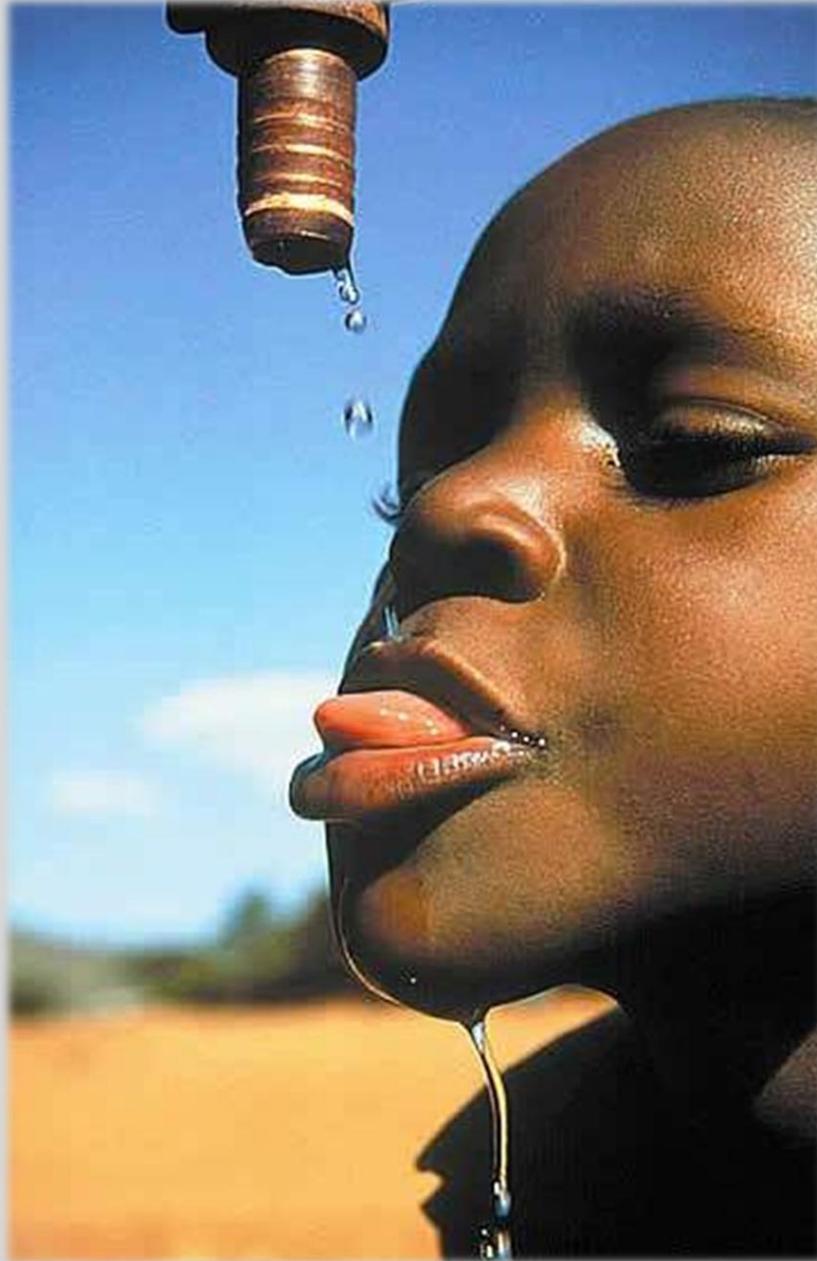


Aqua Para La Vida

Water For Life



“A waterkiosk as business: it cuts both ways.”

Van Hall Larenstein
L. Groendijk
Water Technologist

22th of January 2010

Vera Huijberts
Madieke van der Putten
Tami Welker

RSG Slingerbos|Levant
A. Pouw

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Prologue

Imagine... three young women from the Netherlands, just about to finish high school, first had to write a paper. Not knowing what to write about, their biology teacher, Mrs Pouw, told them about a project called **Imagine...** from Delft. Then their story began.

We didn't know what this project was about, so we searched for information on the internet. We really liked the concept of working with a scientist in order to implement a new technology. We knew we couldn't save the world with it, but in a small community we certainly could make a difference!

We started this project with **Leo Groendijk**. He is a scientist who has invented a simple way of water purification. He has helped us understand how the technology works, and we have done some simple experiments at the van Hall Larenstein institute. See page 16 for the outcomes of it.

Later on, we have met several people who have inspired us with their ideas and experiences. The final outcome of our effort is this paper. And we are proud of the result!

Every project should have a catchy phrase. We wanted to have one not only for the attention but also to make the point of view of this paper clear. Since our project will take place in a Spanish speaking country, we wanted a Spanish title. And our paper is about the need of water; so we came up with:

“Aqua Para La Vida | Water for life”.

This paper is more than just a piece of text. With it, we want to create awareness of big problems in the world. Every problem has a solution; sometimes it's complex but often the only thing that is missing is the motivation to solve the problem. We believe that with the right motivation, inspiration and hope this project can be successfully carried out.

**Vera Huijberts,
Madieke van der Putten,
Tami Welker**

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Throughout this paper there are references to the appendix. The information in the appendix illustrate, explain or give additional background information on certain subjects. The references look like this: (subject, page on which the information can be read).

Summary

Everyday **4000 children die** because of a lack of clean drinking water. They get diseases like cholera and diarrhoea, and because of that they get dehydrated and eventually die. This problem can be solved very easily by providing them with clean drinking water.

It is a worldwide problem, which is worse in developing countries, for example **Ecuador** in South-America. The blue province Imbabura is known for its great amount of natural lakes, but most of them are contaminated. 39% of the people in Ecuador do not have access to clean drinking water.

Leo Groendijk, a water technologist, has invented a simple water purification system, which is sustainable, easy and cheap. This is the **Mobile Water Maker**. This water purification system uses a ceramic membrane in order to clean the water.

There are 4 phases in this process of cleaning:

Phase 1: With an easy water pump the water is pumped into the water storage, which is placed above the Water Maker.

Phase 2: Since there are lots of big objects like tree branches and leaves in the water, this will be filtered out by the prefilter. The objects that are filtered out have a diameter bigger than 0.5 mm. This prefilter can be anything from a piece of clothing to a towel.

Phase 3: By pressing a button, the water will fall through the membrane. Since there is a valve at the end of the membrane the water has to go through the membrane and everything bigger than 40 nm will be blocked.

Phase 4: Then the water will be free of bacteria. To make sure the water won't be contaminated right away after exposing it to the open air, an electrolysis will take place.

The clean water will be sold in a **kiosk** run by 4 local women. In setting up this project it is very important to focus on the community. They will be involved in every aspect of setting up this water kiosk. In total the time to set up this project is 24 months. It will cost \$13,080 to set it up, including three Mobile Water Makers.

A Dutch organization, called Impulsis, will provide a subsidy of \$12,500 and an Ecuadorian microfinance institute, called Finca, will give a microcredit to the women of \$700. This way, the women feel more responsible and in charge of their water kiosk.

