

The Neem Tree

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Neem Tree
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Prologue

Malaria is a severe problem in many developing countries and the number one cause of death in Africa. To be able to create a prevention medicine for the ones who need it the most, was something we had never imagined doing. We are both very interested in other countries and cultures. Besides, we think it is very good to try making a change for inhabitants in developing countries by using western research possibilities. You always have to apply your knowledge in good ways and participating in this Imagine project is a good example.

We are two students of the Eerste Christelijk Lyceum in Haarlem, The Netherlands. This year we will be taking our final exams. It is mandatory to write a thesis - a so called 'ProfielWerkstuk' - in this year. We were thinking of a subject for this together, but we had difficulty finding a subject that appealed to the both of us. When we read about the project 'Imagine Life Sciences' in our digital learning environment we were immediately enthusiastic. We thought it would be a great opportunity to write a 'ProfielWerkstuk' within a competitive project. Besides, the requirement that the 'ProfielWerkstuk' had to be written in English was something we thought to be difficult, but soon we thought of it as a real challenge. Our school's 'ProfielWerkstuk' supervisor was very excited we decided to take part in this project.

Many thanks to the people who helped us write the outline of our project. First of all we would like to thank scientist Jelmer Tamis for answering our questions and being very enthusiastic. It was a pleasure working with him in an actual laboratory. Secondly, we would like to thank Ms. de Boer and Ms. de Jong for being our coaches. They often helped us and we learned a lot from them. Especially the *Kill your darling's* sentence. Moreover, they were very supportive and motivating to us. Furthermore, we would like to thank Ms. Bakker for checking our English and Tim Neutel for his creative mind and making the cover. Finally, we would like to thank our parents for always being helpful and supportive.

We hope you will enjoy reading this 'ProfielWerkstuk', as much as we did writing it!

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Introduction

When we decided to take part in this competition, we had to choose a subject. The Neem tree was the fourth subject we received by e-mail. The minute we saw and read about the Neem tree, we felt this was the right subject for us. We are both very interested in medicine and helping people and with this project we felt we could learn more about remedies against malaria. A few weeks later we got the confirmation that we could participate in the Neem tree project.

We started the in-depth reading about the Neem tree and figured out that not only the seeds, but also other parts of the tree had healing properties. The Neem tree has multiple possibilities and we had to make a choice about which parts of the tree we wanted to use.

During the Kick-Off meeting we figured out what method we would use for our plantation. Sometimes we had to think out of the box to come up with solutions. In a developing country you have to be able to set up a project by using local resources. Moreover, we had to make a product that people would actually want to buy, not something only we thought would be a great idea. Obviously, we learned a lot from this project, especially thinking in People, Planet & Profit.

In the following chapters you can read how we see the realization of our project. We have formulated multiple questions to discuss all different aspects of setting up a business that will produce Neem oil. Our questions are:

- *Neem oil against Malaria in a developing country?*
 - *How do we see a Neem oil production business being set up?*
 - *Which country is best suitable for this project?*
 - *What kind of technology will we use?*
 - *What will our business model look like?*

Our project

We discovered that the Neem Tree has many different uses. Everything from the tree can be used as a remedy, a prevention or a maintenance. In our project we want to set up a plantation for the extraction of Neem oil, which we would like to use for the prevention of getting malaria. It is important to provide a preventive solution for the people in Burkina Faso, because of the high number of people that are infected with malaria. By using Neem oil they can decrease the chance of getting malaria.

We want to set up a plantation in Burkina Faso with Neem trees that are 15 to 20 years old. We will start with a plantation on which we have 15 full-grown Neem trees and adjacent we will plant five more trees that will grow and can be used for production a few years later. The local inhabitants will harvest the seeds and will extract the oil from it. By building the plantation we will provide jobs and a regular income for the local people. It is important to consider the willingness of the local inhabitants to buy our product, because, even though we might think it is a great idea, they might not. We have thought about this carefully and concluded that the people in Burkina Faso will be interested in buying our product, because they can decrease the chance of getting malaria. The oil can only be applied to the skin of adults, but we discovered that Neem oil can also be used as lamp oil. In the latter case, the generated smoke will keep the mosquitoes away. The idea is that the work area and shop are also on the plantation. We will sell the oil in refillable bottles of 250 ml. With the first purchase the inhabitants will buy a refillable bottle containing the oil. The next time they want to buy new oil, they have to bring their refillable bottles and only have to pay for the new oil.

