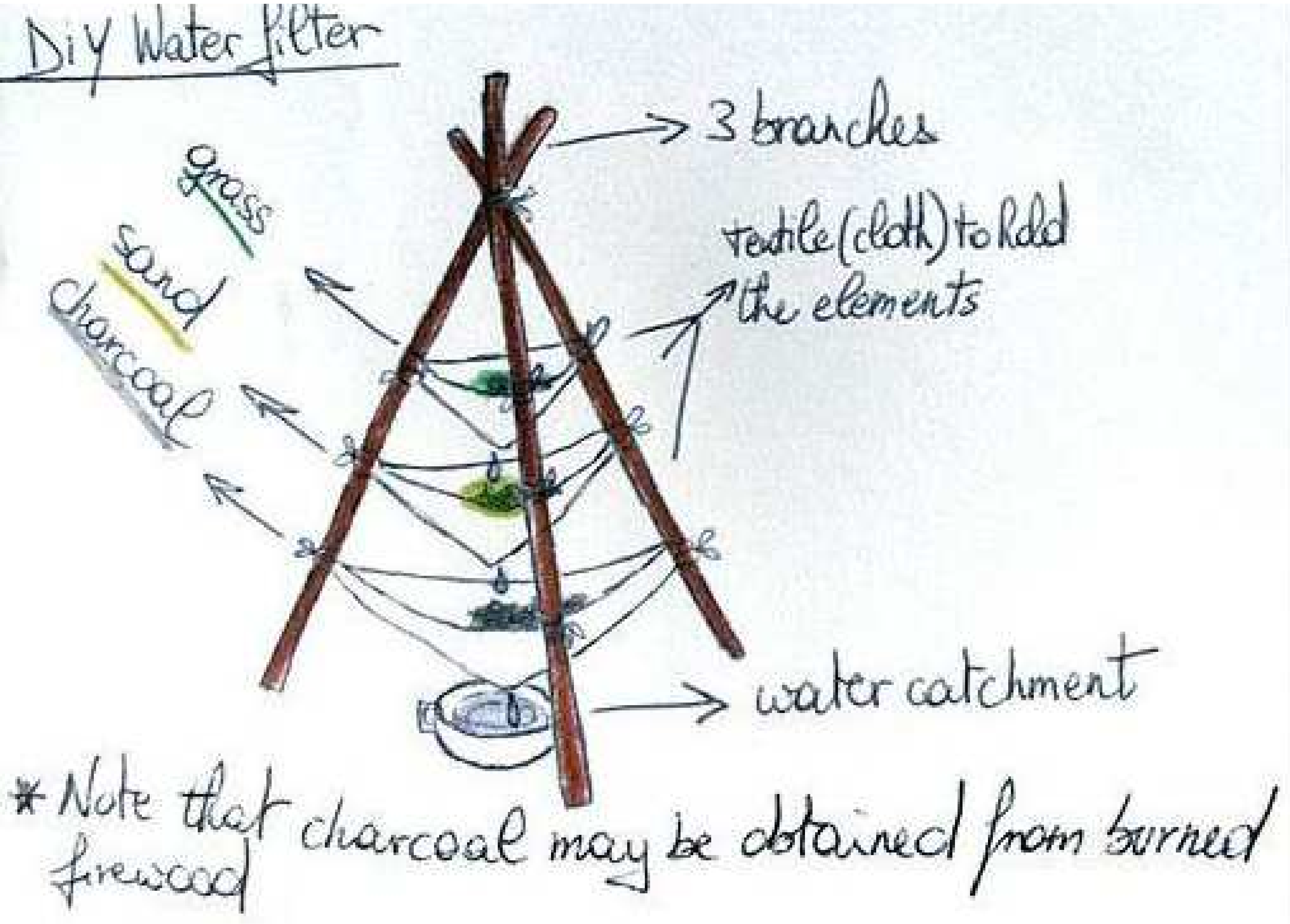
Other similar example is "Plastic Water Bottle Filter". It is made of ordinary plastic bottle, cut from the bottom and filled with four layers of filtering materials: cotton, charcoal, sand and gravel. Such filter as well as previous one also is able to remove most of the harmful pathogens (Write the Vision, n.d.).

One more interesting filter is "Matka Filter" designed for Indian communities in North Bihar in India (fig. 48.).This filter setup comprises of thee porous clay pods stacked on each other where the middle one is filled with water filtering materials: wood charcoal, brick bats and sand with nylon mesh layers in between. Water passing through all these layers gets purified and stored in the bottom pot (Poddar and Tiwari, 2011).

All these above mentioned filters are made from in-expensive materials such as sand, gravel and charcoal, and work perfectly to purify water in emergency situations.

49. Right: "Matka" water filter

48. Bottom: Homemade Grass-Gravel-Charcoal water filter




M.P.A
M.P.A

Solar Water Disinfection

Besides earthy water filters other method to purify water is solar water disinfection (SODIS) that depurates water using sun rays.

The simplest way to disinfect water using sun rays is to fill a plastic bottle with water and expose to sunshine for minimum of six hours. The UV-rays of sunlight kills all germs, bacteria, viruses and parasites and in fact removes 99.9 percent of harmful pathogens (Survival Gear Guru, n.d.). Such technique today is widely applied to many developing counties which are facing pure water crisis (fig. 50.).

For instance, three Korean industrial designers Jung Uk Park, Myeong Hoon Lee, and Dae Youl Lee using such technique created a simple water purifier from recycled plastic grain sacks that they titled a "Life Sack" (fig. 51.). Such water disinfector was created for African nations facing water scarcity. By exposing water filled sack to the sun rays harmful microorganisms and bacteria in the water are killed. (Ecofriend, 2010). What delights me in this creation is hat designers used locally available pokes to transform them into ingenious valuable kits helping many people to gain their own safe drinking water.

51. A simple solar water disinfection tool – "Life Sack"

50. A woman in Kadmandu using solar water disinfection to purify her portable water

53. Parabolic solar cooker devised by ARO Fab Lab in Kenya

Water Pasteurization

One more manner to depurate contaminated water is pasteurization that uses a heat to kill bacteria and other harmful microorganisms.

One of such examples that employ such method is "A Pan Cooker" developed by Constantine Orfan (2010) (fig. 52.). His creation uses a few simple gadgets that are inexpensive and usually found at one's home and is easy to make. As he says "it consists of a 12 x 24 inch flexible back reflector, 18 x 24 inch shiny surface mat, 12-quart clear plastic ice bucket" and "black enamel cooking pot". Placed on a sunny location back reflector focus sunlight to the center of the mat where the pot with water starts to be heated. The black color of the pot absorbs all light striking its surface and plastic bucket on the top helps to retain the heat. In the air temperature of at least 24 Celsius water can be heated up to 65 Celsius that is enough to kill harmful waterborne bacteria and virus. Using such pan cooker, more than four liters of water could be pasteurized in three hours.

Following this design there were more powerful and complex solar cookers devised such as a solar cooker in Kenya made by ARO Fab Lab that uses parabolic shape bowl to heat the water and food (fig.53.).

What fascinates me most in such designs is their simple solution to disinfect the water using sun ener-

52. A simple solar water pasteurization kit - "A Pan Cooker"

2.3 Rainwater Storing Techniques

After rain water is captured and purified it must be safely stored for short or long time period. Continuing my investigation I am presenting several techniques of how rain water could be preserved.

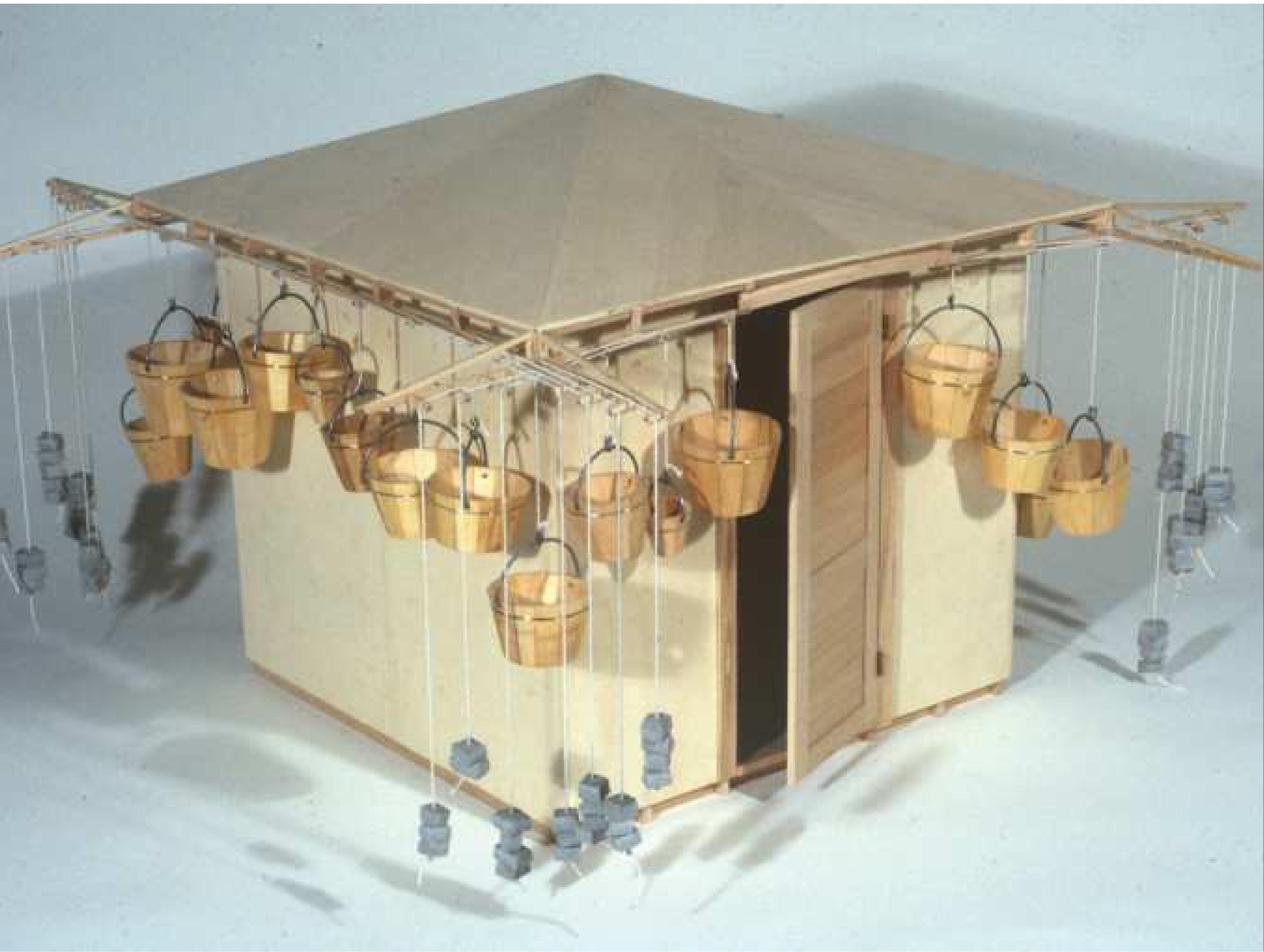
Rainwater Storing in Ferro-cement Tanks

One of such principles is rain water harvesting in ferro-cement tanks. Such system, for instance, was successfully installed by the "Inspector Eatham Housing Project" organization in 2007 in Pottuvil village in Sri Lanka were people are facing water crisis (fig. 54.). All around the village Ferro-cement water cisterns constructed from iron mesh and cement helped many people safely store they rainwater. Besides this technique as such, "Inspector Eatham Housing Project" members has organized Pottuvil village community gatherings and implemented awareness programmes to teach and train locals of how to construct such water cisterns and manage their own rainwater harvesting models (Lanka Rain Water, 2007). I believe that such technique could be easily applied to my design location as all houses in Santa Cruz Meyehualco made from cement-work, thus I could assume that this material is easily available around the area.

54. Right: Woman in front of the rainwater harvesting system in Sri Lanka. Photograph taken by Passanna Gunasekera

56. "Water Brick Containers" stored under the bed

55. "Building for Water Collection with Buckets" by Allan Wexler, 1994



Rainwater Storing in Domestic Utensils

Besides ferro-cement tanks other water storing methods could be employing all domestically available utensils, buckets, plastic containers and bags (that families in Santa Cruz Meyehualco usually have more than enough).

One of such example could be a household roof in Kathmandu in Nepal, where people are storing their water using all domestically available buckets.

This water storing principle I could compare with Allan Wexler's (1994) project "Building for Water Collection with Buckets" (fig. 55.). This work is a simple scale model depicting ingenious water capturing and storing technique with buckets. Here "rain falls onto the pitched roof of the building and collected in the buckets that hang along the roofs edge" – says the artist.

Storing water in domestically found utensils is quite a cheap method, but it also requires space. It is important to find a proper location within household to contain all these water saving units. One of possibilities could be to try to integrate all these units into domestic landscape. For instance, "Water Brick Containers" in this case could be a good example (fig. 56.) (Water Brick, n.d.). Though these containers are industrially produced and designed to be stacked well with each other, what is interesting for me in this design, is a plenty of possibilities of their integration within interior space. Stacked together they can become a part of a table, a cupboard, a chair or could be easily hidden under the bed.

Other design that integrates water storage into household furnishings is "Cedar Rain Bench" with additionally integrated plastic bags inside its volume for water harvesting. (fig. 57)) (Gear, 2015).

In conclusion, all these discussed examples draws a vision of how water for long or short term could be stored within one's dwelling.

57. "Cedar Rain Bench" for rain water storing

2.4. Domestic Water Related Appliances' Transformation Methods

After discussion of how rain water could be captured, stored and purified, with the following I will examine various domestic water related appliances and try to research simple methods and techniques how they can be transformed in order to maintain water with care.

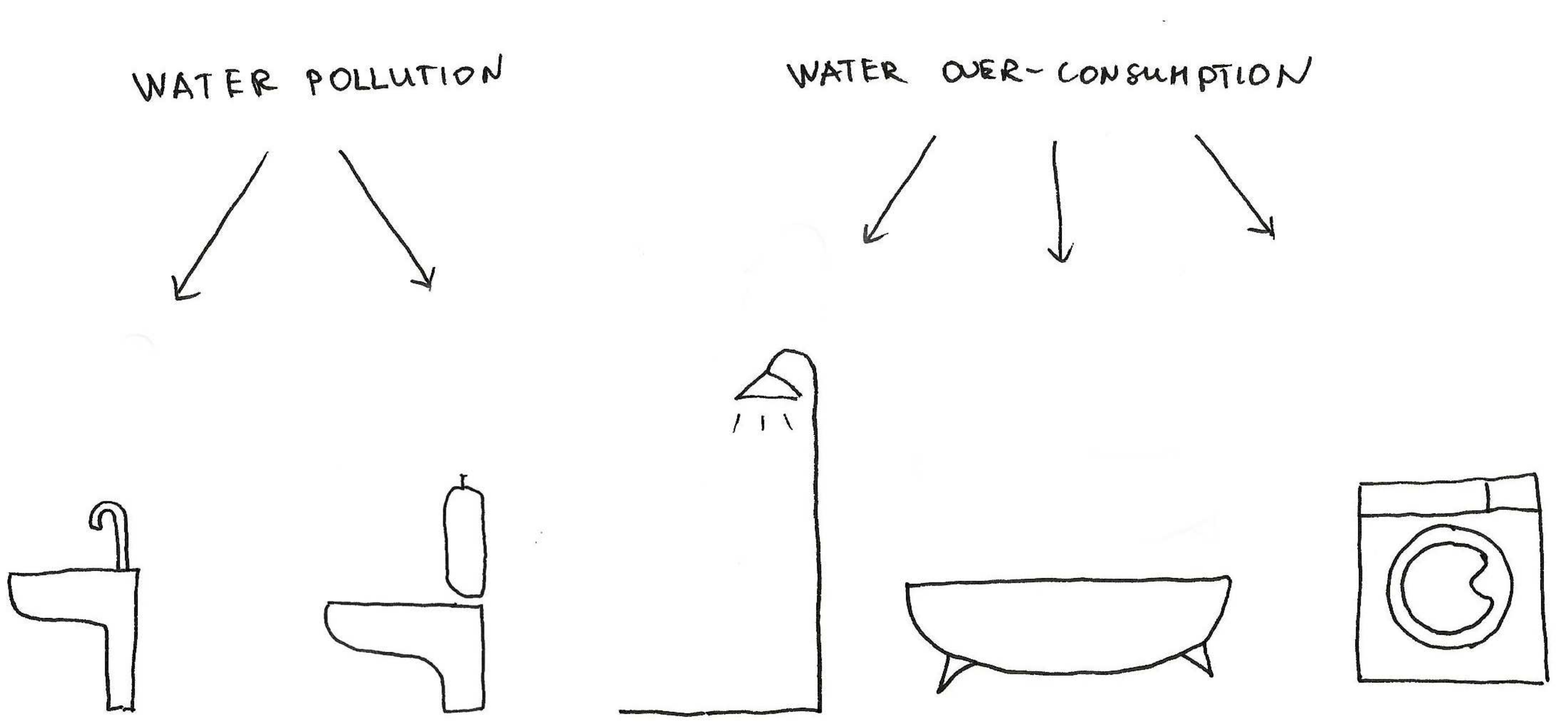
After all my research that I have done so far I believe that water pollution and over-consumption are two key factors determining catastrophic water fate of today.

Therefore, in order to change the water use within the domestic realm, I have grouped contemporary domestic water appliances and fixtures in two groups. The first group contains the ones that are fault for water pollution and the second one – water over-consumption (fig. 58.).

In my opinion latter-day domestic elements that are fault for water pollution are flush toilets and sinks. They are usually in charge to discharge black and grey waters into natural environment.