The water will be sold for \$0.09 per liter. This will result in an income of \$23,000.

The yearly costs like wages and maintenance are \$20,000, which gives a profit of \$3,000.

As shown already, this is not just a **cheap** project but also gives an economical impulse to the community. The profit made will be invested in schools and sanitary facilities. All of this will result in a lower child mortality.

By giving the women a responsibility and a job their position will improve. Because of the hierarchy the women will probably be wife's of men with a high status. It is important to realize that that is still a breakthrough since those women don't have rights themselves.

The Mobile Water Maker is a sustainable, easy and cheap way to provide a community with clean drinking water. This will reduce the number of children who die due to a lack of hygiene.

Introduction

In the western world, extreme poverty, hunger and thirst are things that are rarely seen. Of course, the media does report that somewhere in the world people are struggling for their lives. That they are struggling just to be able to feed their babies and to make sure their offspring will survive. This project is our contribution to make the world a little bit better. To make the people in our bubble think about the issues, and convince people to undertake some action as well.

The lack of clean water is deathlier than the lack of food. This is a serious problem which should be tackled. Water is the essence of life. Our planet surface is covered with water for 71%. In total 2.5 % is fresh water¹. This comes down to 8.6 million m³ of fresh water². So why is it that over two billion people still do not have access to clean drinking water? Everyday more than 4.000 children die³ because of a lack of clean drinking water.

How can the people without access to clean drinking water be helped?

First of all, the technology is available to make this change. But there is more to this project, besides providing them clean drinking water. We have focused on several points:

- The purification technology: how it works and in which way it can be integrated in a developing country.
- The place: which community we want to help, and what the economical, social and political situation of that country is.
- In which way the water purification technology can be integrated into a sustainable project.
- The communication with the local people, and how this project can be set up and realized.

So there is no need to waist more time. Why shouldn't we try to fulfil one of the primary needs in life: clean drinking water?

The technology is ready, so let us help the world!

¹ <http://www.lennotech.com/water-trivia-facts.htm>

² <http://www.waterforlife.nl/Nieuws/AllNews/Schoon+water+niet+voor+ieder+kind+beschikbaar.htm>

³ <http://www.waterland.net/index.cfm/site/Nederlands%20Watermuseum/pageid/9CAB2B5A-BCE3-A35A-0B9D7985AE4387F8/index.cfm>

The purification technology

Requirements

It is important to know what kind of technique or technology could be used in a developing country. We came up with some **requirements** that this system should meet in order to be successful.

It should have:

- An effective disinfection of the water.
- An easy maintenance; no difficult actions needed in order to maintain the purification system.
- Low energy need and only sustainable parts.
- No or little human interference in the process of producing clean water.
- An easy and healthy way of transporting the clean water to the local people.

Throughout this project, these conditions should be kept in mind and have to be met.

The working of the Mobile Water Maker

The water purification technology uses a ceramic membrane (ceramic membrane, 18) in order to clean the water. The system itself is called the Mobile Water Maker. A schematic inside of the Mobile Water Maker can be seen in figure 1.⁴ The water that is cleaned can only be taken from surface water (e.g. a lake or river). The Mobile Water Maker is illustrated in figure 2⁵.

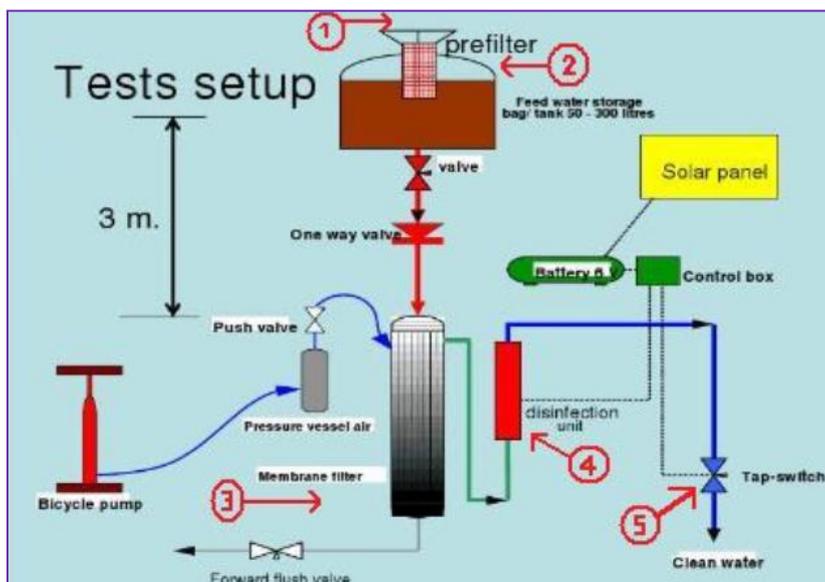


Figure 1: the numbers correspond with the phases during the purification. Figure 2

There are five phases in the process of cleaning the water:

1. The water is pumped into the water storage that is placed above the actual Water Maker. This pumping can be very exhausting but we will be using an 'easy water pump' (easy water pump, 18). With this, the water is easily pumped to a height of three meters.
2. **Prefilter**: This water contains lots of big objects like tree branches and leaves. These should be filtered out of the water, this is done by the prefilter. The water that is pumped will fall into the water storage, which is situated just above the Water Maker. The prefilter is placed just above the water storage, anything bigger than 0.5 mm will be stopped from falling into the water storage. This filter can be anything from a piece of old clothing to a towel.

⁴ <http://www.mobilewatermaker.nl/>

⁵ Leo Groendijk

3. **Membrane:** A one-way valve at the end of the water storage will prevent the water from falling into the actual Water Maker. By pressing a button, the valve is opened and there will be a flow going from the storage *through* the membrane. When the water falls down, there is a pressure build up that pushes the water through the membrane (there is no other way 'out' since there is a hold at the end of the tube). This membrane is made up of special ceramic filters which are very small: they have a diameter of about 40 nm. The membrane is permeable, so the water can flow through it, but the smaller contamination and bacteria get stuck in the membrane, since those are larger than 40 nm.

4. **Disinfection unit:** This water will be free of bacteria and other contamination. But, to be sure, we will use a chemical reaction that will kill every harmful thing that is still in the water. Naturally there are chloride ions in the water. Using 4 electrodes, these chloride ions will go together with hydroxide to form HOCl. This molecule kills micro-organisms that are still in the water. In addition to this, the water will stay clean from bacteria for eight hours, since the HOCl stays in the water and will kill any bacteria that gets into it. (disinfection unit, 18). Since there are electrodes used for this chemical reaction, energy is needed. This will be provided by a small solar panel.

5. The clean and healthy water can be tapped.

Since heavy metals or other heavy pollutants will not be filtered out of the water, it is important to keep in mind that this Mobile Water Maker can be used *only* for surface water without heavy contamination.

The process of cleaning

As already stated, by using the Mobile Water Maker the smaller contamination gets stuck on the membrane. When using it thoroughly, there is a layer of **cake** formed in the membrane of these particles. This results in a slower speed of filtering and will eventually stop the filtering.