The Neem tree has multiple possible uses and we do not want to neglect the other parts of the tree. The leaves, for instance, have a healing effect on skin conditions and with some water tea can be made from them. The tea can improve the immune system and have a cleansing effect in the body. The production months for Neem oil are June until August and we can sell the dry leaves in the time we are not making oil.

We will dilute the Neem oil with sesame oil so we can make more oil; it will smell better, the risk of skin reaction is much smaller and the oil will be less expensive. By doing so, the Neem oil will not lose its power to ward off insects. We will buy the sesame seeds from local farmers for a reasonable price. The sesame seeds can also be extracted in the Piteba Oil Expeller. In the months we will not be extracting the Neem seeds, we will extract sesame seeds and sell sesame oil. The latter is good for the whole body: it helps lowering blood pressure and can be used on the skin and for oral hygiene.

Neem trees do not need a lot of irrigation and the press cake from the expelling process of the Neem seeds can be used as dung for the trees. The trees do not need that much maintenance, so we can focus on the expelling process and the sale of the oil and leaves. We think it is important that everyone learns about the dangers of malaria and hope that by giving lectures people will become more aware of those dangers. We want to help the residents of Burkina Faso by setting up a plantation, therefore we will educate the employees and the future manager everything they need to know about the plantation, so eventually they can independently operate the business.

Burkina Faso

General information

The African country Burkina Faso is formerly called Upper Volta, because the country contains the upper part of the Volta River. This river is divided in three parts: called the Black Volta, the White Volta and the Red Volta.

Since 1984 the country is called Burkina Faso. Figuratively, 'Burkina' may be translated as 'men of integrity' (Mooré language) and 'Faso' means 'father's house' in Dioula. Moore and Dioula are two of the major native languages in Burkina Faso. Its inhabitants are called Burkinabe's.



Burkina Faso is a landlocked country in West Africa with an area of 274 000 km². It shares borders with six other countries; Mali, Niger, Benin, Togo, Ghana and Côte d'Ivoire. The northern parts of Burkina Faso are in the Sahel, a strip of land on the edge of the Sahara. The country is mainly flat, but in the south-west there are some hills. The capital of Burkina Faso is Ouagadougou, which is situated almost in the middle of the country.

Climate

The climate in Burkina Faso is primarily tropical with two very different seasons; the wet and dry season. In the dry season, which runs from March until May, the Harmattan blows. This is a dry, hot, dust-laden wind from the Sahara. The rainy season lasts from June until October during which the rainfall is the heaviest in the south. From November until March the temperature is comfortable and the weather is dry. The temperature in the dry season ranges from 40°C to 48°C and in the wet season from 30°C to 35°C. The tropical climate is ideal for the Neem tree. Furthermore, the Neem tree needs just a little water, which means it is not necessary to fix an irrigation system.

Population

Burkina Faso has 15 757 000 inhabitants, which means the country has a population density of 48 people/km². In comparison; the Netherlands have a population density of 389 people/km², Burkina Faso therefore is an underpopulated country. The largest ethnic group is the Mossi, making up approximately 40% of the total population, followed by other smaller ethnic groups. The official language in Burkina Faso is French. This originates from the colonial period in which Burkina Faso was colonised by the French. In addition to French, there are some native African languages belonging to the Sudanic family spoken by 90% of the population. More than half of the inhabitants are Muslim (60.5%), but there are also large groups of catholics (19%) and animists (15.3%). Animism is a kind of primitive religion with a great belief in ghosts.