Domestic elements that are fault for water over-consumption, I believe, are bathtubs, showers, and washing machines.

After such my identification I started to look for the methods of how these inappropriate domestic elements could be transformed in order to maintain water properly the age of water scarcity.



58. Domestic water appliances fault for water consumption and over-exploitation

Flush Toilets

Flush toilets I think are the ones who pioneered environmental rivers contamination since their establishment in already discussed Knossos Palace in 1700 BC. They are the ones which were also fault for Themes River contamination in London in 18th century and, too, for environmental violence in Japan, slowly contaminating Pacific Ocean's floor with human excreta. Nevertheless, besides pollution, they are the ones of the most water consuming elements within the realm of domestics. Therefore I believe that the toilets of the future should be waterless and similar to "Loowatt" - a composting toilet designed by Virginia Gardiner (fig 59.).

What I found fascinating about her innovating design of the toilet is that it uses zero water and is completely environmental friendly. Addressing improper global sewerage systems and waste disposal it aims to revolutionize the realm of the restroom. Instead of using water flushing to dislocate human excrement it just simply composts it in a sealed, odor-free container. What is more, the compost afterwards is used as a source for energy - "once the toilet is full, the user takes the poo package to an outdoor bio-digestor, which in exchange provides a free source of biofuel for cooking" (Chino, M., 2011).

This technique to deal with human tailings not only allows saving plenty gallons of fresh water, transform human waste into energy, but also transform it into natural soil fertilizer. Human waste composting fixtures usually are using "natural process of decomposition and evaporation" for which is responsible aerobic bacteria that transforms human excreta into fertilizing soil. Such end product (if composted properly) does not contain any pathogens or viruses therefore can be used as a natural fertilizer for plants in small and large scale. (Let's Go Green, n.d.)

Therefore I am certain, that composting human waste is one of the most reliable and ecological ways to deal with water contamination caused by flushing toilets.

59. Portable composting toilet "Loowatt" designed by Virginia Gardiner

Bathtubs

Other domestic appliances that are fault for contemporary water over-consuming society are bathtubs. The most of this natural resource today is usually used by soaking in a water tub that requires about 70 gallons of water (Jen, 2011). However, 70 gallons of water might sound as a huge waist, if you think, that according to Pat Henry (2013), the minimum of water that is needed to keep one-self clean, are just "seven cups".

Pat Henry, a traveler and writer, in his article "Sponge Bath: Keep Clean without Running Water" published in The Prepper Journal tells the story of how the body in extreme conditions can be kept clean only half a gallon of water. He says that "a complete [...] bathing outfit should include a 15-inch metal basin, washcloth, towel, soap, baking soda, and fingernail brush." The body is washed with a small amount of water from the basin, rubbing the skin with soap (or soda), brush and removing suds with a washcloth.

This washing method, described by Pat Henry, however, is not a novelty. Similar techniques, with which I have found some parallels, are practicing and Japanese. Usually they use wooden bathing buckets that they fill with water. Once they are full, they sit on a low stool and rinse themselves using a sponge and ladle (fig. 60.). This bathing method uses much less water than a bathtub and besides that it is "a really a lovely experience [...]" - notes Lloyd Alter (2014) in his publication critically reflecting on the modern bathroom.

After discussing these examples, I really believe that such "sponge bath" or "ablution bath" in water crisis facing Iztapalapa in Mexico City could replace a lot of water consuming bathtubs and became a new model of future self-cleaning.

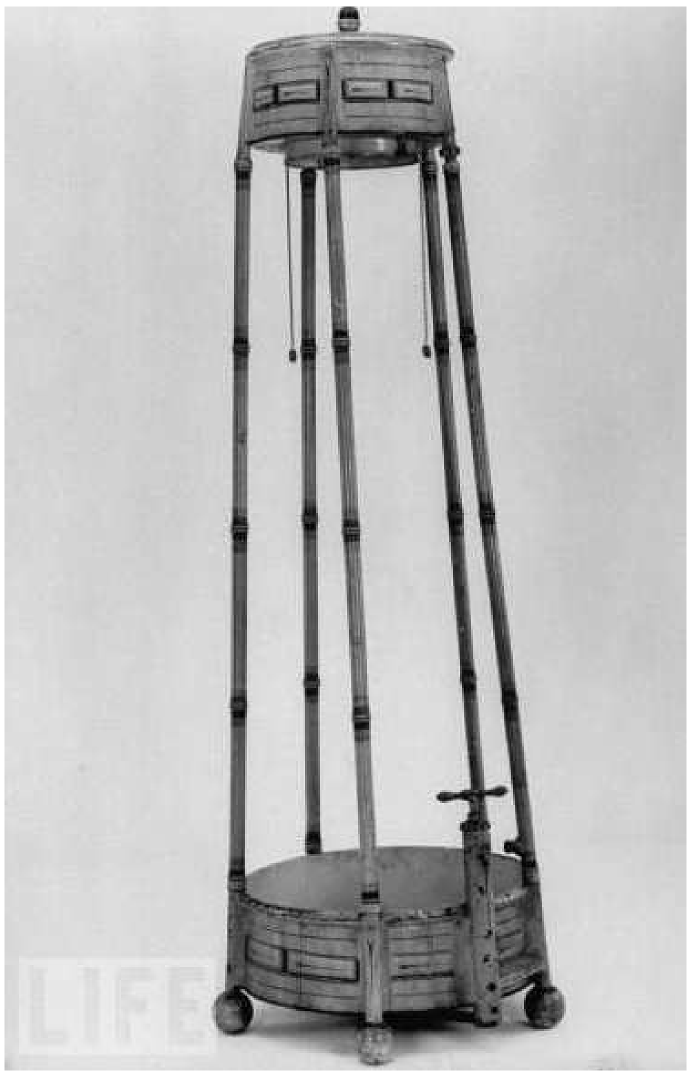
60. Japanese woman bath. Woodblock print by Torii Kiyonaga, 1780s.

Showers

One more domestic element that can be blamed for water over-consumption is a shower. It consumes less water than a bath tub – in five minutes it runs down from 10 to 25 gallons of water (Jen, 2011). However, I am confident, that these numbers can be also reduced.

One of a shower solution, that uses from 2, 5 up to 5 gallons of water per bath is a "PVC-Free Solar Shower" designed for camping (fig.61.). It consists of a simple black flexible PVC-Free bag and a shower nozzle fixed in its bottom. Once the bag is filled with water it starts running down from the nozzle creating a primitive shower (Smart Camping Guide, n.d.).

61. PVC-Free Solar Shower



63. The English Regency Shower

Another shower solution that uses just few gallons of water is a “Bucket Shower” (fig. 62.). Such simple shower uses a simple plastic bucket with perforated bottom. As soon as it is filled with water and hanged on tree water starts flowing down creating a shower experience (Tiny House Listings, 2014).

Such pragmatic shower has some similarities with “The English Regency Shower” that has been invented in the second half of 19th century in England (fig. 63.). It features with a similar showering principle, as it also uses a perforated “bucket” of water above the bather (Jane Austen’s World, 2010).

These discussed examples clearly show a various possibilities of how to reduce water consumption through showering. I am certain that these simple and smart shower systems employing a water bucket could be very useful for water scarcity facing people in Iztapalapa.

62. “A Bucket” Shower

Washing Machines

Other domestic appliances featuring high water consumption are washing machines. A typical washing machine usually consumes from 40 to 45 gallons of water per load (Home Water Works, 2011). Therefore, I again believe that there are many ways to reduce water consumption while doing laundry.

One of the examples that I believe uses less water is a pedal-powered "Mini Washing Machine" designed by Remya Jose (fig. 64.). Such machine consists of laundry container and pedal system making it a mechanical devise and as it seems uses maximum of 10 gallons per load (Giacomazzi, 2007).

Another similar example is pedal-powered "Gira-Dora Washer" designed by Alex Cabunoc and Ji A You (fig. 65.). All of what it consists is a plastic tub and a spinner inside which is activated by pushing the pedal (Matus, 2014). Such machine is using a minimum amount of water needed to do laundry, as it is filled manually.

These discussed examples shows how water expenditure making laundry could be reduced from 45 gallons to 10 gallons per load. I believe that pedal powered washing machines not only saves water but also use human power allowing reducing electricity bills for many poor people in Iztapalapa.

64. Pedal powered "Mini Washing Machine"

65. Pedal-powered "Gira-Dora Washer"

2.5. Domestic Water Saving through Grey Water Re-use

Besides domestic water related appliances transformation that aims to reduce domestic water consumption and pollution, I believe that water re-using is another important method which can help to save and treat water with care.

Usually waste water (that is also called grey water) collected from washing hands, laundry or bathing could be used a second time. It could be employed to irrigating gardens, cleaning the house and watering domestic plants.

One of the examples of water re-using domestic appliances is a "Take-Away Sink" designed by Jessica Nebel (fig. 66). It is a simple portable container placed below the water tap that collects water from washing the hands or brushing teeth allowing later to re-use for other domestic activities such as watering the plants or cleaning (Dunn, 2007).

Other similar example is an "Ecocubo" designed by industrial design student (fig. 67.). This project features by a simple sink and an integrated bucket underneath it which collects grey water while washing hands or performing other washing activities. When the bucket below is full, it can simply be removed allowing recycling and reuse accumulated grey water for mopping the floor (Scholtus, 2011).

66. "Take-Away Sink" designed by Jessica Nebel

67. Grey water re-use sink "Ecocubo"

The last example that attracted my attention is "Gris" – a waste water collecting system that collects all the water used during showering (fig. 68.). Designed by Alberto Vasquez such system aims to help recycling the water for residents of Third World Countries and specifically addresses water consumption issue in Columbia. Its design consists of four interlocking cells that collect 90 percent of used water during a shower. After a bath these cells can be separately lifted up and collected grey water can be re-used for flushing the toilet, cleaning the house for other washing activities (Behance, 2015).

These three presented projects clearly show ample possibilities of how domestic water could be recycled by adopting really simple and smart principles. Reusing water I think is one more habit that could be adopted in water crisis facing Iztapalapa households.

68. Shower waste water reusing system "Gris" designed by Alberto Vasquez

Chapter 3.

Final Design

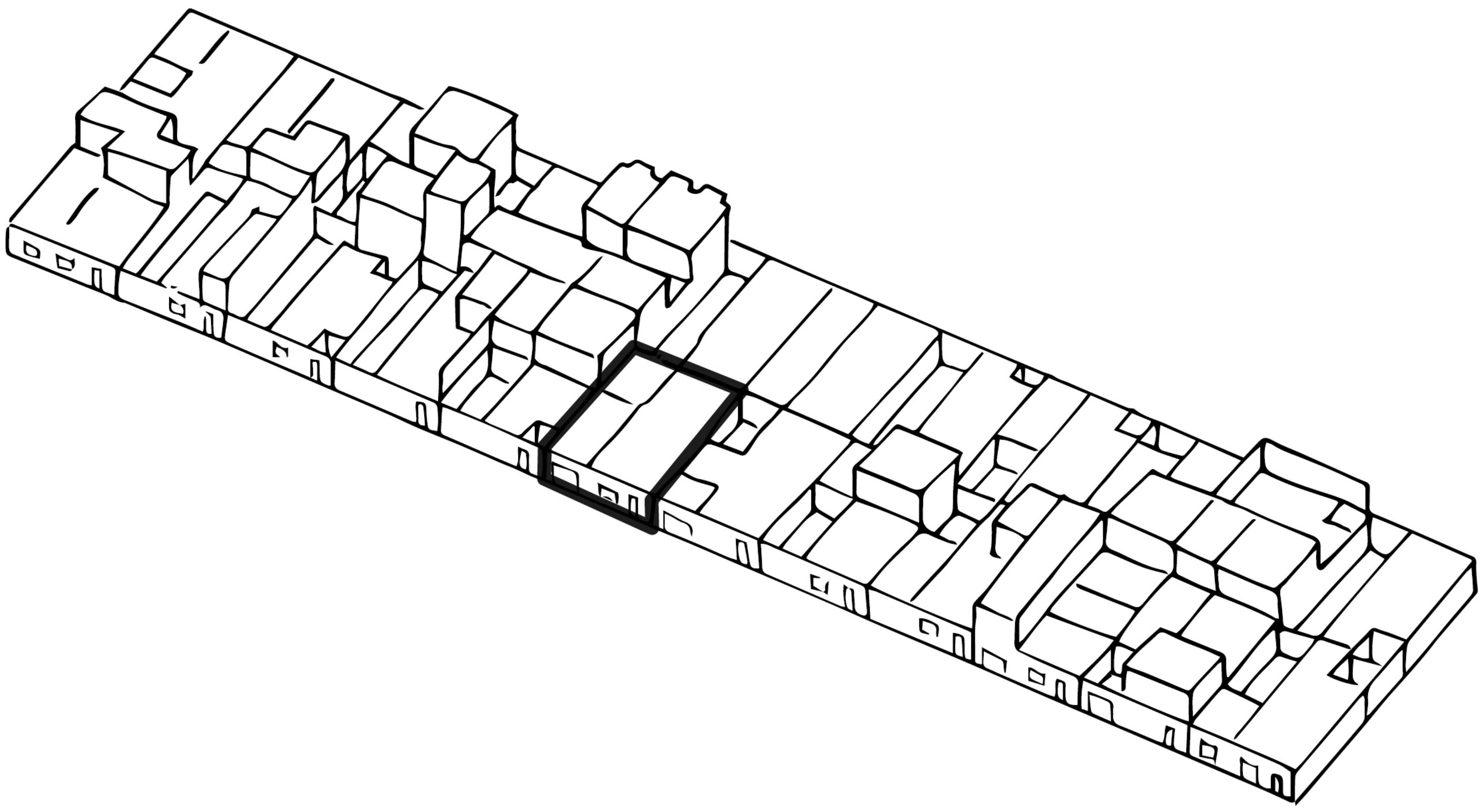
3.1 Strategy

As previously mentioned, one of my design goals was to develop a pure water generation system - a system that captures, purifies and harvests rainwater.

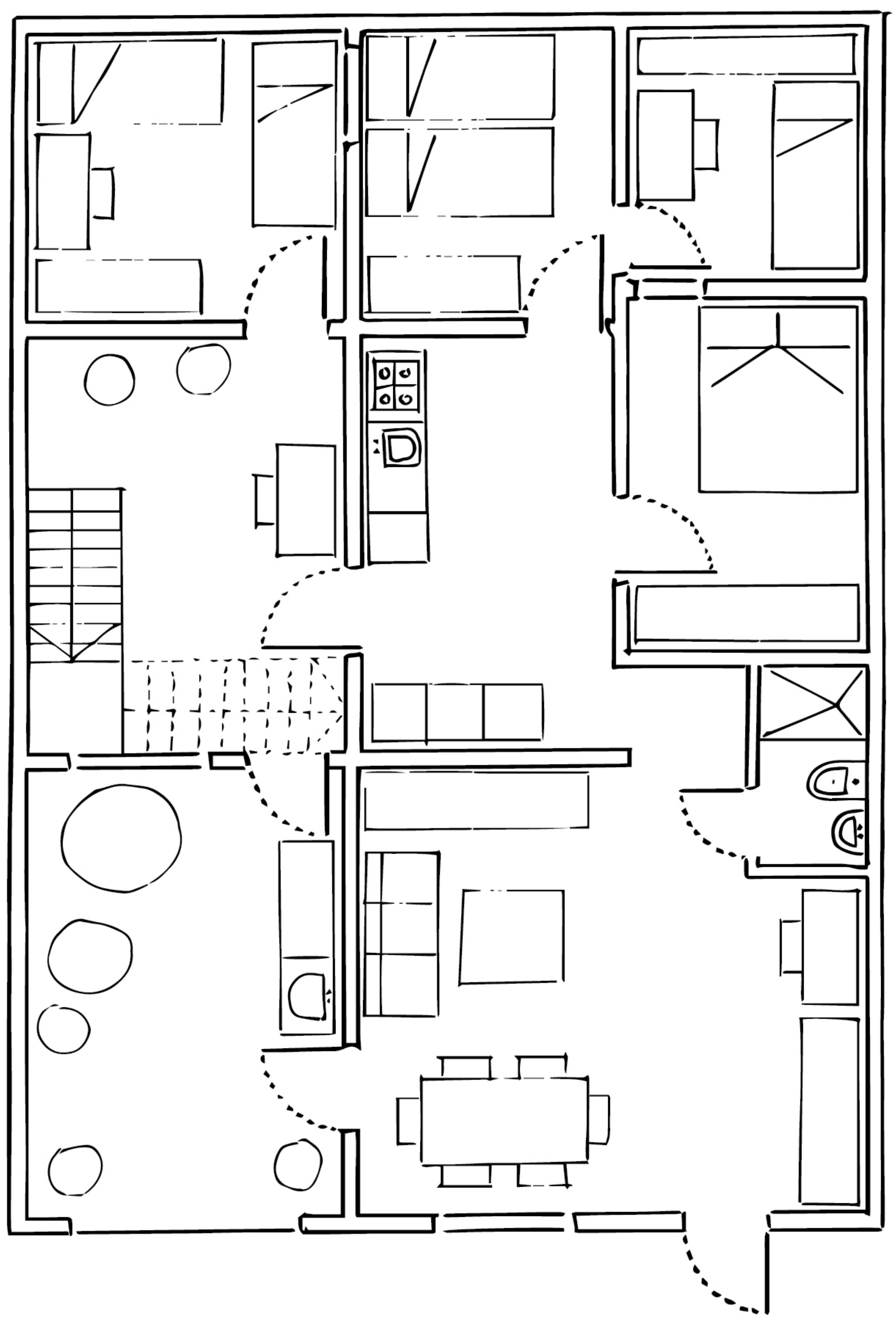
My second goal was to rethink domestic water treatment methods and re-solve water related appliances in order to reduce domestic water consumption and foster its re-use.