Therefore, cleaning of the membrane is needed. The particles get stuck *in* the membrane (rather than *on* the membrane). During the night (when the Mobile Water Maker isn't used) the membrane relaxes and the cake loosens. Therefore it is better to clean in the morning. In the morning the first thing that should be done is the so-called **Back Wash**. First, with the bicycle pump a pressure of about 6 bars is created. Then with one push on the button, this pressure can be released on the outer side of the membrane. So in fact, the air is going in the opposite direction from the contaminated water, taking the cake with it. After this, the cake is loosened from the membrane. A **Forward Flush** washes the cake away, out of the Mobile Water Maker. This is done in the same way as the normal water purification. The only difference is that the water will not go through the membrane, but will fall down the membrane and flow through a valve that is opened. It is tapped, though using a different crane, and thrown away. After this, the cleaning process of the Mobile Water Maker is done. This should be done every day!

Usage in a developing country

It is important to realize that this technology should be introduced in a developing country.

Since the water shouldn't be contaminated right away, the water will be distributed in jerrycans of 7 L. Those should be cleaned once a week. They are rinsed with cleaned water to which some soda⁶ or table salt has been added. 3 tablespoons of table salt is sufficient to clean the jerrycan. After this, the jerrycan is shaken. The soda can be gotten from a local shop in the area.



Figure 3

The contaminated water needs to be transported from the lake or river to the Mobile Water Maker. The distance will be a few kilometres. The best way to do this is using a large a large barrow, this is shown in figure 3⁷. This will be something that can be made from local products, or is already there.

⁶ http://www.proximedia.com/catalogue/photos/189334_a.jpg

⁷ <http://img-fan.theonering.net/rolozo/images/herring/barrow.jpg>

Ecuador

Choosing a country for our project, we focused on several conditions. Like the presence of surface water, the possibility to communicate with the local people, and it had to be a third world country. But we also wanted a political stable country, since instability makes it hard for a country to develop itself. Africa comes in mind first when talking about Third World countries, but it is also important to focus on other parts of the world. The two countries that stood out were Ecuador and Indonesia, since those are developing countries and are political stable.

There was communication with organizations that worked in Indonesia as well as with people working in Ecuador. At first, Indonesia was our first choice. But the communication with the organization in Indonesia was very difficult. However, in Ecuador there were people very enthusiastic about our idea. The organization is called 'The Azama Project' and carries out projects in order to improve the facilities in rural communities.

South-America

This continent has 563 million inhabitants⁸ of which 20%⁹ does not have access to clean drinking water. This continent is developing strongly at the moment, but still a few countries stay behind and need lots of help. For example the country we have chosen; Ecuador.

Ecuador

The country is called Ecuador because it is situated on the equator. Ecuador is a democratic country with a president called Rafael Correa. It is political stable and a member of the United Nations.

Ecuador has about 13 million inhabitants of which 29%¹⁰ does not have access to clean drinking water. In the rural areas this percentage is even higher: 39% doesn't have access to clean drinking water. They have low wages and poor sanitary facilities, only 51% have got access to good sanitation.

Until the 70's, Ecuador was one of the least developing countries in South America, but then in 1967, Texaco discovered large amounts of oil. Even though it is now their biggest source of income, in 20 years, that oil reserve will be empty. The industry is mostly based on textile, vegetable oil, cocoa, sugar, tobacco, beer and rubber¹¹, but this slightly changing: the start to import goods for their own benefit.

Ecuador is according to the United Nations a **developing country**¹².

Imbabura

The Azama project focuses on the province Imbabura.

The specific place in Ecuador is going to be in the province of Imbabura. We have a contact there who is helping us to find the exact location and contacts for our project. It is located in the north of Ecuador as shown in figure 4¹³.

Imbabura is also known as the blue province, because of the great amount of natural lakes. Since this is what we need (fresh surface water), we think it is the perfect province for the project.

Imbabura is a countryside and there are little to no facilities in the villages. The people live in great poverty and absence of clean drinking water is a huge problem for their health.



Figure 4: the province Imbabura is shown.

⁸ <https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html>

⁹ <http://www.mapsofworld.com/thematic-maps/safe-drinking-water.htm>

¹⁰ http://www.fightingdiseases.org/main/country.php?country_id=53

¹¹ <http://www.landendweb.net/ecuador/economie/>

¹² <http://www.icce2010.org/docs/developingCountries.pdf>

¹³ http://en.wikipedia.org/wiki/File:Ecuador_Imbabura_province.svg

Project plan

A water kiosk

How can the Mobile Water Maker be integrated into a project, in such a way that this project is successful? About 85%¹⁴ of projects in developing country have failed to be successful. The common made mistakes can be seen in the appendix, page 19.

The best way to make this project prosperous, is to set up a water kiosk in Ecuador. This is a small company managed by local women, that sells clean and healthy water for a low price to the community.

This gives a lot of benefits:

- The women who are in charge of the water kiosk feel directly responsible for their company. This gives large **involvement** of them . And with them the community sees that this project is more than the technology only.
- Since women will be in charge, the **position** of the women will improve. People will see that also women have the right and ability to do something vital. Nowadays only 31% of the women are employed, which is low since 89% of the men are employed. And the percentage of women who work in rural areas is even lower! With a water kiosk, this problem is addressed.
- The Mobile Water Maker will be used in the water kiosk for water purification. Of course we can't cope with large companies as SPA mineral water, but we will be able to sell the water for a low price which the local community *can* afford, rather than for an unfair and too high price.

Setting up the water kiosk

Setting the water kiosk up right away will give a lot of problems. It is vital to communicate with the local people first. They should be involved, not only as 'customers' but also as people who feel responsible and proud of their water kiosk. First, a social network should be created around the kiosk. The **community leader** is very important in this part, because he is the person the whole community listens to. If he is enthusiastic about this project, and understands where it is about, then the whole community will be more willingly to participate as well.

We have decided to have **four women** in charge of the water kiosk. Because then they are responsible together rather than alone. And they can deliberate and solve problems together. In addition to that, the women probably don't want to work every day in the kiosk. Therefore, they can decide who is working when. It is most likely that two women will get the water in the morning, and one is cleaning the kiosk and the Mobile Water Maker and the fourth one has a day off. Of course it is not definite that it will be four women, three or five is fine as well.

In those small rural communities, the hierarchy is very important. So that is why the community themselves should decide who is going to be responsible of this water kiosk. It is likely that the women chosen are the wives of men with a high status. It is important to realize that that is still a breakthrough since those women don't have rights themselves. So the position of the women will change.

In figure 5 the phases that can be distinguish in the process of setting this water kiosk up are shown. In the last column one can read why these phases are important, or an explanation. There are four phases, and in total the time taken to set this project up is 24 months. It perhaps sounds long to take 2 years for the set-up of this project, but in the end the most important thing is that project will last forever. And, as explained earlier, a broad social network is essential for the success of the water kiosk.