Politics

Burkina Faso became independent from the French in 1960. Since then the country is a parliamentary republic. The last Presidential elections were held in November 2010, in

which President Blaise Compaoré was re-elected. The voting was not really representative; only 1.6 million of the almost 16 million Burkinabe's voted. Compaoré has been president of Burkina Faso since October 1987. Until the early 90's there were several military coups and in 1991 the first multiparty elections took place.

Infrastructure

The transport system in Burkina Faso is poorly developed. There is a total road network of 92 495 km¹ in Burkina Faso, which is a lot for the country's size. However, the conditions of these roads are very bad. Only a small part of this road network is paved and the other kilometres are gravel or sand roads.

There is a railway system in Burkina Faso which is 622 kilometres, but it is also in a very bad condition and does not operate well. In addition to that, Burkina Faso has 33 airports, but just two of them have paved runways and can be used for international flights. Since Burkina Faso is a landlocked country, it has no ports. The nearest ports can be found in Cote d'Ivoire, Benin and Togo.

Economy

Burkina Faso is one of the poorest countries in the world. In 2009 they had a GDP (Gross Domestic Product) per capita of \$ 516². Comparing this to Côte d'Ivoire, one of the neighbouring countries, which had a GDP of \$ 1105. Agriculture is the most important activity and employs about 90% of the labour force. For domestic consumption they grow rice, maize, millet and sorghum. Burkina Faso exports a lot of cotton. Sesame seeds, shea nuts, groundnuts, sugar and cashews are also exported in small amounts. The main imports of Burkina Faso are capital goods, such as machines and petroleum products.

The inhabitants of Burkina Faso earn little, so they do not have enough money for health care. Our project will provide a remedy against malaria for a low price, in order to provide even the poorest Burkinabe his or her health.



The Neem tree

Why Burkina Faso?

Malaria is a serious problem, because the disease can be life-threatening. Every 30 seconds a child dies from malaria³.

In Africa there are a lot of mosquitoes and in many African countries there is a great risk of being infected by malaria. A lot of African people do not have prevention measures like mosquito nets. It is therefore really important to help those vulnerable people with our project.

Malaria is caused by a parasite called Plasmodium. This parasite is transmitted via the bites of infected mosquitoes. Once in the human body, the parasite multiplies in the liver and infects the red blood cells. The main symptoms of malaria are headache, fever and vomiting. If

¹ See appendix 1

² Source: World Bank Data, OECD National Accounts Data.

³ <http://www.who.int/features/factfiles/malaria/en/index.html>

the disease is not treated malaria can be deadly, because the parasite disrupts the blood supply to vital organs.

In 2009 there were 4 537 600 suspected cases of malaria in Burkina Faso, which is an enormous number. In addition, there were 7.982 reported malaria deaths per 100.000 population⁴. These numbers show that malaria is a real problem in Burkina Faso and that something must be done to reduce the number of deaths caused by this disease.

Healthcare is very bad in Burkina Faso, there is only one doctor per 33.333 people⁵.

However this country is one of the most politically stable countries in Africa.

This shows that Burkina Faso really needs this project and is a country in which we can actually set it up.

Technology

Many seeds contain oil and that oil can be of significant value. For example, some seeds comprise oil that have a nutritional value which is used in food. The oil in the Neem seeds contains azadirachtin, an ingredient that will prevent stings from malaria mosquitoes and in addition wards off all sorts of other insects. A lot of people are infected with malaria in Burkina Faso and therefore it can be of great value for the residents.

The Piteba Oil Expeller

1: Opening for the seeds

With the help of a funnel you can easily get the seeds into the expeller. This funnel can be made of a PET bottle.

2: Crank to operate the expeller

3: Cap with adjustment bolt

With the use of Neem seeds the adjustment bolt needs to be screwed into the cap. The cap has two holes where the press cake is released.