After all my presented design research in previous chapter I have devised my final design strategy that comprises of two parts: rain water harvesting systems and domestic water related appliances set-up.

To visualize my design I am choosing one housing block in a neighborhood of Santa Cruz Meyehualco and one of its houses interior where I apply my strategic solutions (fig. 69, 70).



69. Design location - a housing block in Santa Cruz Meyehualco,Iztapalapa

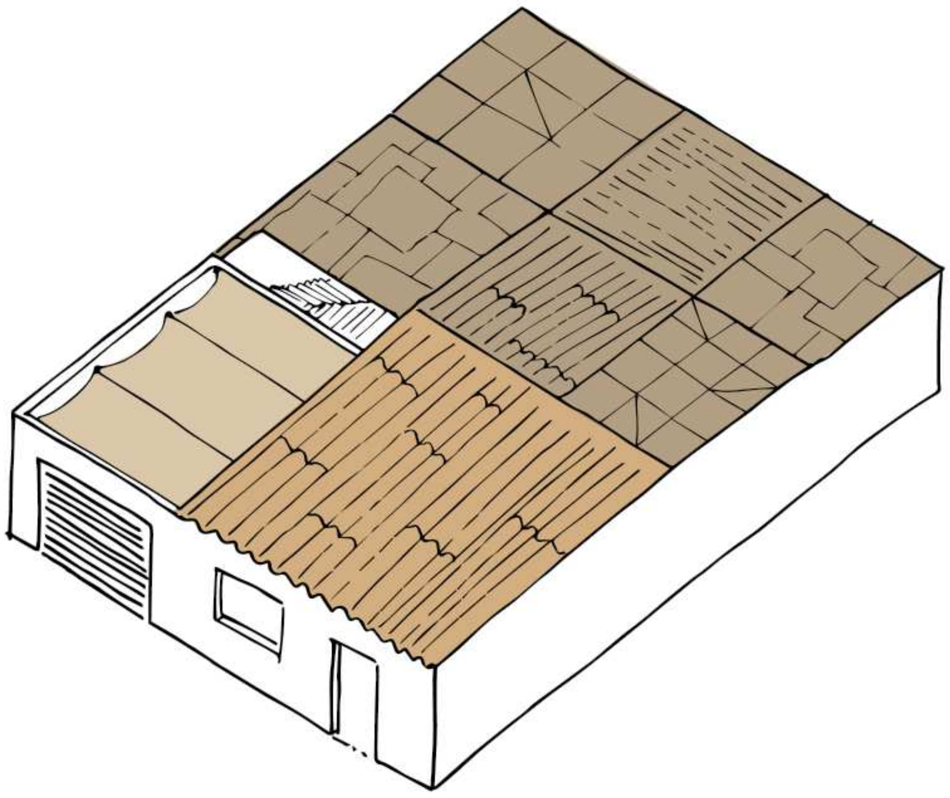


70. The Floor plan of a selected house

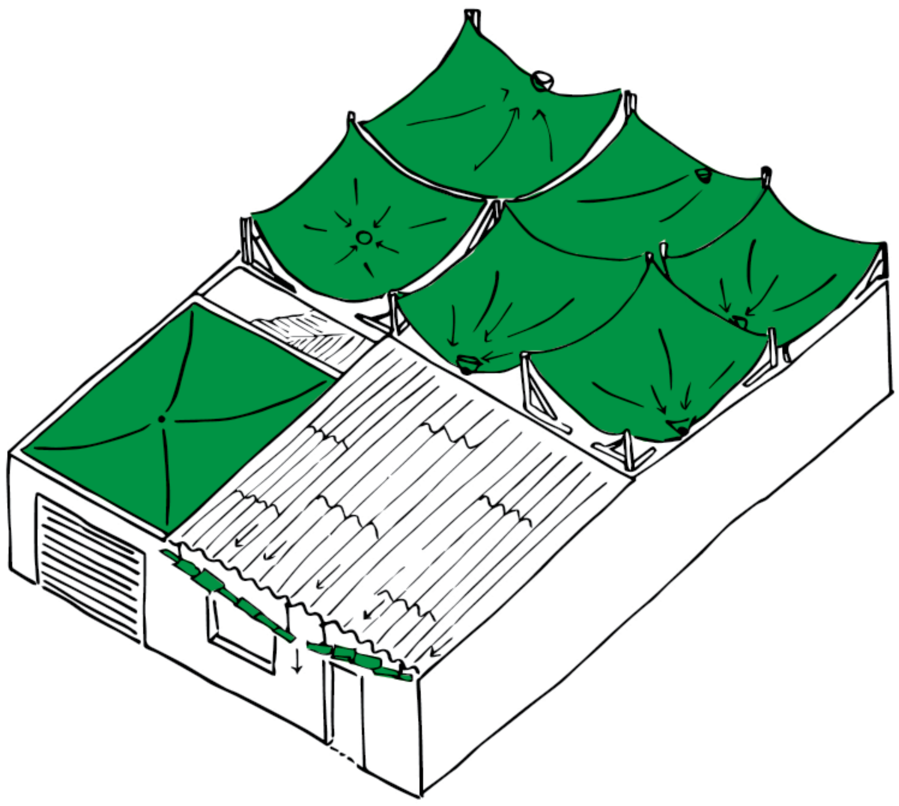
Rainwater Harvesting Systems

My devised rainwater harvesting system comprises of three parts: water capturing elements, water filtering elements and water storing elements.

For rainwater capturing I have applied waterproof textiles and gutters systems that were decided taking into account existing roofs quality and its inclination (fig. 71,72).

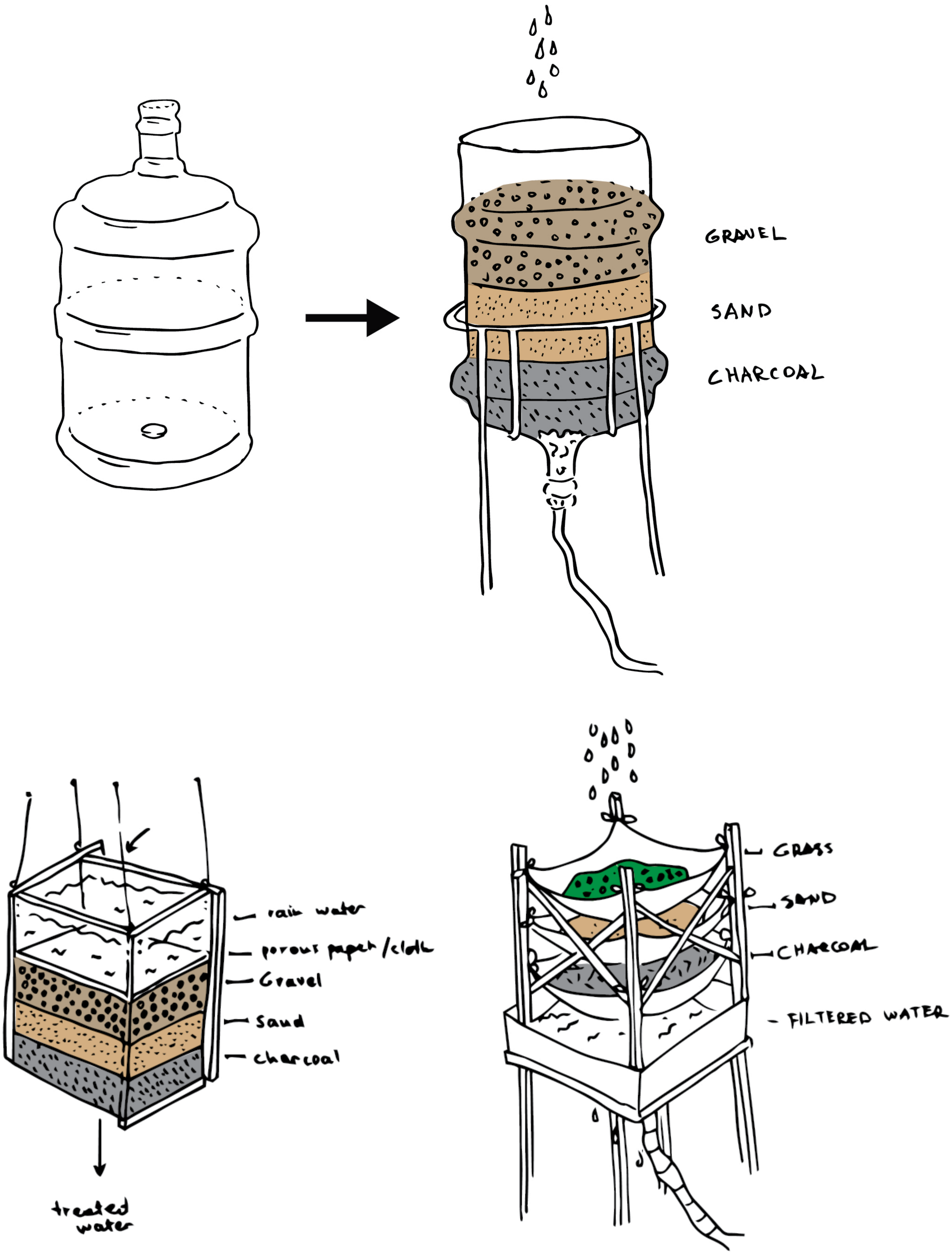


71. Roof structure and quality scheme



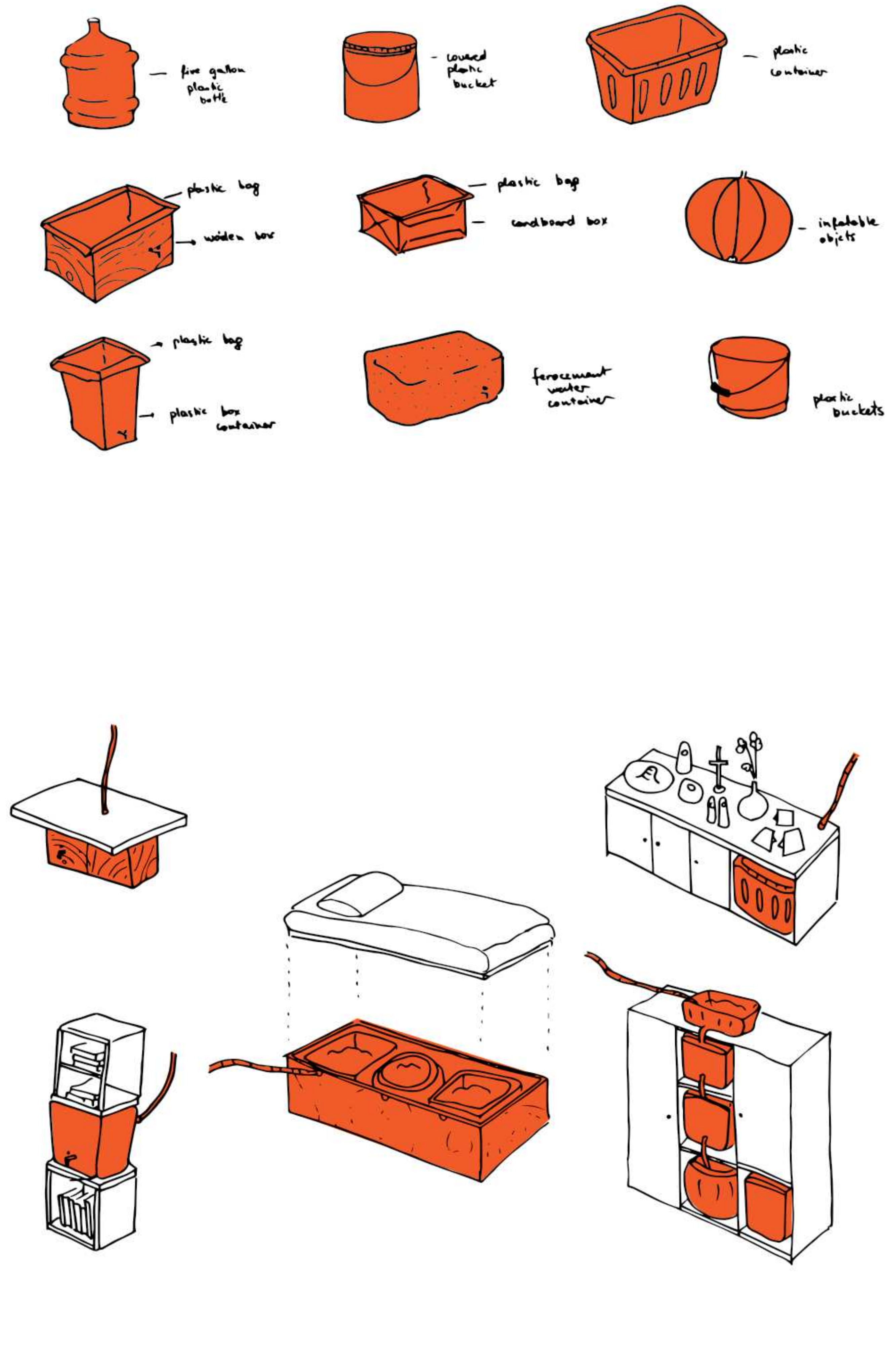
72. Rainwater catchment with textiles and gutters application scheme

For rainwater filtering I have applied various earthy filters (fig. 73).



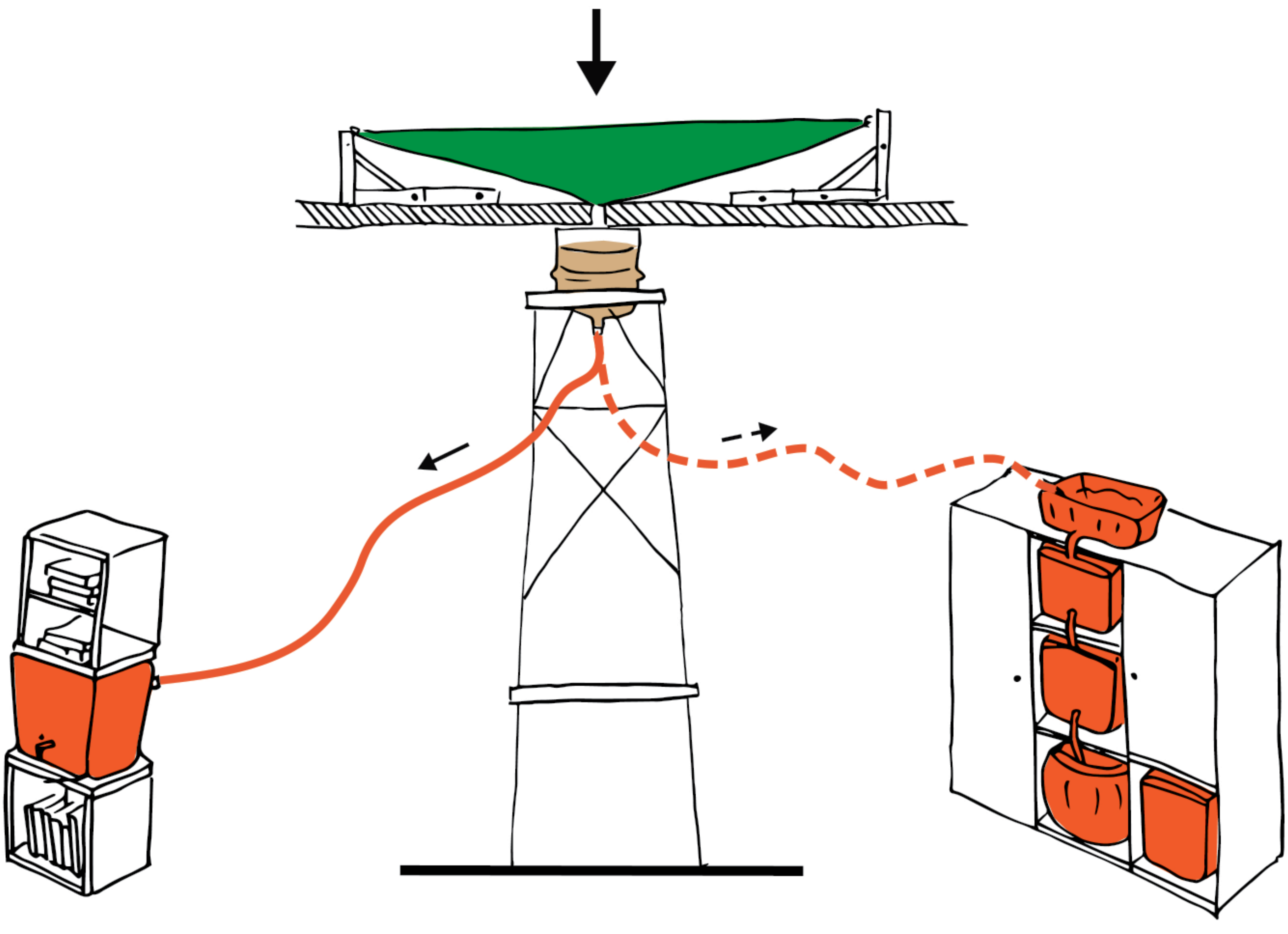
73. Earthy water filters made from locally available materials

For rainwater storing I have applied a technique of storing rainwater in ferro-cement tanks and in all domestically found utensils (74.).