¹⁴ <http://www.ejsdc.org/ojs2/index.php/ejsdc/article/viewFile/277/176>

Figure 5:

	Duration	Description	Note
Phase 1	6 months	<ul style="list-style-type: none"> • Get in touch with the community leader(s) in Ecuador. • Be informed on how big the problem of contaminated water is. • Investigation of the surface water; what is the degree of contamination? 	Since the Mobile Water Maker only works when the water is not contaminated with heavy metals or chemical pollution, it is very important to know the degree of contamination of the surface water. See 'The water purification' for more details.
Phase 2	4 months	<ul style="list-style-type: none"> • Investigate which community members want to be involved/responsible for the water kiosk. Especially focusing on the women instead of men. 	
Phase 3	8 months	<ul style="list-style-type: none"> • Build the water kiosk, done by local people. • Transport the Mobile Water Maker to Ecuador. • Teach the 4 women on how to use the Mobile Water Maker and accounting course. • Inform the community members on why the water of the water kiosk is healthy and free of bacteria. 	It is important to inform the people on why this water is healthy. This will be done with pictures, through the community leader as well as at schools.
Phase 4	6 months	<ul style="list-style-type: none"> • Start using the water kiosk. 	This last phase is used to help the 4 women with introducing the water to the local community, and sorting out starting problems.

Transfer of knowledge

In order to teach the 4 women on how to use the Mobile Water Maker (phase 3, figure 4), we have made drawings showing them what to do when. They portrait the actions needed (those are discussed in “the process of cleaning”, page 7). See the pictures at the end of this paper, these are in plastic. Besides those pictures, they will be taught how to use the Mobile Water Maker. The drawings are additional, in case they don't know what to do they can use them. They also need to get an **accounting course**. Since they aren't used to cope with a large sum of money, they need to how to record all their expenses.

Business plan¹⁵

Every business, no matter how small it is, needs to have a business plan. Otherwise it can become out of control. Therefore, we came up with a business plan of the water kiosk.

Main long-term goal: Providing a small community (around 300 people) living in poor conditions with a future in which they do not have to worry anymore about the presence of the basic needs.

Mission: To bring clean drinking water to developing countries, so the living conditions of the people will be improved and children get the chance to grow up healthy.

Strategy: To provide the community with healthy drinking water by using the Mobile Water Maker. This will be done by setting up a water kiosk, which is managed by local women. They use the Mobile Water Maker to produce healthy water which they will sell for a reasonable price to the local community.

Target: A local community of about 300 people. The main focus are women and children: this group usually takes care of getting the water and the food. Especially mothers take care of the water for their husband and children.

Competition: Although there are no competitive businesses, it is important to keep in mind that the people are used to getting water in their own way. This is usually a well that is very far away and most of the times polluted. But it is free and the only way for them to get drinking water! So it has to be made clear that drinking polluted water is bad for their health. This will be done by instructing them about the consequences of drinking polluted water, e.g. talking with the community. The four women will be taught about these consequences and they can instruct the other women of the community. And for just a little bit of money they can get clean drinking water which is also very near.

Marketing mix:

- **Product:** Our product is clean drinking water as well as a jerrycan. People use 3.5 L water each day¹⁶. They take it in a jerrycan that can be refilled on a daily basis. Every day they can take their jerrycan and fill it again. This jerrycan is owned by the water kiosk. The people pay a surety and for that they can clean it once a week. If they do not need the jerrycan anymore, they can get the surety back. Because of this 'cleaning service', the people can always transport the water in a clean jerrycan. Clean drinking water is no use for anyone if it is put in a dirty jerrycan. In a community of 300 people, two-third will be buying the water at the kiosk. So that is 700 litres a day that will be sold. Therefore, three Mobile Water Makers are needed to be able to provide this amount of water since it takes 1.5 minutes for cleaning 1L.
- **Properties of our product:** We are not planning on changing the status of the people by selling the water in a bottle. We are only aiming at the health of the people and not the commercial value. There is no expressive nor instrumental function.
- **Price:** Chosen is to sell 1 litres of clean water for US\$0.09. This is very reasonable since normally packed clean water is sold for over US\$1.15!¹⁷ See the financial plan for more details.
- **Place:** The kiosk is located very close to a surface water source like a river. The customer comes directly to the kiosk, so there is no need for distribution.

¹⁵ http://www.jongondernemen.nl/fileadmin/dam/documents/Handboeken_2009/JON_8_Handboek_HAVO-VWO_LR.pdf

¹⁶ <https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html>

¹⁷ <http://www.cambiosecuador.com/2008/12/salario-minimo.html>

Financial plan

Financially seen, this project should be achievable. In figure 6 an overview of the financial expenses during the setting-up of this project can be seen. Underneath, a description can be read. The total costs are US\$7.880. In order to finance these costs, a **subsidy** from a Dutch organization is used. This organization is called Impulsis (Impulsis, 18) and invests money in projects taking place in developing country. It is supported by the Dutch government and the EU. It's most likely¹⁸ that this project receives a subsidy of €9.500,-.

Another way this project will be financed, is a **micro credit**. Micro finance is an upcoming industry in lots of developing countries. The idea is to give (poor) people a small loan in order for them to set up a business and make money. By doing this, poor people can give themselves and their offspring a better future. A micro credit is a loan, so should be paid back. One of the reasons that micro finance is so popular in those countries, is because it gives people an opportunity to climb on the social ladder!

For this project, a micro credit is attractive as well. Not only to finance the costs, but also for the involvement of the women. The micro credit will be gotten from a local microfinance institute, called FINCA (Finca, 19). In the Ecuadorian culture, it is a shame when borrowed money isn't paid back. So the four women in charge want to pay the credit back. A local institute gives a social control on the financially side of the water kiosk as well. So the women are supported by FINCA and supervised.

Figure 6:

Costs:	Price in US\$:	Income:	Price in US\$:
Mobile Water Maker ¹	7,800	Subsidy Impulsis ⁹	12,850
Easy water pump ²	100	Microcredit ¹⁰	700
Purchase of 300 jerry cans ³	0		
Getting a license for a small business. ⁴	350		
Construction of water kiosk. ⁵	1,300		
Equipment of water kiosk. ⁶	300		
Educating the employees. ⁷	300		
Unforeseen. ⁸	3,700		
Total:	13,850		13,850

The Mobile Water Maker costs €1.800,-, including the solar panel so this is US\$2.600¹⁹. Since three are needed, that comes down to US\$7.800.

² The easy water pump is something we most likely can make from local products as no technical parts are needed. It is estimated that the price will be around US\$100 for three of them.

³ Hopefully the jerrycans we need, around 300, can be collected for free from local companies.

⁴ Of course we need a license for this small company.²⁰

⁵ The construction of the water kiosk will be done by local people.²¹ This amount of money is also spend on paying for the ground during the setting-up, which will be rented.

⁶ The water kiosk itself needs to be equipped so that it can be a proper shop.

⁷ The employees get a bookkeeping course and will be taught how to use the Mobile Water Maker.

⁸ It is very important to take unforeseen costs into account, otherwise this review will not be realistic.

⁹ The subsidy of Impulsis is approximately US\$12,850.

¹⁰ The microcredit from FINCA will be around US\$700. This is the amount a normal micro credit usually finances!