4: Lamp oil burner secured with an elastic band

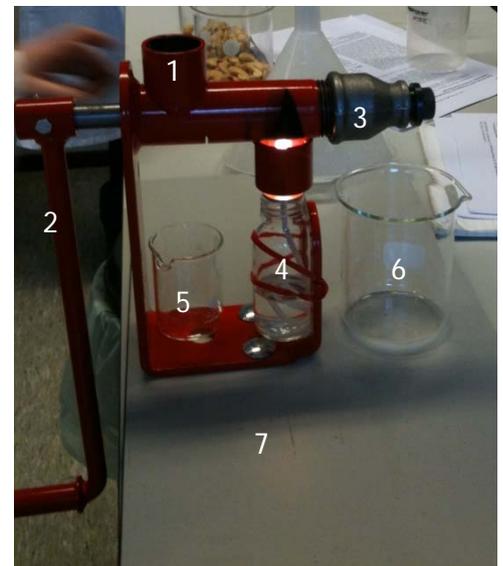
5: Oil collecting beaker

Underneath the expeller you can find the oil outlet. This is where the oil comes out after it is released from the seeds and is squeezed from the press cake.

6: Press cake collecting beaker

When the press cake is not entirely dry, you have to screw the bolt further into the cap.

7: Vertical board with secured Piteba Oil Expeller



How to use the press

For our project we will use the Piteba Oil Expeller. It is easy to use, small and has a high yield. The expeller needs to be moulded onto a board to lighten the extraction process.

⁴ See appendix 1

⁵ See appendix 1

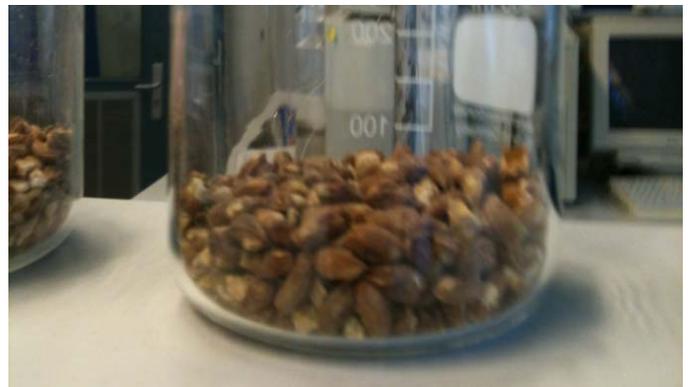
The board also makes sure that the expeller does not move. The board with the expeller can be fixed on a table with a clamp to secure the placing. At the end of the expelling process of the Neem seeds the turning of the crank gets heavy and when the expeller is not fastened it will be impossible to continue expelling.

Temperature

The expeller needs to be warmed up before it can be used. This will happen at the end of the expeller with the use of coloured lamp oil for about 15 minutes. We use coloured lamp oil because the warming process will be shorter. As the expeller is warmed, the oil can escape the seeds better and hot oil flows better to the oil outlet, than cold oil. Although the seeds are heated, the extracted oil can still be seen as a result of cold pressing, because the temperature at the end of the press is about 50°C. Oil that is extracted by cold pressing has a higher quality and will still have its natural flavours.

Seeds

The seeds are ripe when they are brown. When the Neem seeds are harvested they need to dry, which can be done in the sun, and have to be used within two to three weeks. Otherwise the seeds are too old, oil will be darker and smell stronger with lesser effect. It is important to remove the sand from the seeds, which can easily be done with a screen with little holes just big enough for the sand to escape. The bigger parts can be removed manually. The shell of the Neem seeds does not have to be crushed before it can be put into the expeller, it can be crushed easily by the screw inside the expeller.



Maintenance

It is very important that the expeller is cleaned after every expelling process. Otherwise the press cake will harden at the end of the press and it is difficult to remove the hardened material. The oil outlet can easily be cleaned with a kitchen knife to remove some of the dirt and maintain the oil flow. At some point the washer is worn out and needs to be replaced. Therefore you need to have a few spare washers. The expeller cannot be cleaned with water, because the screw is not made of stainless steel and it is better for the screw to be oily.

The oil and press cake

Because the oil still contains a small amount of dirt, it has to settle down after it has been extracted. This will take about a day and has to be in a warm room, because the oil will then be thinner and the dirt can settle easier. When the room is cold the oil is thicker and the dirt cannot settle down properly. The press cake should be stored somewhere dry, because moulds can easily grow on wet press cake in which it cannot be used as animal feed anymore. The press cake can always be used as dung.