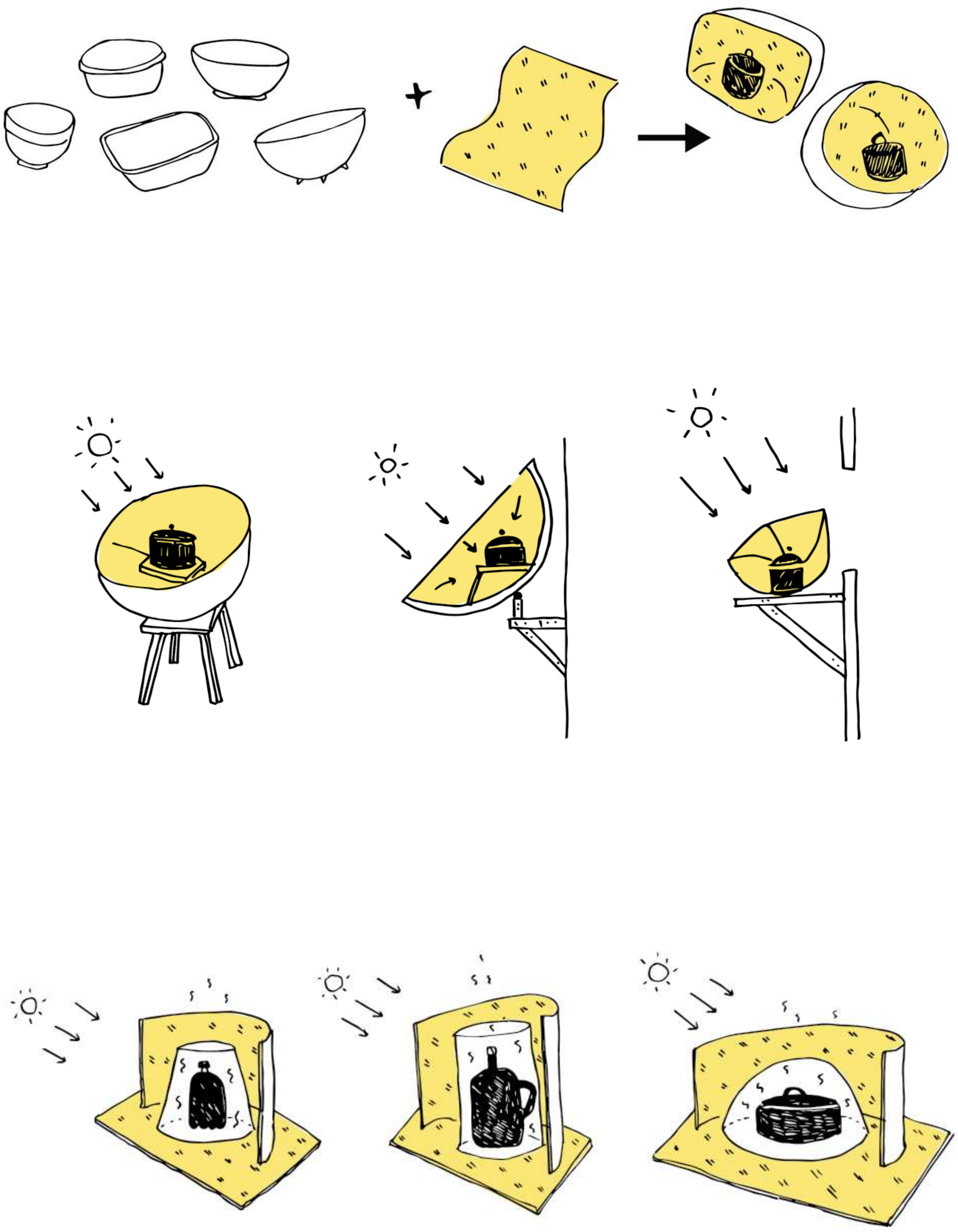
74. Rainwater storing possibilities

All these elements together compose in-expensive and ingenious rainwater harvesting systems that are made by locals using locally found materials (fig. 75).

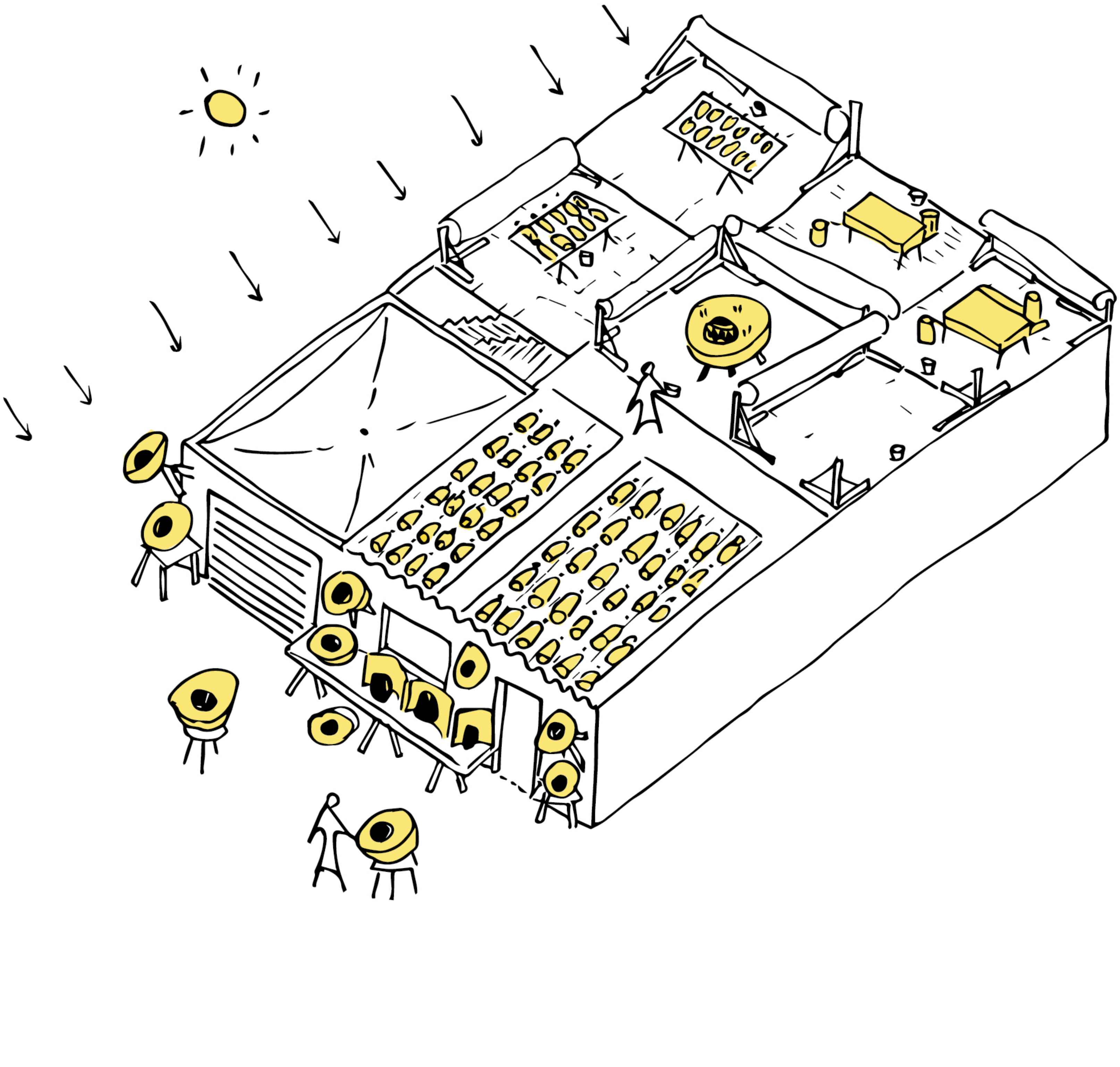


75. Rainwater harvesting system scheme

Additionally, in order to heat collected water during dry season I have devised water heating gadgets that are using sun rays to warm and pasteurize this natural resource (fig. 76,77).

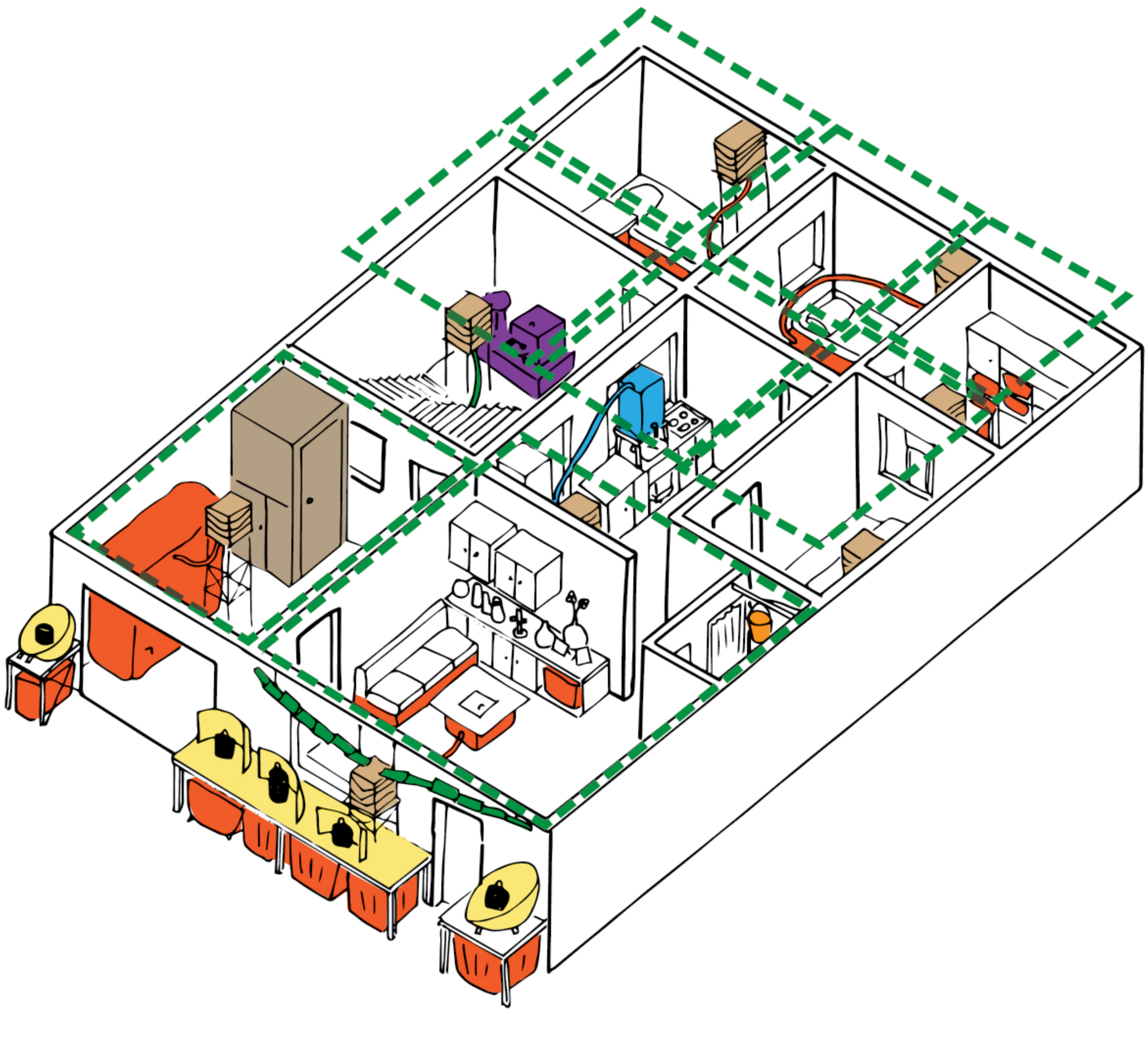


76. Water heating elements made from domestically found utensils and materials



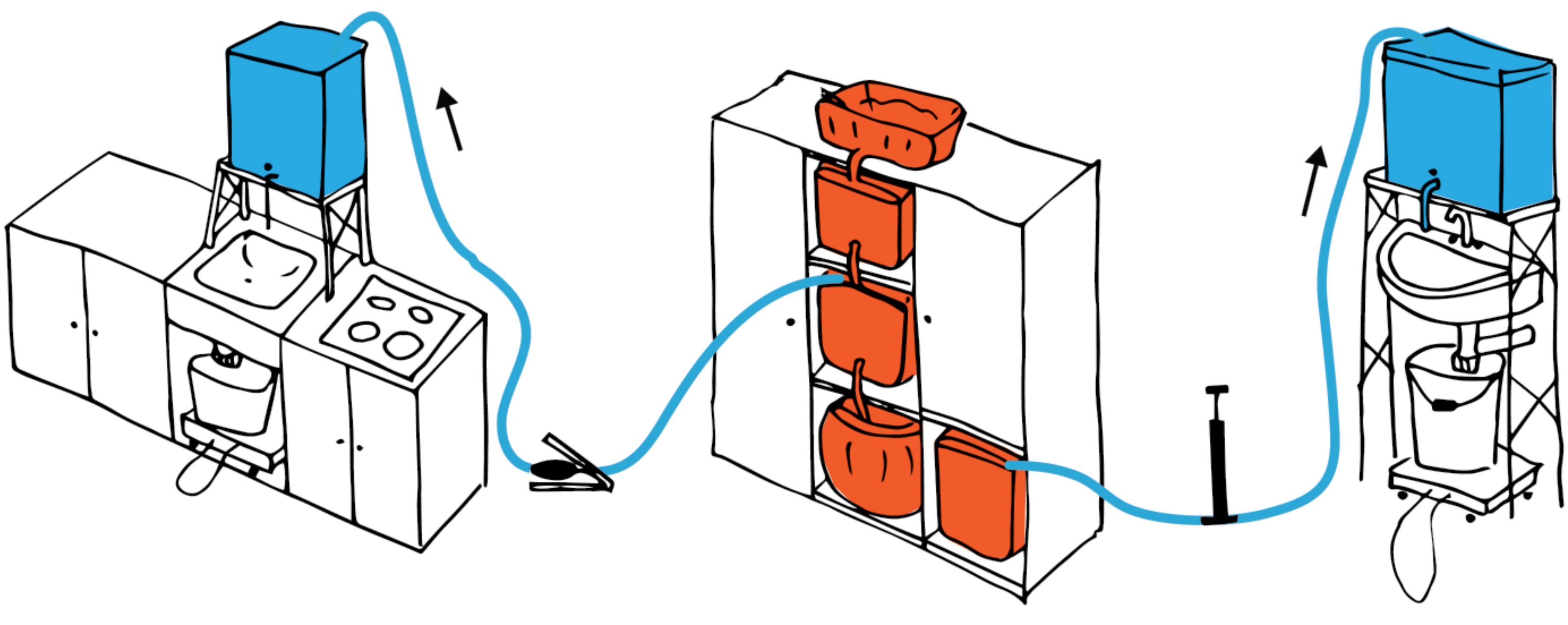
77. Water heating systems distribution around the house

Each system occupies one room in a house, therefore local people, depending on their water needs, can decide how many systems they want to have and how many rooms to occupy (fig.78).



78. House with eight rainwater catchment systems in every room

In order to use the water from storing elements, it can be taken manually or pumped to domestic "water towers" situated above sinks where it easily can be ran down (fig.79).