¹⁸ <http://www.impulsis.nl/nl/index.phtml>

¹⁹ <http://www.theusa.nl/reizen/reisinformatie/omrekentabellen/euro-dollar.htm>

²⁰ <http://www.doingbusiness.org/exploreconomies/?economyid=60#StartingBusiness>

²¹ <http://www.thescholarship.com/pdfs/Students-and-Staff-Build-and-Purchase-Home-for-Family-in-Ecuador.pdf>

When the business is all set and will start to run, we need to make sure that this project can be done financially. Therefore, we have made a financial review of the expenses and income we will have. These can be viewed in figure 7.

Figure 7:

Costs:	US\$:	Income:	US\$:
Wages ¹	16,800	Sale water ⁹	23,000
Maintenance water maker ²	50		
Maintenance business ³	50		
Taxes ⁴	350		
Payment of micro credit ⁵	150		
Insurance company ⁶	250		
Payment of rented ground ⁷	500		
Unforeseen ⁸	1500		
Total	19,650		22,995

¹ The four women each earn monthly US\$350. This amount is determined by the World Bank to cover all the expanses of one household living on the countryside of Ecuador. The average monthly wages on the countryside is US\$215.²² That is annually $350 \times 12 \times 4 = \text{US\$}16,800$.

² The maintenance of the Mobile Water Maker will cost something, since the water storage can be broken, or something similar.

³ The water kiosk itself requires maintenance as well.

⁴ On average the taxes will be US\$350.

⁵ The micro credit (US\$ 663.50) should be paid off in five years: this means US\$132.70 each year. With the interest this will be around US\$150.

⁶ The insurance that we will get for the company, will be on average US\$250.

⁷ The rented ground needs to be paid off.

⁸ It is always important to include unforeseen costs.

⁹ It is expected to sell 700 litres a day (3,5 litres per person, for 200 people). That is annually 255,500 litres. Since the sale is the only income, it should cover all the expenses made. When 1 L is sold for US\$0.09, the yearly income is around US\$22,995.

Future plan

One can conclude that this business will be making some profit, around US\$3.345 each year. After five years, this will be around US\$16.000. In addition to this, the water kiosk doesn't have to pay anymore for the micro credit since it has to be paid off in 5 years. This means that there will be a large sum of money left over after a couple of years. It is important to realize that the water kiosk isn't trying to make profit! But this money can be used for a different developing project, preferably in the same community. It can be used for improving schools, sanitary or other things.

²² http://store.eiu.com/product/160000216EC.html?ref=product_detail_list_Country_title

Conclusion

The Mobile Water Maker will be used for the purification of the surface water. It's sustainable since it doesn't use disposable parts, and it has an easy maintenance: the local people can do it themselves. There is a low energy need, which will be provided by a small solar panel. Using the easy water pump and a large barrow, it is very **suitable** to use it in a developing country project.

The blue province **Imbabura** is a poor area in Ecuador. There is little to no technology used in their daily life. And because of that, they have to worry about the presents of the basic needs. 39% of the people doesn't have access to clean drinking water. By providing them with healthy drinking water the next generation can spend their energy on going to school, rather than getting water.

Integrating the Mobile Water Maker in a **water kiosk**, will have lots of benefits. The local community is involved rather than helped, and the people will feel responsible instead of the ones who need to be helped. The main goal of this water kiosk is eventually to provide a small community a future in which the basic needs are present. First of all, we want to tackle the problem of clean drinking water. But imagine, that this community will get an economical impulse and will develop into a great community in which people have a chance to make something out of their lives and climb on the social ladder.

The total costs of setting this project up are US\$7.880. A large part of this will be provided by Impulsis as being a subsidy. A micro credit from FINCA is used as well. This will enlarge the feeling of being responsible of the women in charge of the water kiosk. In the end, the water kiosk will make profit. Therefore, this project is **financially achievable**. This money will be invested in the community (e.g. improving sanitary facilities).

It is worthy to realize that this project has a small chance of not being successful. Lots of other institutes are involved, like FINCA and Impulsis. Contrary there are no agreements yet made with a community in Imbabura, Impulsis and FINCA. So the success of this project depends on these parties too, which makes this project complex. But that is not a reason why this project shouldn't be done. As said earlier, every problem has a solution. It all comes down to having the **motivation** to solve the problems. The motivation is high since this project makes a difference for the people in Imbabura.

The technology is ready, so let us help the world!

Aqua Para La Vida | Water For Life

With thanks to

This report wouldn't be the same without the people who have helped us. We want to mention a few people particularly:

Leo Groendijk is a scientist from the Wageningen University. He is directly linked to the Mobile Water Maker and has it successfully integrated in developing countries. He has given us helpful advice concerning this school paper.

Our school supported us throughout the process of writing this report.



Annet Pouw is our biology teacher and supervisor from our school. She has helped us with her enthusiasm and her view on our ideas as well as giving a different look on things.

Mr. Aktepe is an economy teacher on our school. He has helped us with writing the business plan.



Mr. Visser has been a source of inspiration for us. He supports, with success, poor people in Indonesia.

Stichting Imagine... enabled us to do something special with our school paper.

Our English teacher Mr. Knippen has helped us with spelling mistakes etc. Which helped us to express our view better!

We have enjoyed writing this report. Especially the fact that we have been dealing with something that is so important for a lot of people in developing country. Though we don't worry about the presence of basic needs, it makes you think about how vulnerable they are.

Hopefully this school paper will become more than *just* a report. Everything taken into account, we hope that the future will bring something good for the people in Imbabura!

The research

In order to thoroughly understand how this Mobile Water Maker works, some experiments were done at the van Hall Larenstein institute at Leeuwarden.

Some contaminated water was taken from a pond next to the institute. This water contained sand, leaves, algae and other small parts. When putting the dirty water in a large water tank, a prefilter was used to filter the biggest parts out of the water. How dirty this water was, can be seen in figure 9. Then, the water was pumped to a height of three metres by an electric pump. However, the easy water pump was also tested. This can be seen in figure 8. This pump can be used easily in a developing country (rather than an electric pump). After that, the water purification was started by pushing a button on the Mobile Water Maker.



Figure 8: Madieke using the easy water pump



Figure 9: on the right the dirty water from the pond, on the left this water after purification.

The filtered water looked cleaner, as can be seen in figure 9. But, in order to know how much 'cleaner' it was, some experiment were done. Those results can be seen in figure 10. The characteristics measured, are those that are important in order to determine whether or not the water can be drunk. They are measured by using a QuestLab.

When measuring the speed at which the Mobile Water Maker filters, the outcome was an average of 1 minute and 30 seconds for 1 litre.

The conductivity of a substance illustrates the ability of transferring an electric current or heat. In water, this is done by free-moving ions. So the conductivity of water shows how many ions are dissolved in the water. As shown in figure 10, after purification the conductivity is lower. Drinking water from the tap usually has a conductivity between 70-700²³ $\mu\text{S}/\text{cm}$, so this water has a normal amount of ions dissolved.