Piteba Oil Expeller in Burkina Faso

The Piteba Oil Expeller is especially made for developing countries, because the inhabitants of those countries do not have the money to buy a power-driven expeller and

are forced to use a labour-intensive expelling process, such as screwing up the seeds. The expeller is light, small and can be used by one person. Seeds that contain more than 25% oil can be used with the Piteba Oil Expeller⁶. The expeller needs to be securely fastened, favourably flat or to a tree, which is more practical in Burkina Faso. After a few hours of expelling the operator can fill up the bottles with the oil that has settled down. The cake press can be used as animal feed and as dung.

The oil which is produced can also be used as grease for the expeller. We will only need a few drops to get an oil coating on the screw and the crank.



Piteba Oil Expeller secured to a bench



Piteba Oil Expeller secured to a tree

⁶ See appendix 4

Business Model

Customer Segments

Our target group will be the residents of Burkina Faso for whom malaria is a problem. Our aim is to decrease the risk of getting infected with this disease. We want to set up our project on a small scale, by building a plantation in a little town. The initial group for the first plantation of Neem trees in Burkina Faso will be the inhabitants of this town and its surroundings. Our starting point will be 2000 potential customers. Our idea is a proposition and it has to be determined where our project will take place eventually. In this business model we will give an outline of our project.

Value Proposition

The product we will be selling is an oil made of Neem seeds, which will keep mosquitoes and other insects away from the skin and therefore prevent being stung. The oil also has a healing function and can cure skin problems. Neem oil is a natural product and does not contain any chemical additions, therefore it is biological decomposable. Only adults can use Neem oil, because it is toxic to take in any of the oil. It is dangerous for children because they are more likely to suck their thumbs and can take the Neem oil in. Neem oil can also be used in flares or kerosene lamps by burning it. Our malaria prevention remedy will be relatively cheap and will be easy to use.

The press cake and the deposit of the extracted oil can be used as dung for trees on our plantation.

Customer Relations

The relationship between the customers and our business will be personally and of a long term. Initially, our project will be community-based, because our target group will be the direct environment of the plantation. Also, with possible further expansion, this kind of relationship will be maintained. We think it is important to create a personal connection between business and customers, to get customers that will come back and keep using our products.

Channels

To inform our potential clients about the dangers of malaria and our solution to this problem, we will give lectures in the villages of our target area. We think that by doing this we can let our clients know that we are there to help them and we let them see that it does not have to be difficult to protect them from malaria. Our shop will be on the plantation and because we focus on the direct neighbourhood, we will not need any trucks or cars for further distribution, which is better for the environment.

Key Resources

To set up a plantation of Neem trees and to extract the oil from the seeds we will need the Piteba Oil Expeller and other products for completing the production process.

Products

- Multiple Piteba Oil Expellers with all the necessary material
- Site
- Neem trees
- Shop

- Production area
- Multiple water butts in which we can clarify the oil
- Refillable bottles for the oil

People

- Knowledge of the production method
- Employees

Finance

- Investments from companies that will be paid back so we can start up the project
- Revenues to pay back the investments and to cover the costs

Key Activities

Our main activity will be setting up a plantation and start to extract Neem oil from Neem seeds. To preserve the business we will educate local people about the production process and possible problems that can occur. In this way we want to hand our business over to local people in approximately one year. We think if the business is managed by locals, there will be more customers, because if other local people already trust the effects of Neem oil, they cannot stay behind. Furthermore we give local people the possibility to have a job. It is a chance for them to see how a business works and our project can inspire them possibly to set a business up themselves. To obtain more buyers for our project we will give lectures about malaria and the consequences of this disease. This will be a kind of advertisement, but the lectures will not only be about our product. Our main goal is to reduce the number of deaths and people that are sick caused by malaria. If some people have another way to prevent mosquito bites, we are also happy. The plantation and oil extraction business we will set up, will be a non-profit organization. This means we need as much revenue as costs to have a break even turnover. Surplus revenues will be used for expansions and to set up similar businesses in other villages.