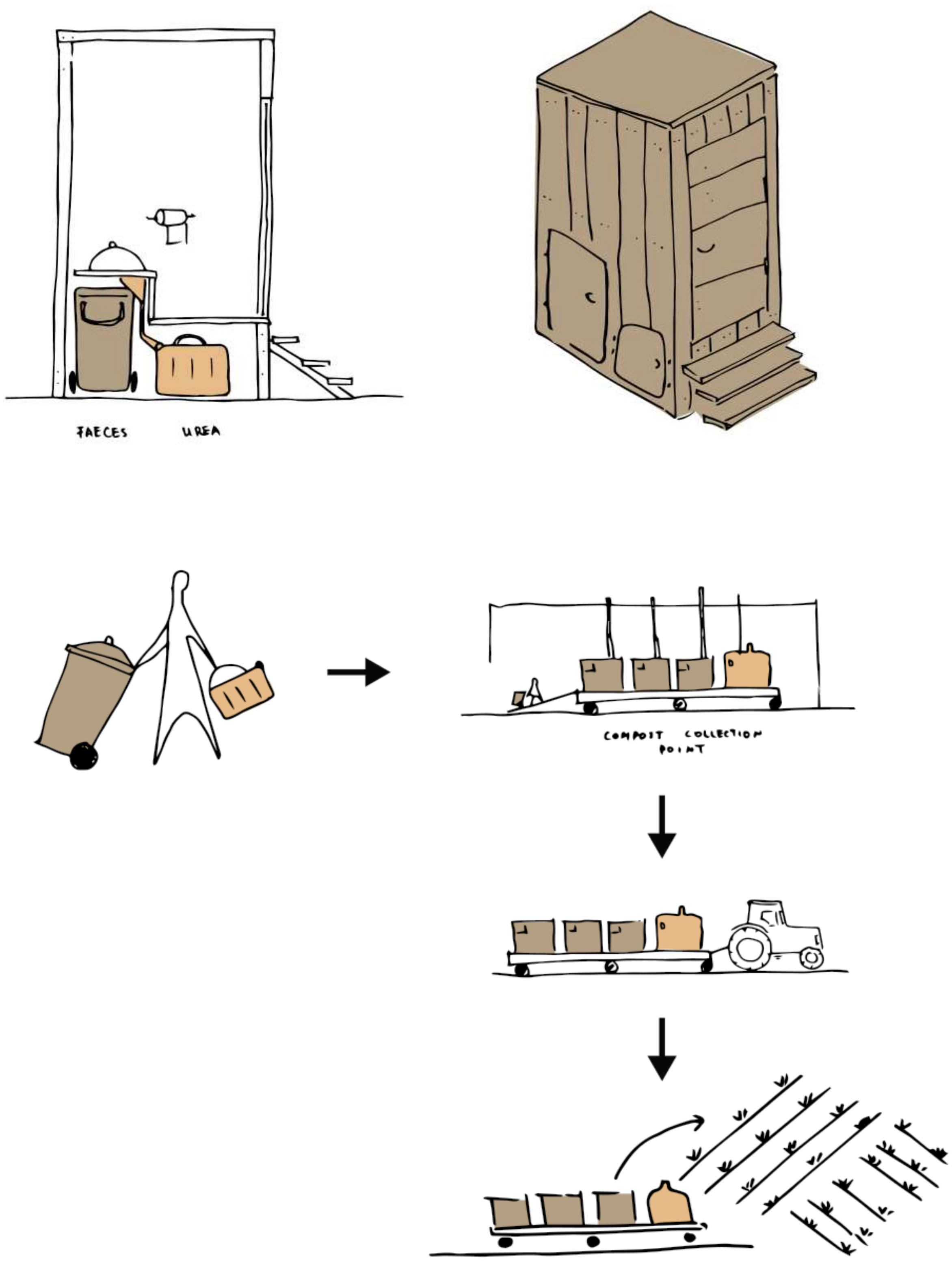


79. Water pumping and circulation system in a house

Domestic Water Related Appliances' Transformation

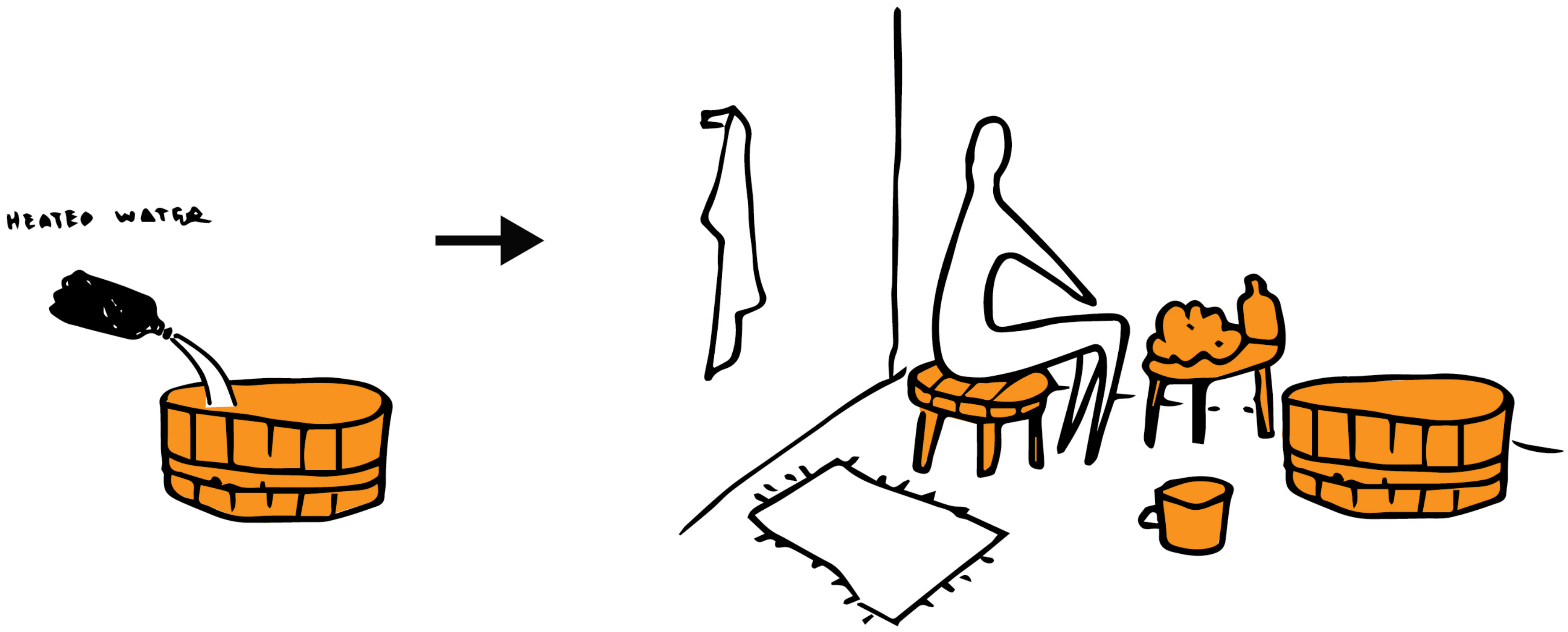
Based on the results presented in my design research part, in order to reduce domestic water consumption, I have transformed a series of domestic water related appliances such as toilet, bathtub, shower and washing machine.

The flushing toilet I have replaced with a composting toilet (fig.80). It composts urea and faeces in two separate containers which later, once full, are distributed to larger communal compost collection points around the district. After that such compost is used as a natural soil fertilizer in agriculture fields in Mexico City outskirts. Such toilet is not only ecological but also it doesn't use any water.



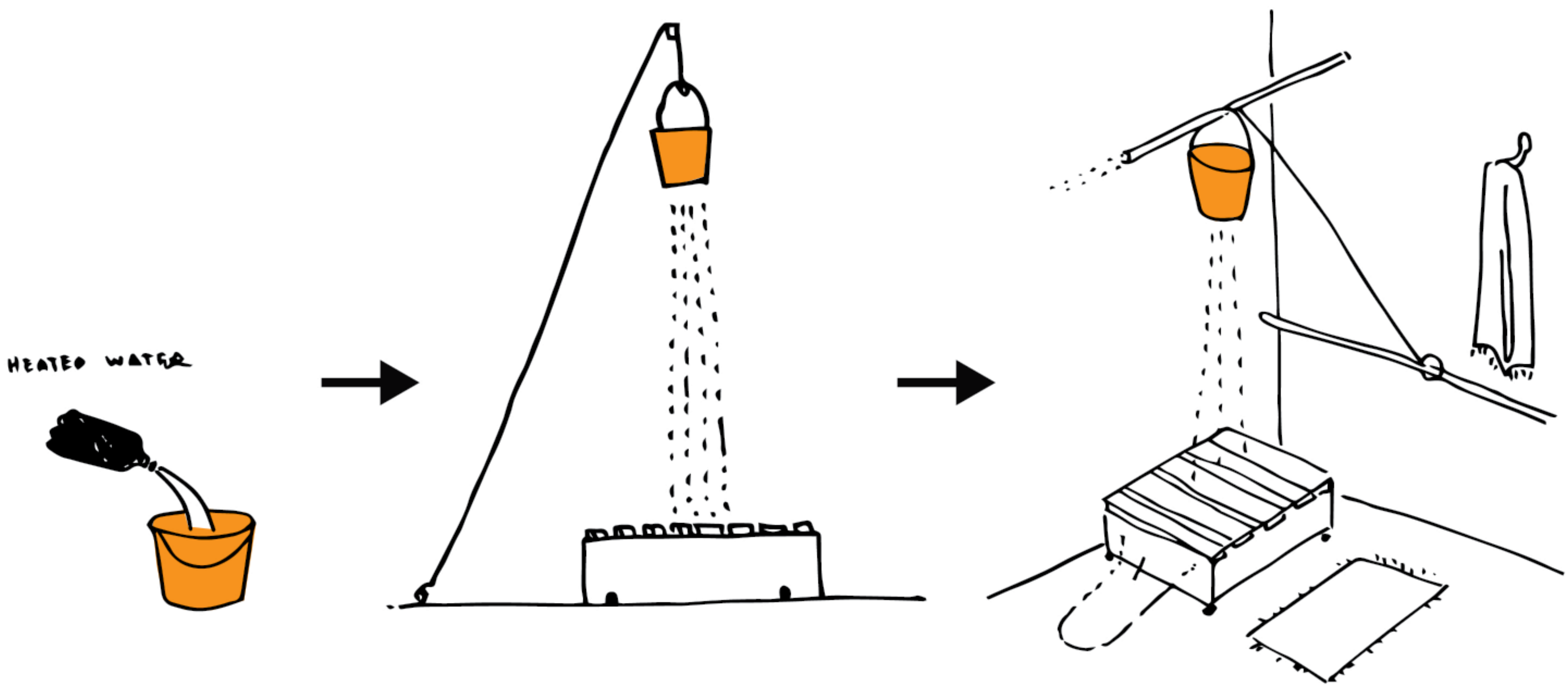
80. Scheme of a composting toilet

A lot of water consuming bathtub I have transformed into a “sponge bath”, which contains a tiny water basin, a sponge, towel and soap and uses very little water for ones self-cleaning. This bath reduces domestic water consumption from 70 gallons to 5 gallons of water per bath (fig.81).



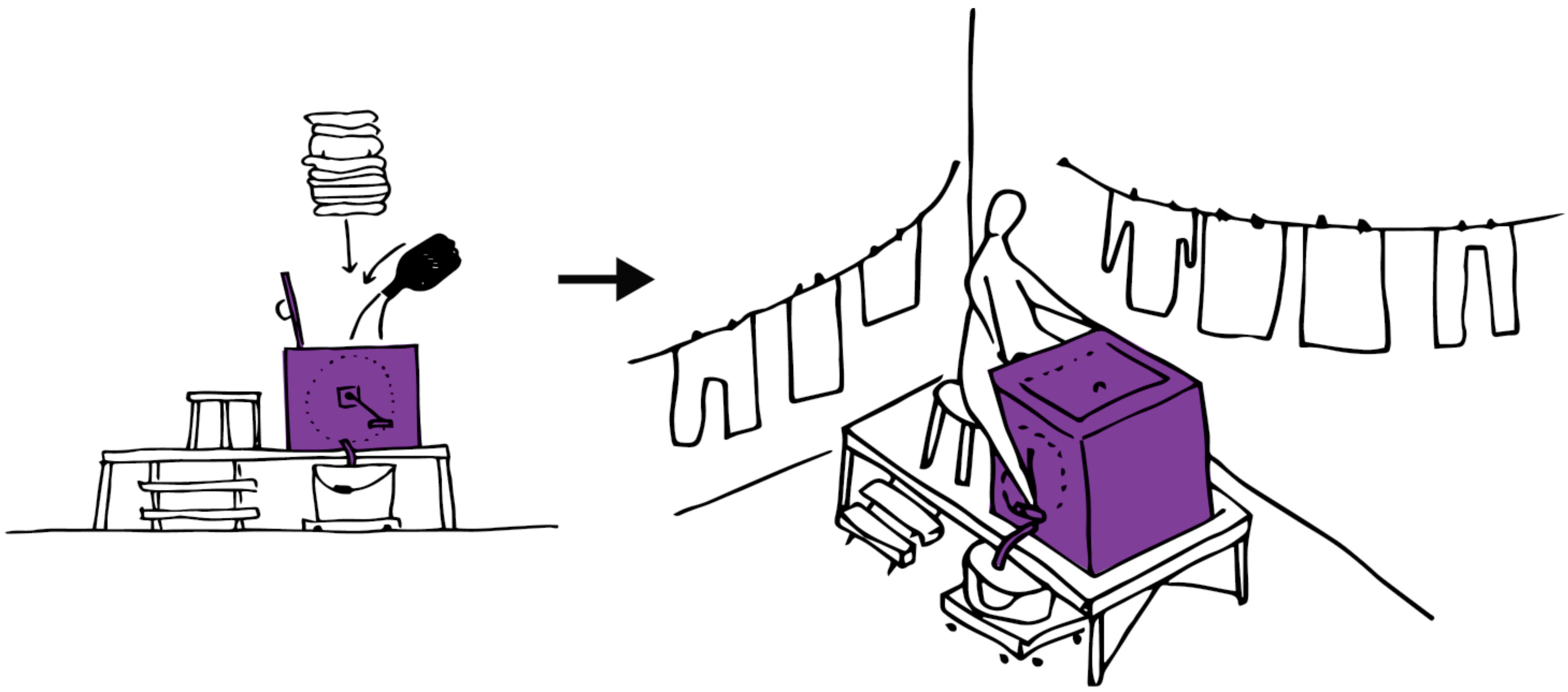
81. Sponge bath system

The long lasting shower I have transformed into a “bucket shower”, which comprises of a simple perforated container filled with water and suspended above the bather. Such shower reduces water consumption from 25 gallons to 2.5 gallons of water per bath (fig.82).



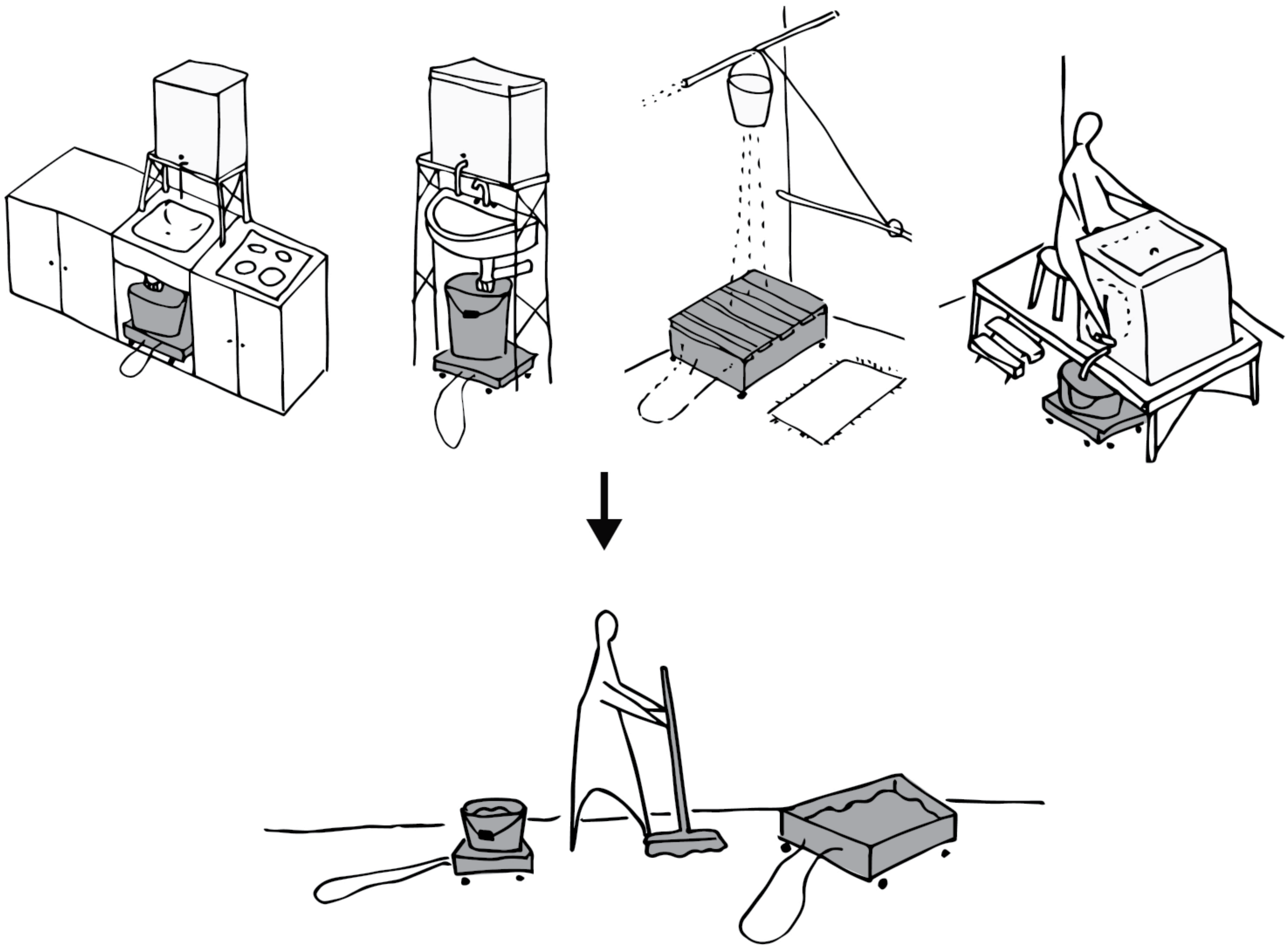
82. “Bucket” Shower

Lastly, plenty of water consuming washing machine I have replaced with a pedal-powered one. Such washing machine reduces water consumption from 45 gallons to 10 gallons of water per load (fig.83).