²³ <http://www.lenntech.com/applications/ultrapure/conductivity/water-conductivity.htm>

Figure 10:

	Before purification	After purification
Temperature	14 °C	14 °C
Conductivity	692 µS/cm	592 µS/cm
Chlorite concentration	70 mg/L	91 mg/L
Oxygen concentration	9.9 mg/L	10.8 mg/L
Ammonium concentration	0.18 mg/L	0.16 mg/L
Turbidity	33 NTU	0.2 NTU
pH	7.30	7.14
Bacteria Total Count	1000/mL	2/mL
E-coli	100/mL	not found

The concentration of chlorite ions in drinking water should be below 250 mg/L²⁴. A high concentration can be toxic. There are more chloride ions in the water after purification, since those ions are formed during the disinfection (see the working of the Mobile Water Maker, page 6), but the concentration is still very low.

The taste of water depends on the amount of oxygen ions dissolved in water. A high concentration makes it taste better, but the down side is that algae can grow better. For drinking water the concentration should be between 3-70 mg/L²⁵ so the purified water meets this standard.

Ammonium is naturally present in water, and has a disinfecting working. But, it does affect the taste of the water in a bad way when its' concentration is too high. The concentration should not be higher than 0.20 mg/L²⁶, so this water does not exceed that limit.

The turbidity of a substance represents the amount of light absorbed by the water, due to the suspended matter in the water. When water has a high turbidity it does not look healthy, since it is not transparent, but suspended matter can be filtered out of the water. That is why the turbidity after purification is much lower, and as shown in figure 9, it looks much more healthier.

The ideal pH of drinking water is between 6.5 and 8.5, so a neutral pH. Naturally, the pH of water is around 7, which is also now the case.

The total bacteria count and the amount of E-coli indicate the microbiological quality of water. Those bacteria are not harmful to people, but it shows the exposure the water has had to pathogens. E-coli indicates the concentration of birds and mammals feces that are in the water. After purification, this amount should be zero, which is the case. The total bacteria count should be below 5 per 100 mL²⁷ which is also met.

So in the end, the water purification is very effective (especially considering the total bacteria count) and the purified water meets all the criteria for drinking water.

²⁴ <http://www.kywater.org/ww/ramp/rmcl.htm>

²⁵ <http://bcn.boulder.co.us/basin/data/NEW/info/DO.html>

²⁶ http://www.who.int/water_sanitation_health/dwq/ammonia.pdf

²⁷ <http://www.oasisdesign.net/water/quality/coliform.htm>

Appendix

Ceramic membranes

There are two types of membranes: polyester and ceramic. The reasons why the Mobile Water Maker uses ceramic membranes:

- Ceramic membranes are sustainable. Polyester has a lifetime of a few months which means that you have to use disposable ones. Ceramic filters have a lifetime of more than 10 years.
- We use a pressure of 6 bars in order to clean the membrane. A ceramic filter can take this pressure, but a polyester will shrivel.
- The polyester membranes will be corroded by the chloride chemicals we use. This will shorten their lifetime. Ceramic filters are not affected by the chemicals.
- In addition to this, polyester membranes have to be used constantly. When the water maker is not used for a couple of days, the polyester membranes will shrivel, and have to be thrown away. Ceramic membranes are not affected when not used for some time.

Easy water pump

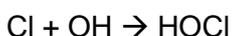
With the easy water pump the water can be pumped to the water storage that is placed above the Mobile Water Maker. The easy water pump uses a rope, and can be used easily. The rope is attached around a wheel and pulley. When the handle that is fixed to the wheel is turned, the rope will go around. The water is taken with it, since there are little plungers in the rope. The water goes up in the pipe, and at the end the water falls down in the water storage. It is illustrated in figure 11.

Disinfection unit

It uses two anodes and two cathodes. The chloride ions and hydroxide ions that are naturally in the water will oxidize at the anode and will form radicals:



Since these radicals are very willing to react, they react with each other:



The hypochlorous acid (HOCl) is a fast moving oxidizer. The bacteria that are still present in the water will be damaged by the molecule since it is a very reactive molecule. When this occurs an atom of HOCl is exchanged with the bacteria. By doing this, the bacteria will be inactivated.

Impulsis

It is an organization that gives subsidy for projects concerning education, water and sanitation, local entrepreneurship, or health. The project should take place in a developing country: Ecuador is amongst the ones that Impulsis regard as being a developing country. It chooses to finance projects that are creative and original in their ideas or approach. According to Gerard Schuil, one of the coordinators, this project is highly attractive for them. Also the subsidy (€5000) is, compared to other projects, quite small.

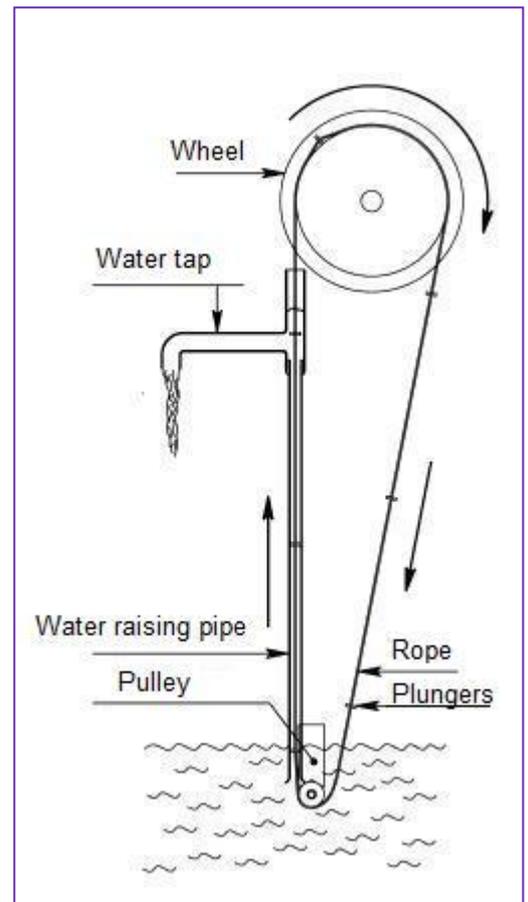


Figure 11: The easy water pump.

FINCA

Finca is a microfinance institute that works in Imbabura only. The institute itself is financed by the government of Ecuador, and is part of a larger network of microfinance institutes in Ecuador. It has a good reputation: 99.8 % of all micro credits are paid back in 7 years.

Commonly made mistakes in setting up a developing project^{28 29}

1. Miscommunication or lack of communication: people have different expectations or ideas, so instead of complementing each other people have disagreements.
2. No defined goal: if one does not have a goal to reach, it is never clear what the result will be. Therefore, the strategy of the project can and will be changed all the time. The goal of the project makes clear to everyone what they want, and when they have successfully achieved it.
3. No support of the local community. Though people can have the right intentions by setting up a developing project, without support or help of the local people it can never be successful.
4. No project plan: similar to not having a defined goal. Without a project plan anyone can do anything so the actions are not guided.
5. No delegation: it is not clear to everyone who is doing what. This can result in people doing the same thing, but also in people having the wrong impression of what others are doing. This is closely linked to miscommunication.
6. Handling of disappointments is very important, people have to be aware that the reality of a project is never the same as how it is designed. Being able to handle these disappointments is very important.
7. Lack of understanding of the cultural background: in most developing countries the culture differs a lot compared to ours. There are different ways of dealing with appointments and deadlines. It is important to have some awareness of how their social interactions differ from ours, and how they see something as an agreement.