83. Pedal powered washing machine

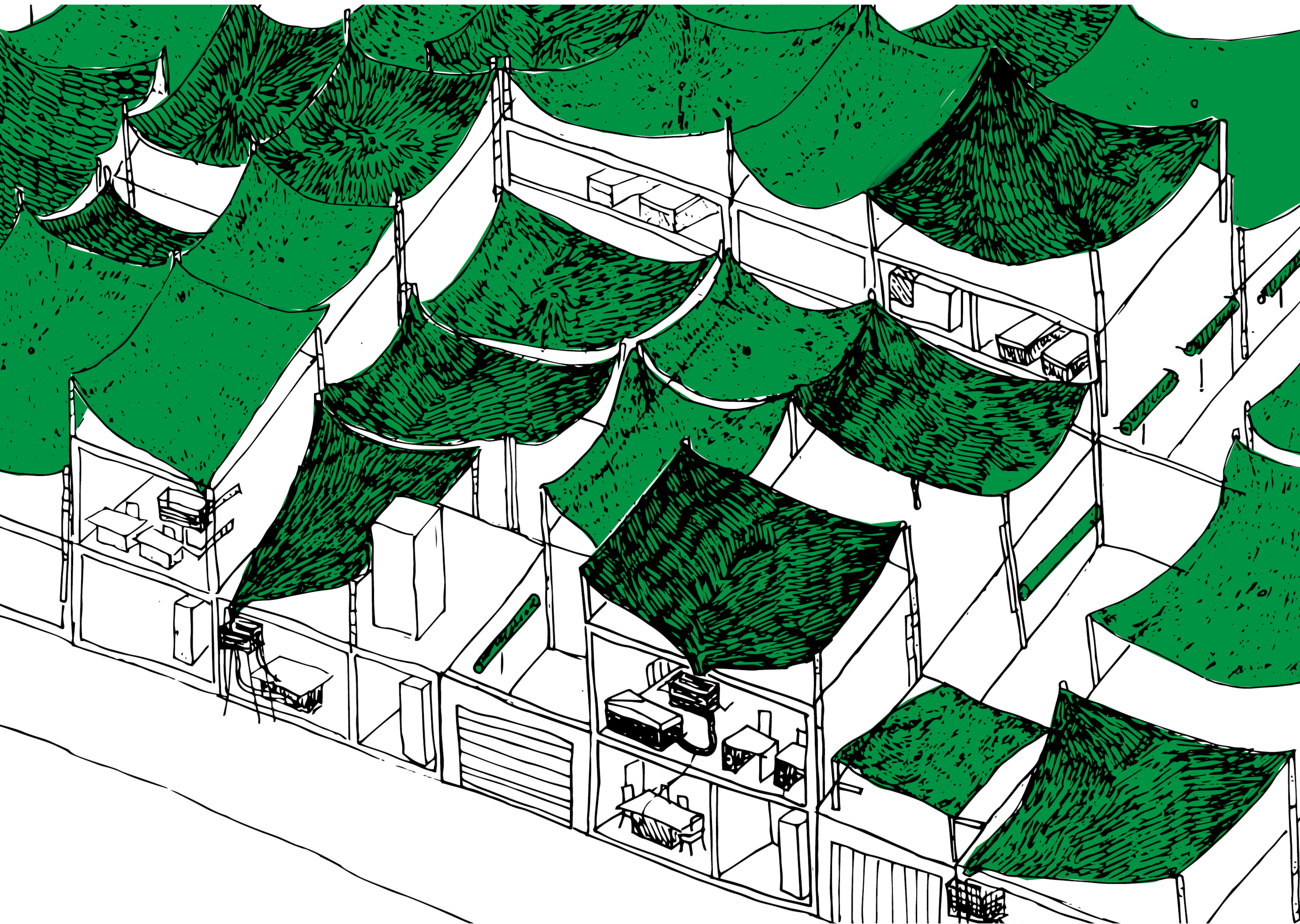
The long lasting shower I have transformed into a "bucket shower", which comprises of a simple perforated container filled with water and suspended above the bather. Such shower reduces water consumption from 25 gallons to 2.5 gallons of water per bath (fig.84).



84. Domestic grey water re-use system

To sum up, my devised rainwater harvesting systems and transformed domestic water related appliances together are forming a seamless aquatic domestic landscape. Such Interior setup in a context of water crisis facing Iztapalapa in Mexico City is supposed to help poor disempowered local people to obtain and treat domestic water with care and responsibility. All these structures are supposed to be made by locals themselves from local found materials (fig.85).

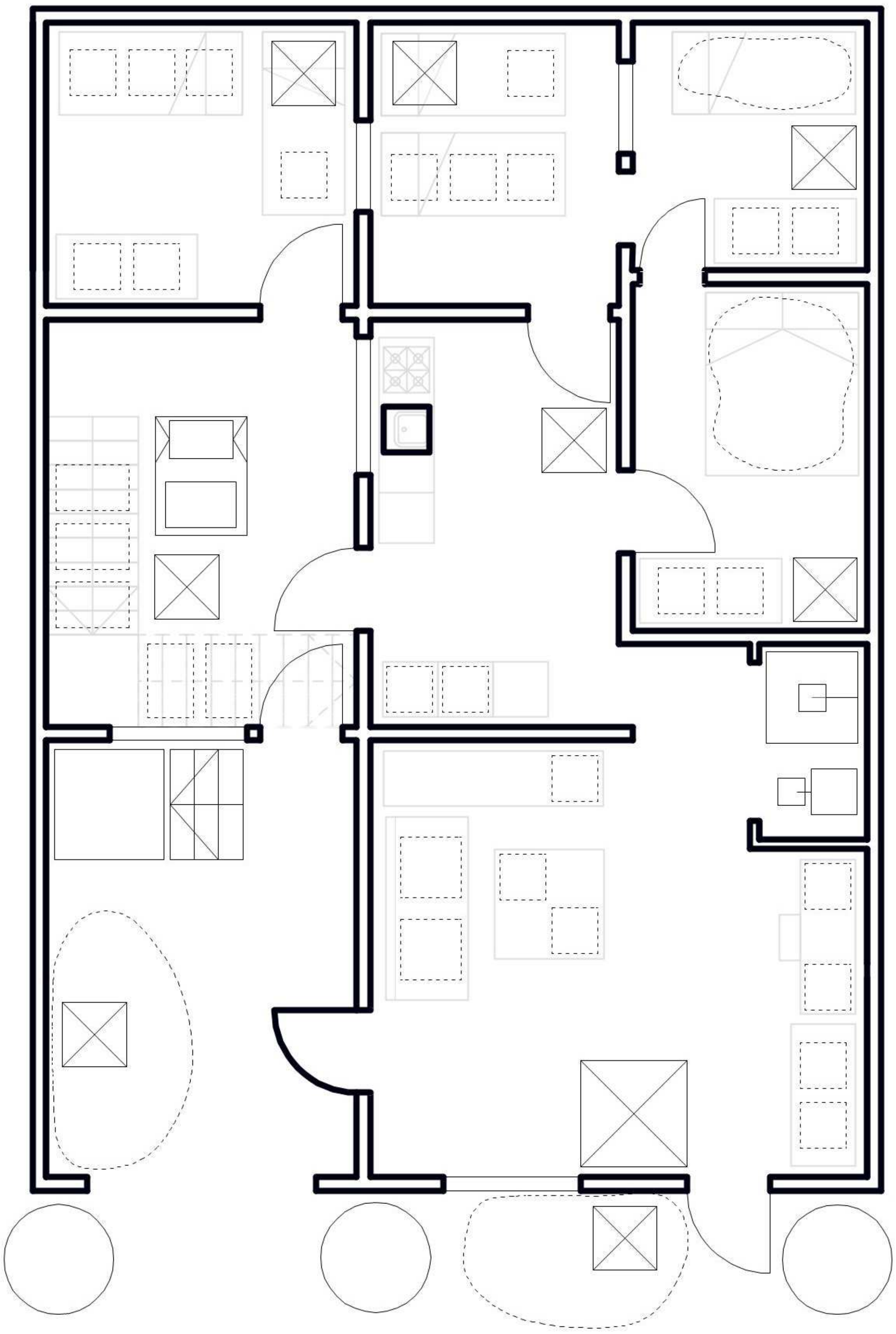
85. Areal view after new systems application



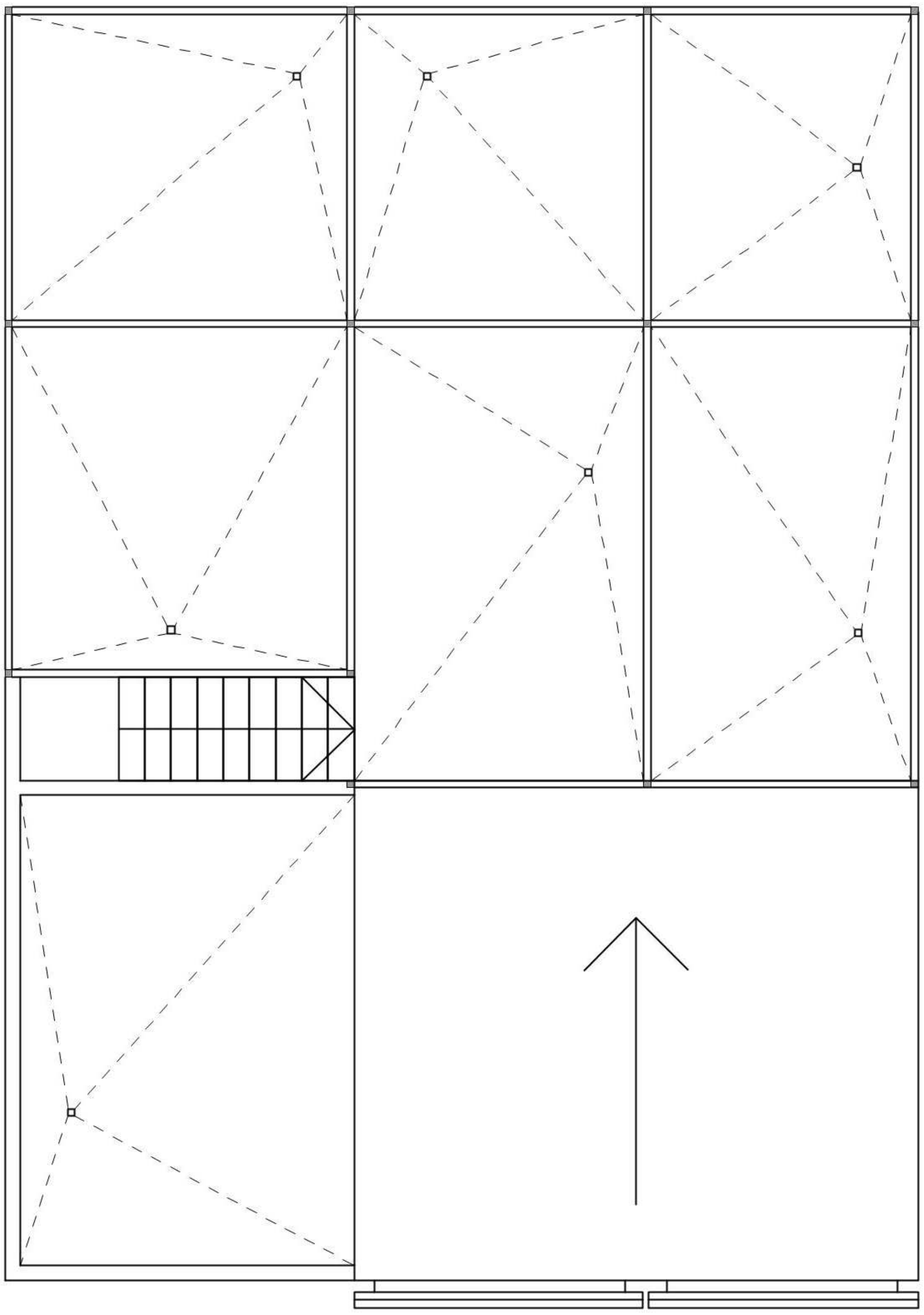
3.2 "Casas del Aquas"

Following my design strategy I have upgraded and detailed my chosen house domestic water landscape. Such transformed domestic interior serves as an example od how to threat water for all Santa Cruz Meyehualco neighborhood and eventually for the whole Iztapalapa district.

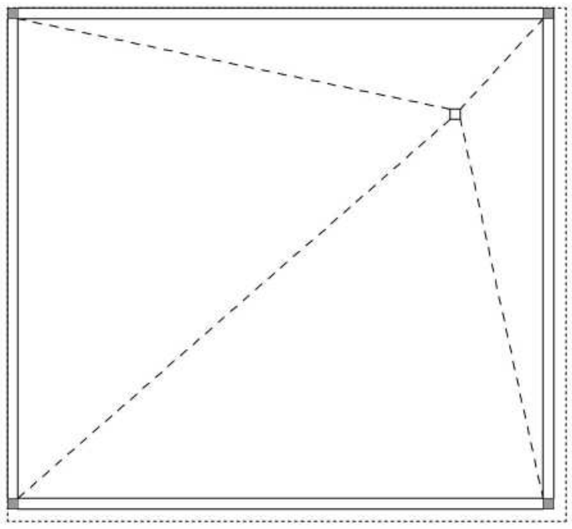
Thus, in this final part of my thesis I would like to present my more developed design project in drawings and photographs.



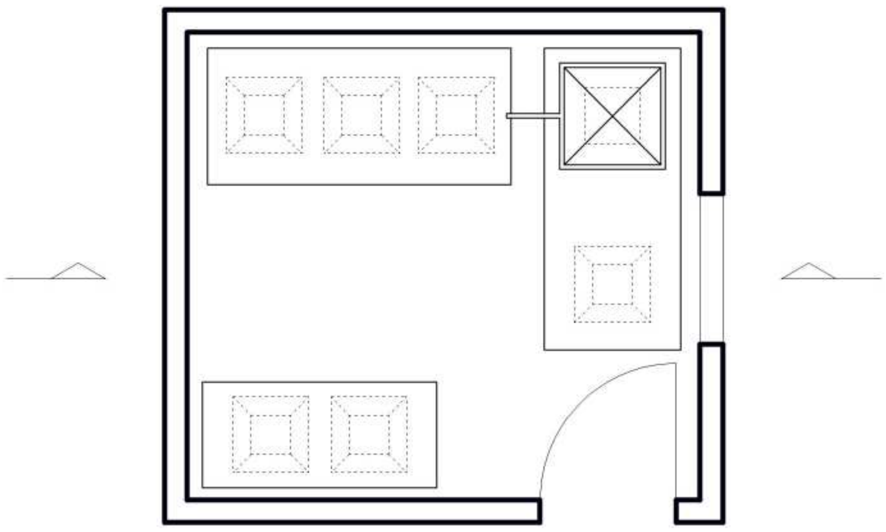
Floor Plan of the House



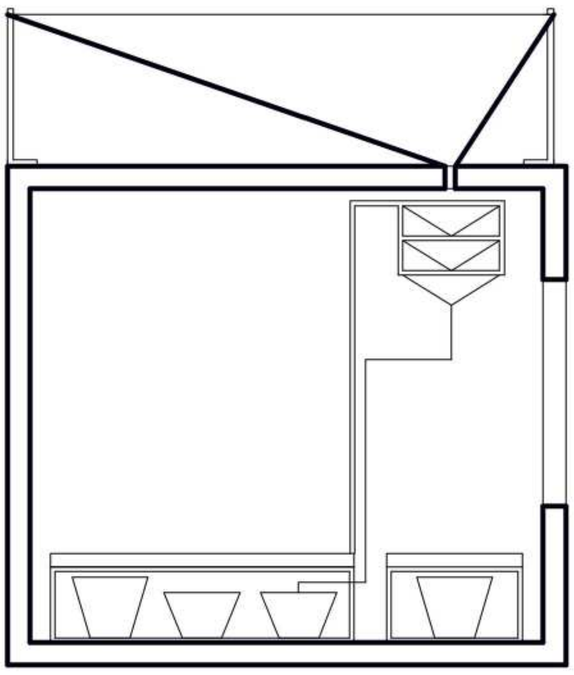
Roof Plan of the House



Roof Plan



Floor Plan



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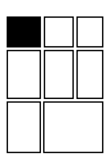

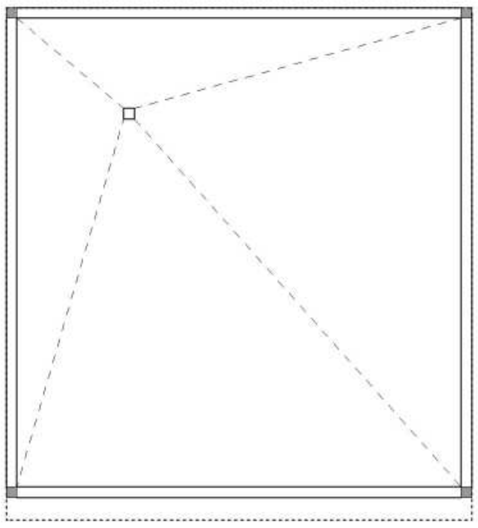

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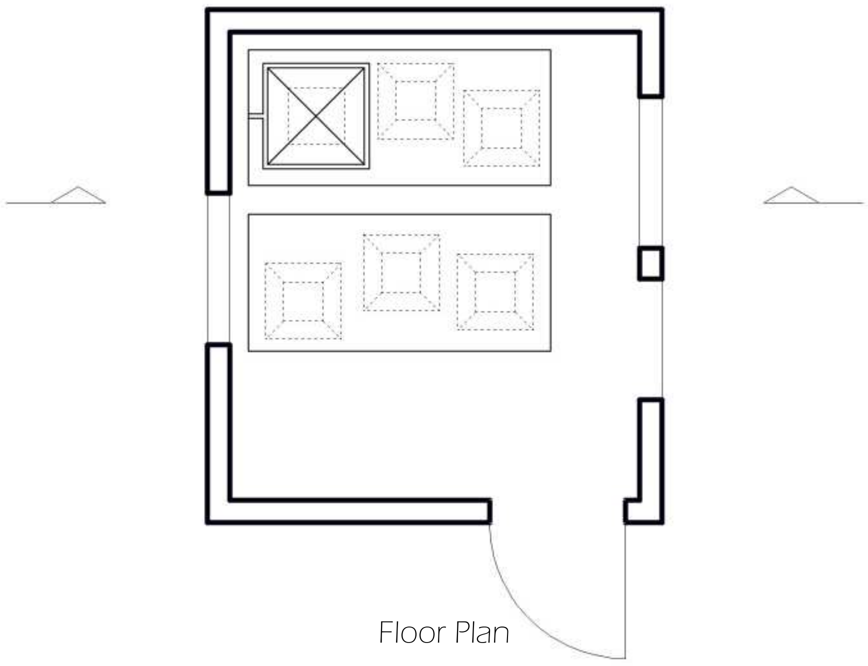

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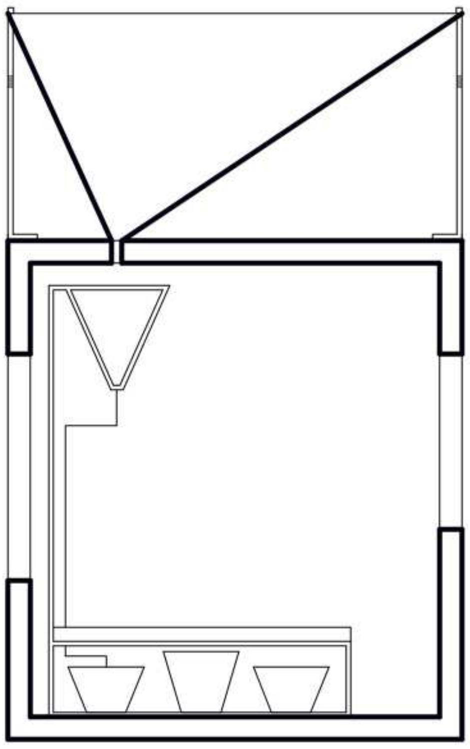

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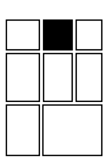

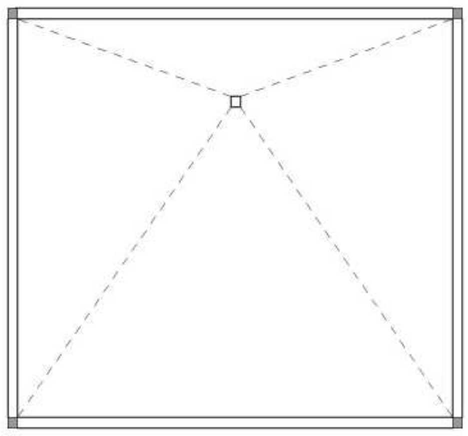

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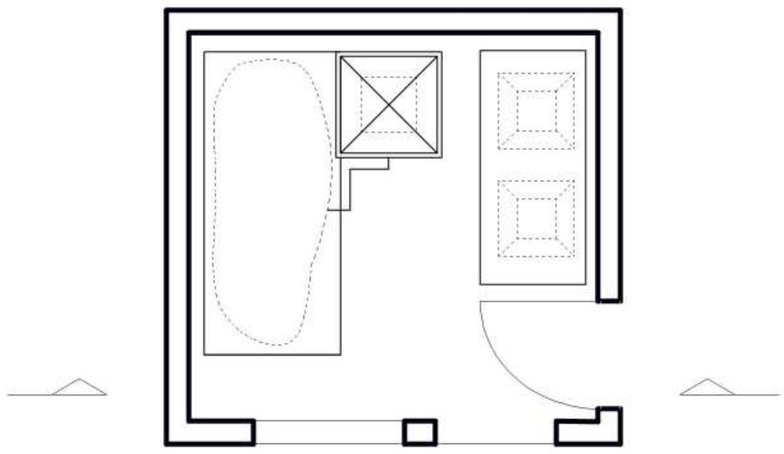
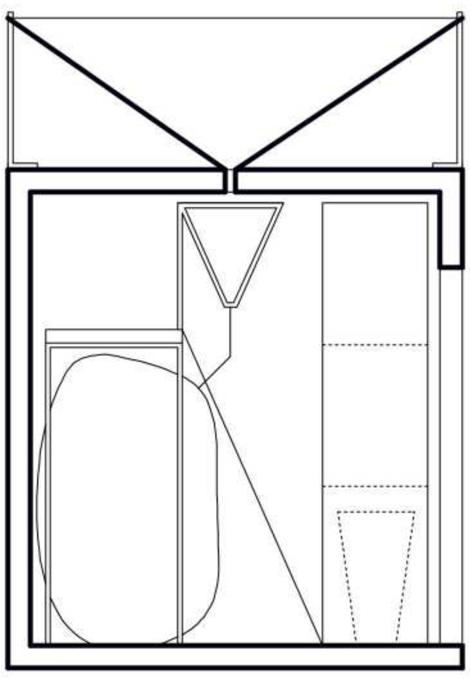


Floor Plan



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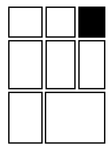

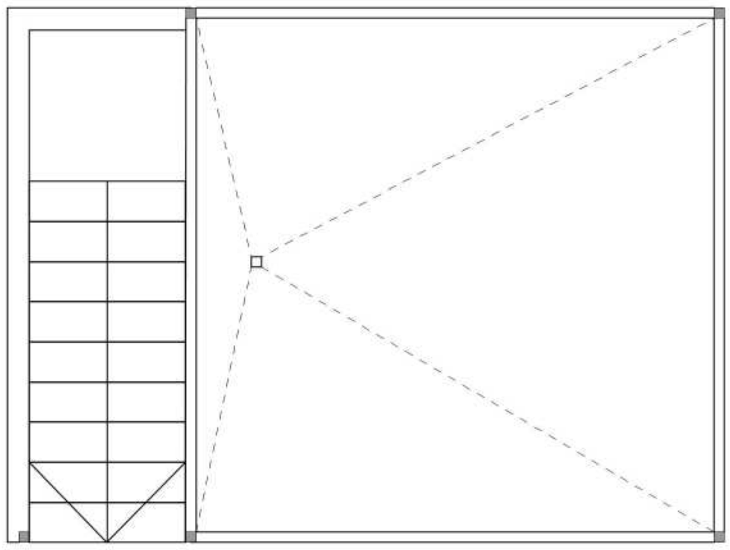

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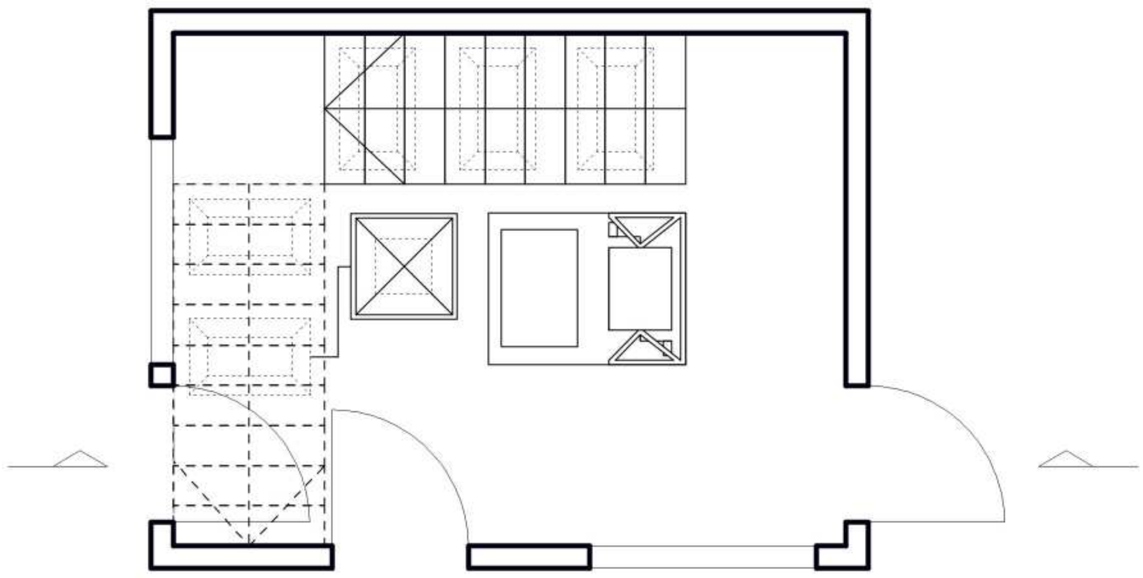

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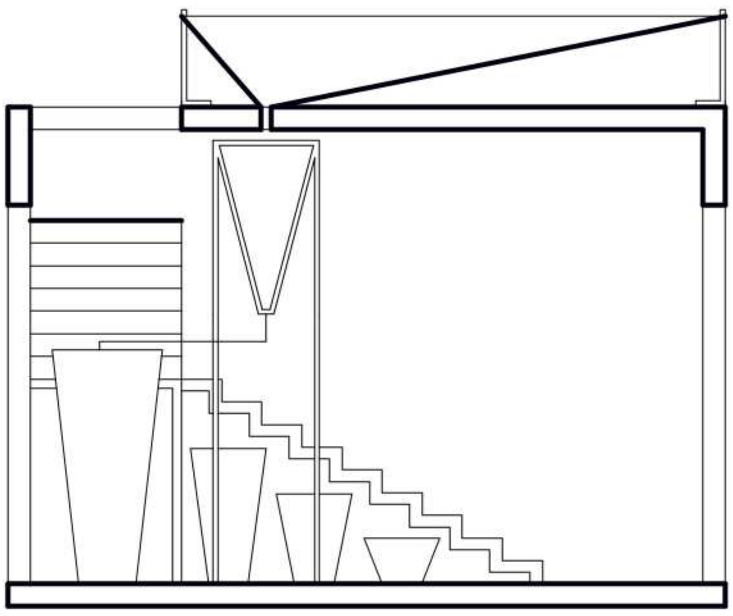

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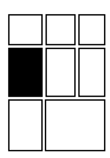

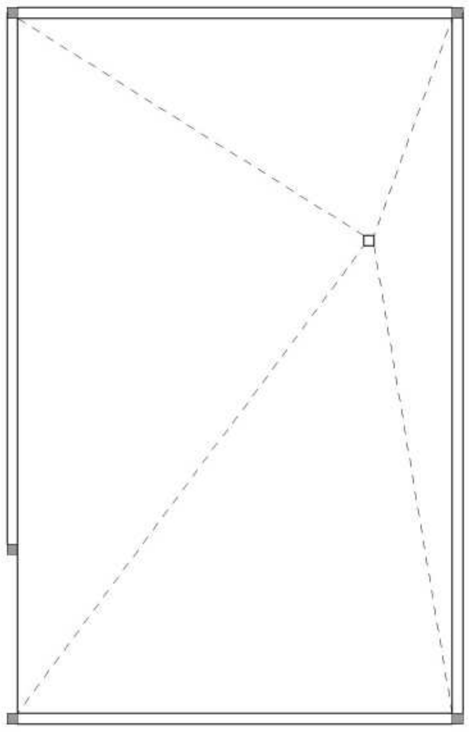

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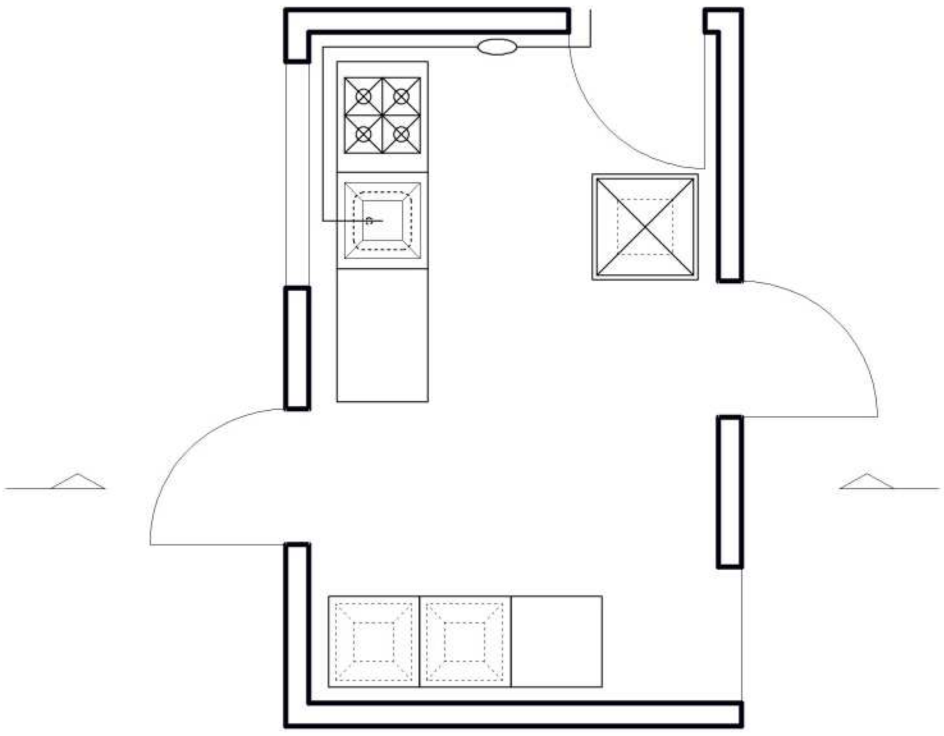

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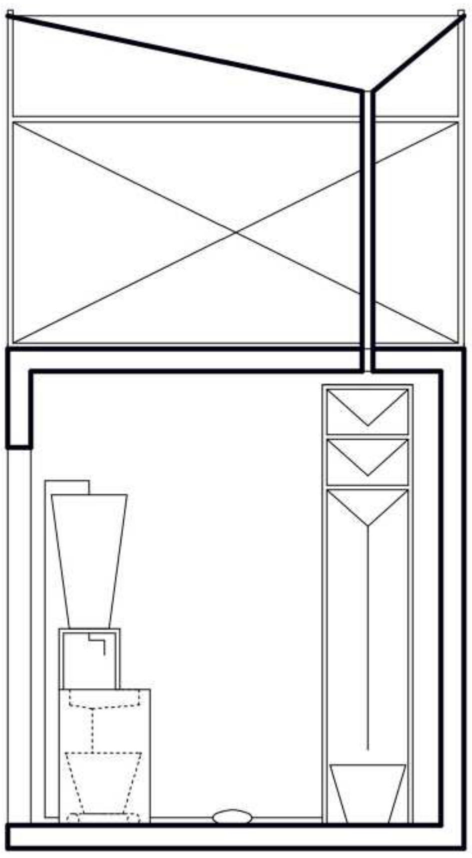

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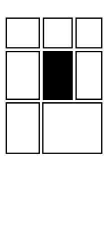

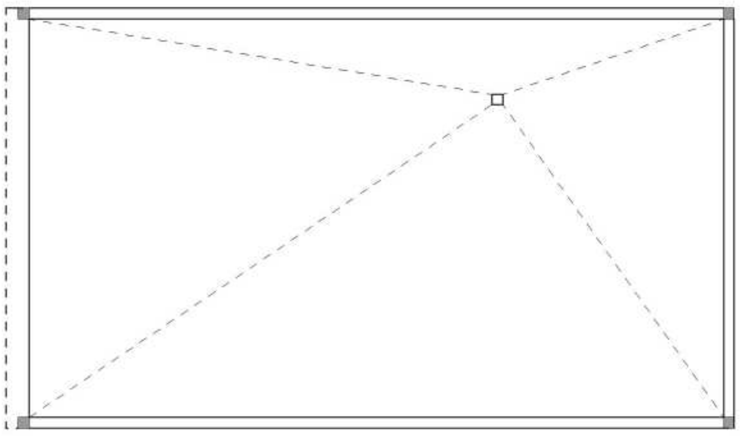
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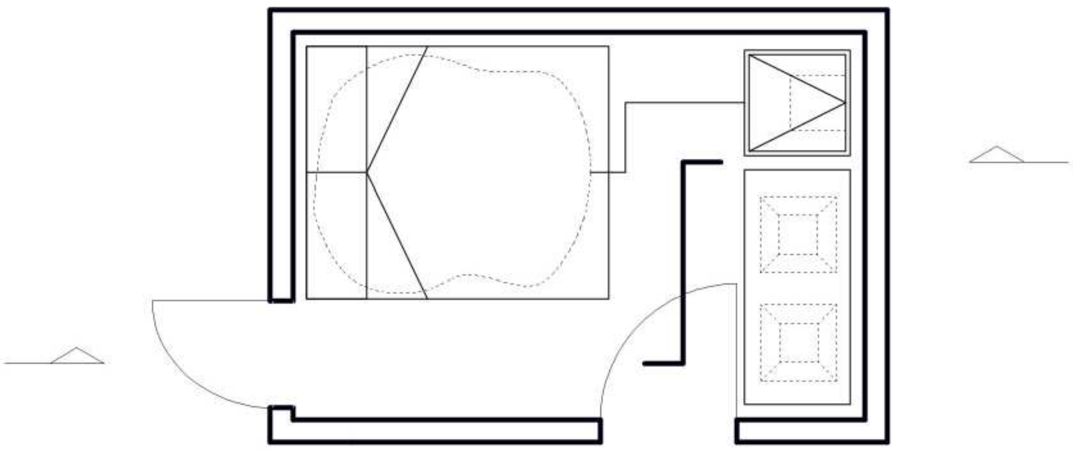
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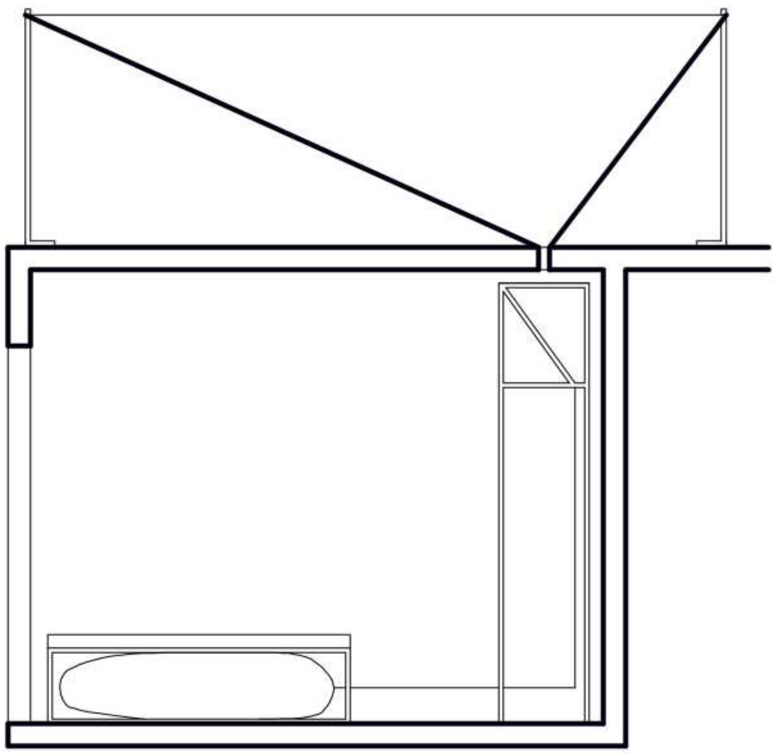
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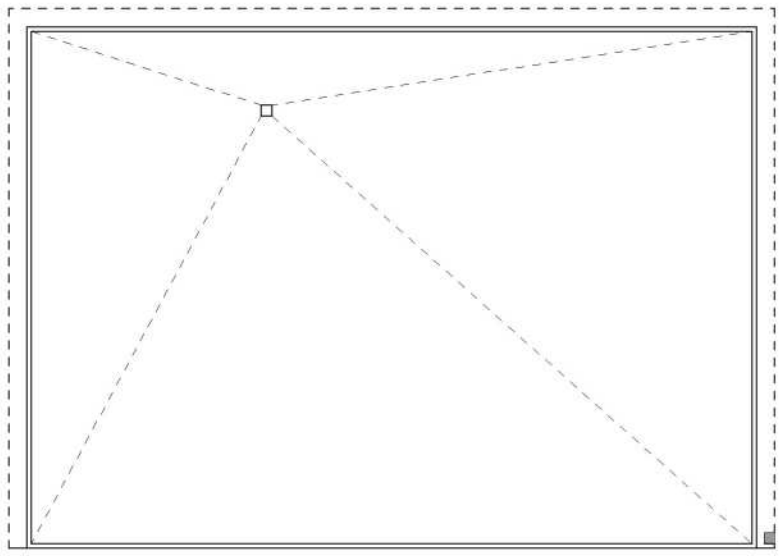