²⁸ <http://projectmanagement.ittoolbox.com/documents/causes-of-development-project-failure-17634>

²⁹ <http://www.ejsdc.org/ojs2/index.php/ejsdc/article/viewFile/277/176>

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Front page

Front page image :

<http://www.leslink.nl/0%20%20Suriname/water%20drinken.jpg>

Introduction

Amount of water on the planet:

<http://www.lenntech.com/water-trivia-facts.htm>

Amount of fresh water:

<http://www.waterforlife.nl/Nieuws/AllNews/Schoon+water+niet+voor+ieder+kind+beschikbaar.htm>

Amount of children that die because of polluted water:

<http://www.waterland.net/index.cfm/site/Nederlands%20Watermuseum/pageid/9CAB2B5A-BCE3-A35A-0B9D7985AE4387F8/index.cfm>

The working of the Mobile Water Maker

Figure 1; the inside of the Mobile Water Maker:

<http://www.mobilewatermaker.nl/>

Figure 2; the outside of the Mobile Water Maker:

Leo Groendijk.

Usage in a developing country

To clean a jerrycan with soda:

http://www.proximedia.com/catalogue/photos/189334_a.jpg

Figure 3; a barrow:

<http://img-fan.theonering.net/rolozo/images/herring/barrow.jpg>

Ecuador

Amount of inhabitants of South-America:

<https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html>

Amount of people in South-America without access to clean drinking water:

<http://www.mapsofworld.com/thematic-maps/safe-drinking-water.htm>

Amount of people in Ecuador without access to clean drinking water:

http://www.fightingdiseases.org/main/country.php?country_id=53

Main industry in Ecuador:

<http://www.landendweb.net/ecuador/economie/>

Ecuador a developing country:

<http://www.icce2010.org/docs/developingCountries.pdf>

Figure 4; the province Imbabura:

http://en.wikipedia.org/wiki/File:Ecuador_Imbabura_province.svg

Project plan

Amount of projects in developing countries that fail to be successful:

<http://www.ejisdc.org/ojs2/index.php/ejisdc/article/viewFile/277/176>

Business plan

The content of a business plan, how to write a business plan:

http://www.jongondernemen.nl/fileadmin/dam/documents/Handboeken_2009/JON_8_Handboek_HAVO-VWO_LR.pdf

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The price of SPA:

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Blom, R.J., Verburg, T, 2002, Jong in zaken.

Keesom, J., 2004, Starters op weg naar een eigen bedrijf.

Regt, Mr. Drs. K., 1998, Financiering.

Romme, K., 2001, JONG een eigen zaak.

Financial plan

Impulsis:

<http://www.impulsis.nl/nl/index.phtml>

From Euro to Dollar:

<http://www.theusa.nl/reizen/reisinformatie/omrekentabellen/euro-dollar.htm>

Getting a license in Ecuador:

<http://www.doingbusiness.org/exploreconomies/?economyid=60#StartingBusiness>

The price of constructing a small business in Ecuador:

<http://www.thescholarship.com/pdfs/Students-and-Staff-Build-and-Purchase-Home-for-Family-in-Ecuador.pdf>

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The research

The conductivity of a substance:

<http://www.lennotech.com/applications/ultrapure/conductivity/water-conductivity.htm>

The concentration of chlorite ions:

<http://www.kywater.org/ww/ramp/rmcl.htm>

The concentration of oxygen:

<http://bcn.boulder.co.us/basin/data/NEW/info/DO.html>

The concentration of ammonium:

http://www.who.int/water_sanitation_health/dwq/ammonia.pdf

The total bacteria count:

<http://www.oasisdesign.net/water/quality/coliform.htm>

Commonly made mistakes

<http://projectmanagement.ittoolbox.com/documents/causes-of-development-project-failure-17634>

<http://www.ejisdc.org/ojs2/index.php/ejisdc/article/viewFile/277/176>

Log book Vera

Date	Time in minutes	Activity
17-09-2009	180	Thinking about a subject.
24-09-2009	45	Appointment with Mrs. Pouw.
28-09-2009	120	Research on different membrane filters.
05-10-2009	240	Meeting in Delft.
06-10-2009	45	Contact with Leo Groendijk and research about Indonesia.
07-10-2009	90	Research about ceramic filters.
15-10-2009	100	Research about the water quality in Indonesia, appointment with Mrs. Pouw
20-10-2009	600	Going to Leeuwarden do to research on the Watermaker.
22-10-2009	60	Going to the library with Tami to find books on how to make a businessplan.
28-10-2009	60	Making notes on how to make a business plan.
11-11-2009	30	Meeting with Mr Aktepe about business plan.
15-11-2009	120	Contacting organisations in Ecuador and Cambodia, starting with the business plan.
18-11-2009	150	Writing a document on the millennium goals and contacting Mr van der ploeg.
19-11-2009	120	Writing to organizations and making a business plan.
22-11-2009	180	Making the business plan and information about Indonesia.
23-11-2009	120	Writing document on general situation in Indonesia, the culture, infrastructure etc.
24-11-2009	30	Meeting with Mrs. Pouw.
27-11-2009	300	Making a document on Ecuador; the political, economical and social situation. Appointment with Mr Visser.
07-12-2009	90	Translating the business plan.
09-12-2009	480	Going to Delft, master classes on developing countries. Thinking about what to do with the profit.
16-12-2009	45	Introduction.
4-01-2010	120	Writing the piece about Ecuador.
5-01-2010	30	Finish the piece about Ecuador.
6-01-2010	45	Take out spelling mistakes.
8-01-2010	120	Writing the with thanks to..
10-01-2010	120	Writing the prologue.
11-01-2010	30	Thinking about a way to transport the water.
14-01-2010	120	Take out spelling mistakes and improve the written texts.
16-01-2010	300	Final check.
18-01-2010	120	Printing of this paper.
03-02-2010	615	Practising of our presentation at Delft.
04-02-2010	135	Working on our presentation
10-02-2010	135	Making the frames.
17-02-2010	90	Making our presentation with keynotes.
18-02-2010	660	Making our movie at Delft.
Total	5845	97 hours