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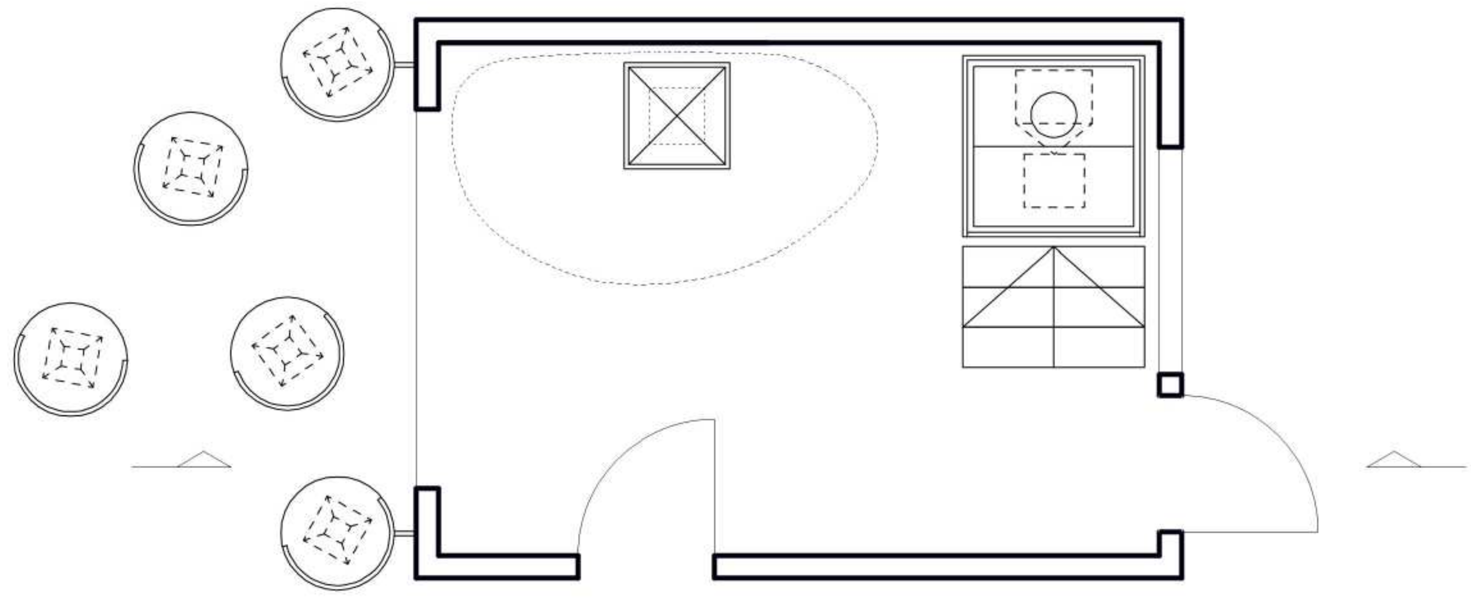

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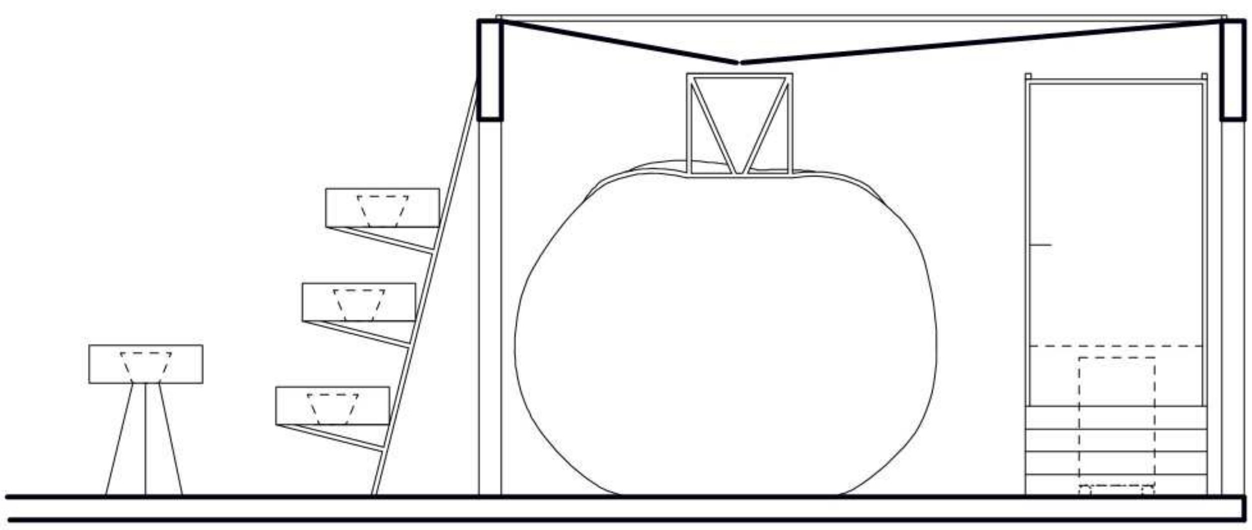

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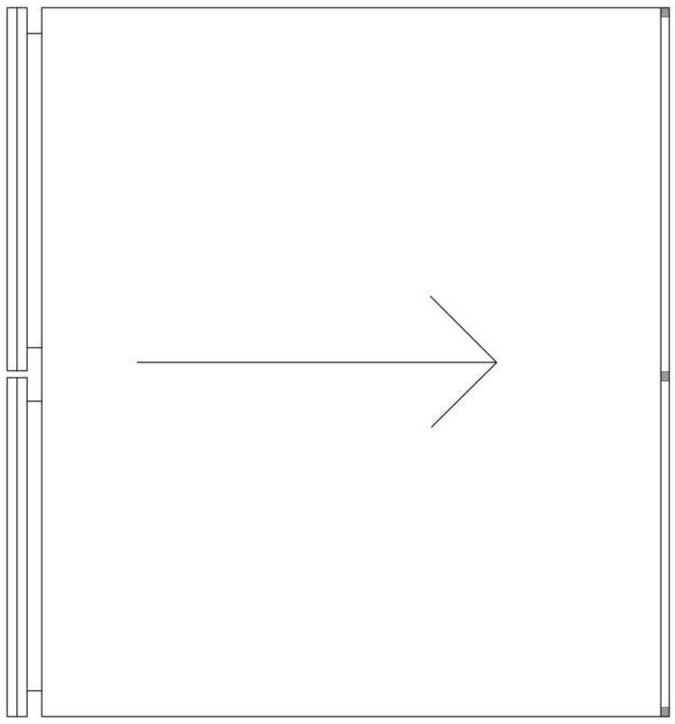

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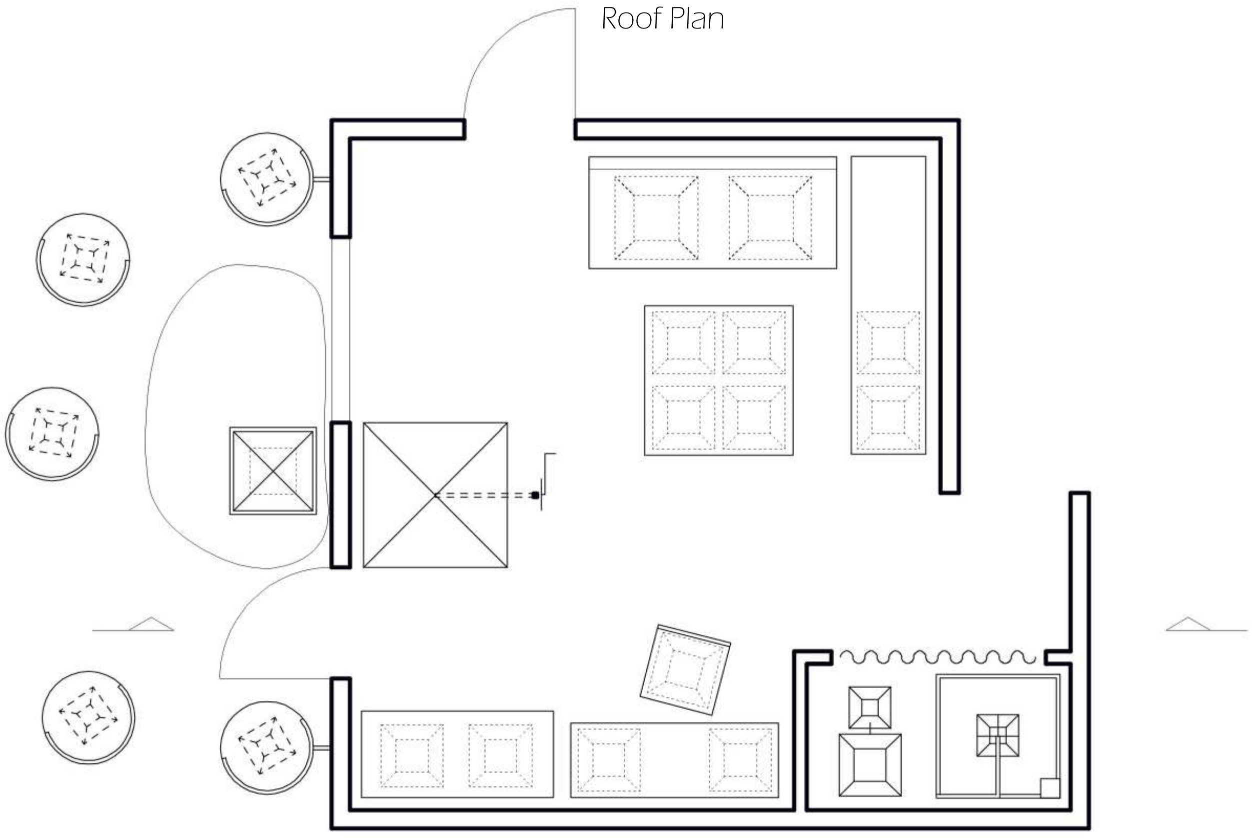

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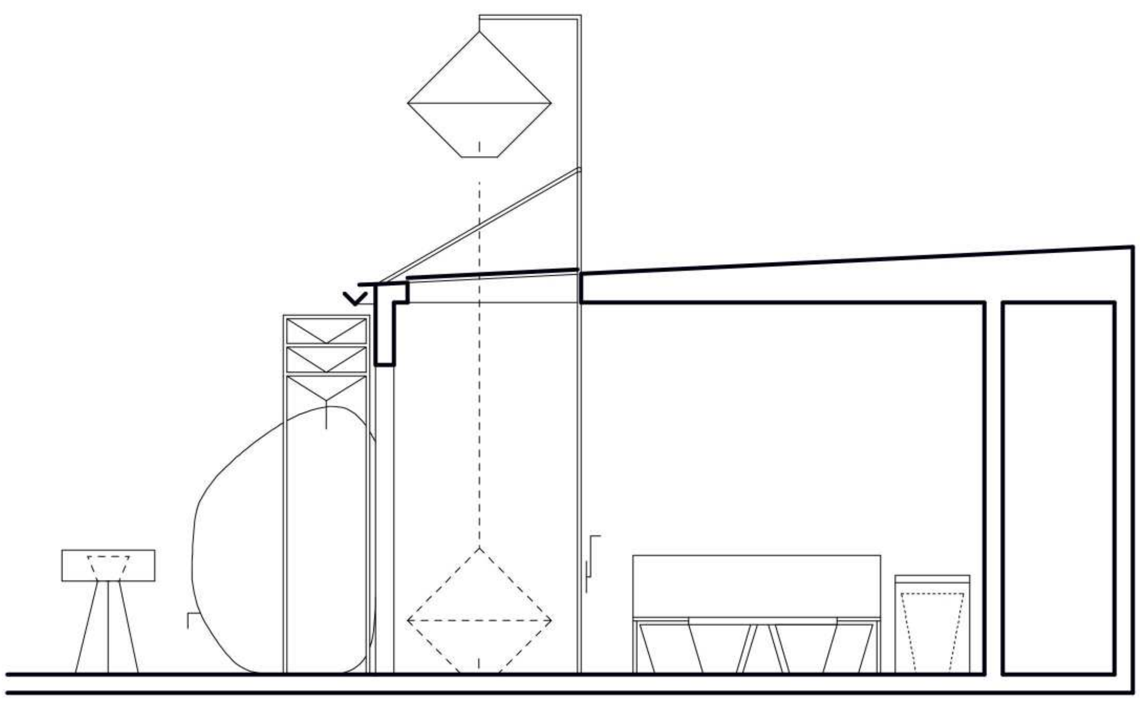

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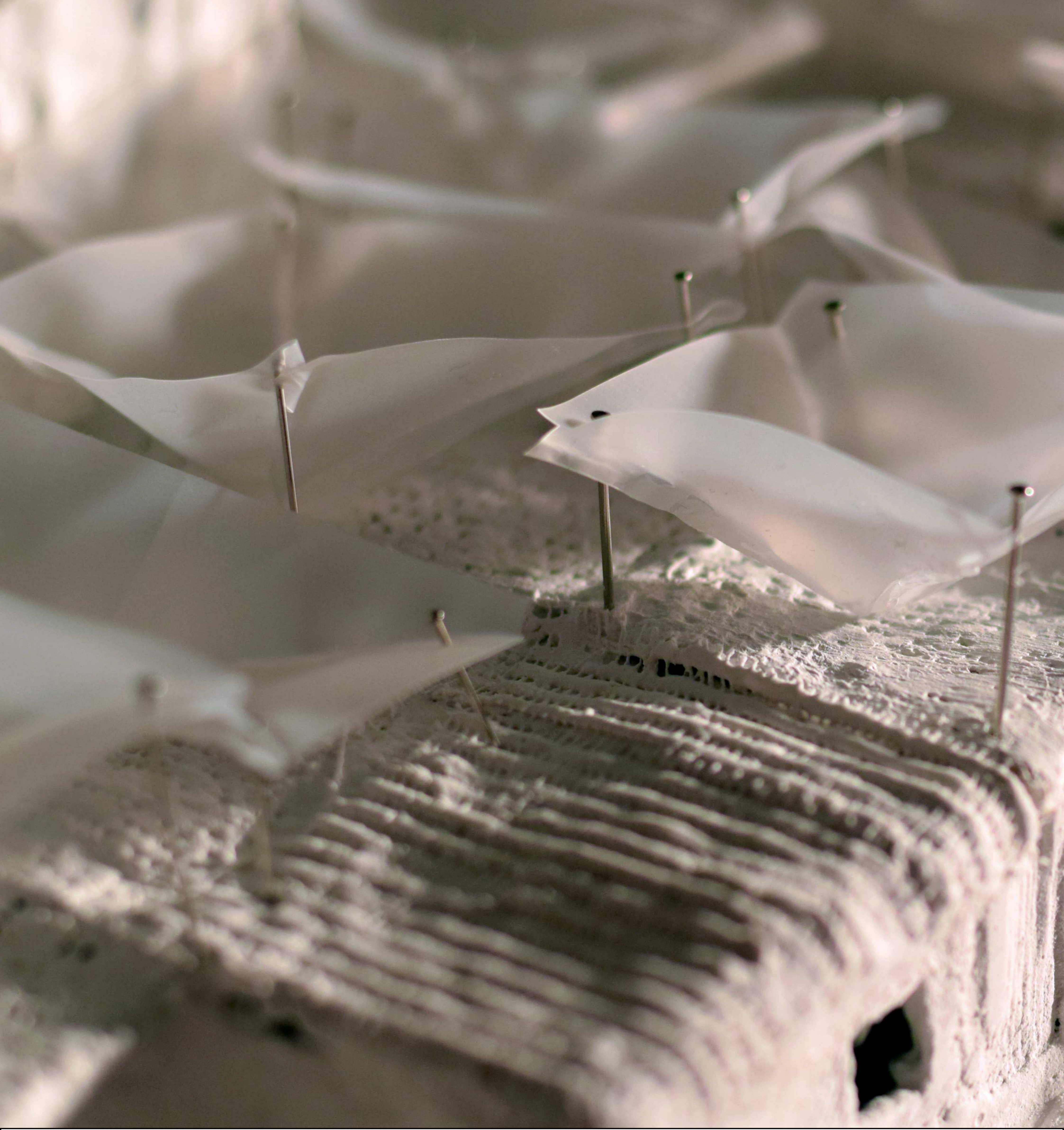

the Roof

the Filter

the Bucket

the Table

the Bed

the Cupboard

the Wardrobe

the Sofa

Water Tank

the Sink

the Sink

the
Washing Machine

Composting Toilet

the Solar Water Heater

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