Log book Madieke

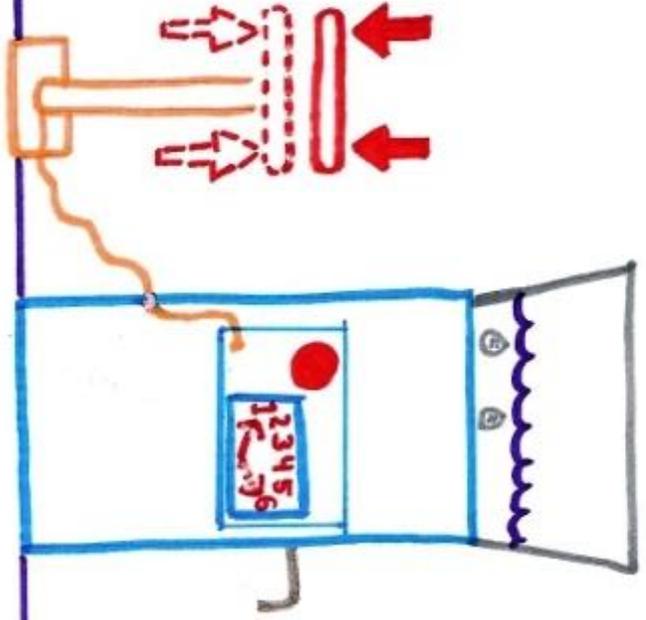
Date	Time in minutes	Activity
17-09-2009	180	Thinking about a subject.
24-09-2009	45	Appointment with Mrs. Pouw
28-09-2009	120	Searching for information, to make a choice for a country.
5-10-2009	240	Meeting in Delft.
7-10-2009	90	Contact Leo Groendijk (about practicum) Research about Waterkiosk in Indonesia.
13-10-2009	30	Research about 'technology transmission'.
15-10-2009	40	Appointment with Mrs. Pouw
20-10-2009	660	Going to Leeuwarden do to research on the Mobile Water Maker.
6-11-2009	30	Reading parts of the book: Jong in zaken, Robert J. Blom en Tineke Verburg
11-11-2009	30	Meeting with Mr. Aktepe about making a business plan.
13-11-2009	120	Make a description of the easy water pump.
17-11-2009	90	Make a description of the Mobile Water Maker.
17-11-2009	30	Reading the document about making a business plan.
19-11-2009	120	Writing to organizations and making a business plan.
22-11-2009	180	Making the business plan.
23-11-2009	120	Research for law forms. Contact Leo about how to get water in the Mobile Water Maker.
24-11-2009	30	Meeting with Mrs. Pouw.
27-11-2009	300	Research on the financial situation in Ecuador, appointment with Mister Visser.
09-12-2009	600	Going to Delft, master classes on developing countries. Thinking about what to do with the profit.
11-12-2009	120	Starting with the introduction
14-12-2009	60	Finishing the introduction
17-12-2009	90	Translating the tips on starting a project.
28-12-2009	30	Number the picture of the Mobile Water Maker.
06-01-2010	60	Starting with the introduction.
07-01-2010	90	Finishing the introduction and thinking about the conclusion.
15-01-2010	180	Log books and references.
17-01-2010	180	References and final check.
03-02-2010	615	Practising of our presentation at Delft.
04-02-2010	135	Working on our presentation
10-02-2010	135	Making the frames.
17-02-2010	90	Making our presentation with keynotes.
18-02-2010	660	Making our movie at Delft.
Total:	5500	92 hours

Log book Tami

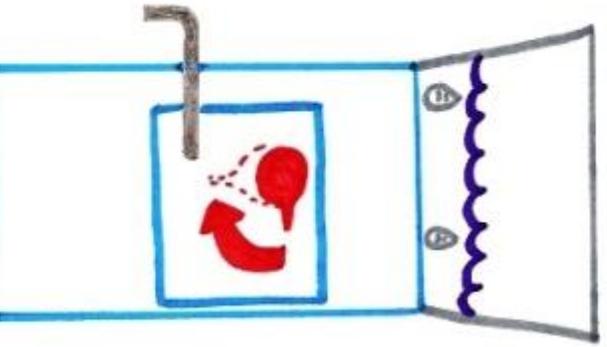
Date	Time in minutes	Activity
17-09-2009	180	Thinking about a subject.
24-09-2009	45	Appointment with Mrs. Pouw
28-09-2009	120	Research for micro finance in different countries.
06-10-2009	45	Contact with Leo Groendijk and research about Indonesia.
07-10-2009	90	Research on possibilities of microfinance in Indonesia.
10-10-2009	60	Contacting possible institutes for micro credits, and research on the benefits of microfinance.
15-10-2009	40	Appointment with Mrs. Pouw
20-10-2009	600	Going to Leeuwarden to do research on the Mobile Water Maker.
22-10-2009	60	Going to the library with Vera in order to find books on how to make a business plan.
08-11-2009	90	Reading a book on how to make a financial business plan.
11-11-2009	30	Meeting with Mr Aktepe about business plan.
15-11-2009	120	Contacting organisations in Ecuador and Cambodia, starting with the business plan.
17-11-2009	30	Contacting organisations in Peru and Bolivia.
18-11-2009	150	Writing a document on how the Mobile Water Maker works and how to clean it, contact several people for local connections.
19-11-2009	120	Writing to organizations and making a business plan.
22-11-2009	180	Making the business plan and finishing document watermaker
23-11-2009	120	Searching microfinance institutes in Indonesia, writing a document on the financial situation in Indonesia, and finishing document on millennium goals.
24-11-2009	30	Meeting with Mrs. Pouw
27-11-2009	300	Making the financial plan of the water kiosk. Appointment with Mister Visser
03-12-2009	60	Continuing with the business plan.
05-12-2009	180	Making the financial plan of the starting-up year and first year.
06-12-2009	180	Making the images of the technological transmission. Starting with the plan on how to set up the water kiosk.
08-12-2009	240	Making the strategy and distinguishing the different phases of the setting-up. Writing a document on the commonly made mistakes of developing projects.
09-12-2009	480	Going to Delft, master classes on developing countries. Thinking about what to do with the profit.
15-12-2009	60	Writing a document on common made mistakes.
04-01-2010	120	Checking the spelling.
06-01-2010	120	Finishing the document about the financial plan.
12-01-2010	60	Doing the references.
15-01-2010	90	Finishing the appendix.
16-01-2010	90	Changing the spelling mistakes, starting with the final layout.
17-01-2010	300	The final check.
18-01-2010	120	Printing of this paper.
03-02-2010	615	Practising of our presentation at Delft.
04-02-2010	135	Working on our presentation.
10-02-2010	45	Making the frames.
17-02-2010	45	Making our presentation with keynotes.

18-02-2010	660	Making our movie at Delft.
22-02-2010	180	Writing a report of the research at Leeuwarden. Changing the amount of Water Maker used.
Total	6190	103 hours

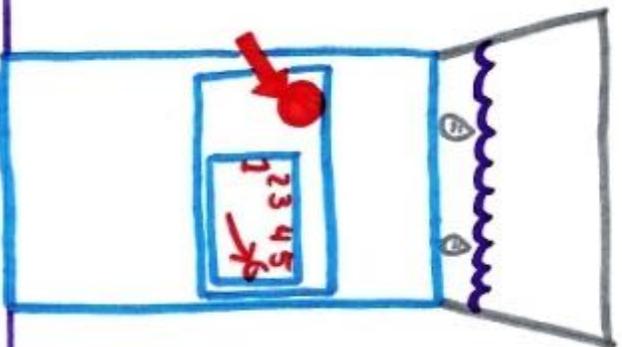
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