Key Partnerships

The most important partners of our project are the inhabitants of the village in which the plantation will be located and the neighbouring villages. A part of them will be our employees and future manager. This is in their own advantage, because they will have a job and regular income. Moreover these inhabitants will be prospective clients. They will buy our product to protect themselves from mosquitoes and other insects, to promote their health.

Revenue Streams and Cost Structure

For setting up the business we need to buy a lot of things, which are mostly non-recurrent expenses. We try to estimate these costs, but a few of them are very hard to value, due to lack of information. We want to rent a property of land, so these costs will be monthly. We need 1 hectare, which we can use for the trees, shop and production area⁷.

⁷ See appendix 3

Non-recurrent expenses	Cost	Amount	Total costs
Piteba oil expellers (including VAT, 15% ⁸)	\$ 128,09 ⁹	3	\$ 384,27
Bottles	\$ 0,23 ¹⁰	1500	\$ 345
Water butts	\$ 20 ¹¹	2	\$ 40
Shop	\$ 150	1	\$ 150
Workplace	\$ 200	1	\$ 200

Neem seeds can be collected from June until August. After collecting, the seeds should be extracted quickly, because you can only store them for 3 weeks at most. This means that our business will only be operating at full capacity between these 3 months.

Our plantation will have 15 Neem trees in the beginning, which we estimate to be 15 to 20 years old. Trees of this age produce approximately 13 kilograms of seeds per tree per year. Since we have 15 trees, we will have 195 kg fruit in total to extract. One can extract around 30 ml from 100 gram Neem seeds¹². This means we will have $1950 \times 30\text{ml} = 58500 \text{ ml} = 58,5 \text{ litres}$ of Neem oil.

Neem oil is very effective and strong. It can even be diluted ten times without losing its power. There are a lot of oils in which you can dissolve Neem oil. For example; almond oil, sesame oil, jojoba oil and Macadamia oil¹³. As a lot of farmers in Burkina Faso grow sesame seeds, this is likely to be the best option. We can buy these seeds from farmers in the village for a price we estimate at \$0,70/1 kg¹⁴. We assume that you get about 51 ml (=0,051 l) sesame oil from 100 gram sesame seeds. We want to mix 20 ml Neem oil with 80 ml sesame oil, this is because we want to be sure that our Neem oil will not lose its power. For our Neem oil in this proportion, we need $4 \times 58,5 \text{ l} = 234 \text{ l}$ sesame oil. This should be pressed $234 \div 0,051 = 4588$ times. Which means we have to use $4588 \times 100 = 458800 \text{ g} = 458,8 \text{ kg}$ sesame seeds.

The Neem oil is mixed with sesame oil in a ratio of one to four. This means we can use the 58,5 litres pure Neem oil to make 234 l diluted Neem oil. The price of 200 ml diluted Neem oil we set on \$1,20. In this way we will not need all our bottles, but we can use the other ones for sesame oil. We can sell $234 \div 0,2 = 1170$ portions in three months. Which means we will sell about $1170 \div 3 = 390$ portions of oil a month.

The Piteba oil expeller can process up to 5 kg seeds/hour, but from personal experience, we know it is very hard to get oil out of Neem seeds. We assume that with Neem seeds you can press 3 kg seeds/hour. If we have our estimated 195 kg seeds scattered over 3 months, this means we have to extract 65 kg/month. Which means $65/3=22$ hours of Neem seed extracting/month. We also have to extract 234 l sesame seed oil in these 3 months.

⁸ Estimated, based on

<http://web.ita.doc.gov/tacgi/OverSeasNew.nsf/alldata/Burkina%20Faso#Tariffs>

⁹ Exchange rate on 7 January 2012

¹⁰ <http://www.midwestbottles.com/index.php?p=catalog&mode=catalog&parent=5&CatalogSetSortBy=price&CatalogSetView=Text>

¹¹ Estimated

¹² See appendix 2

¹³ <http://www.essentialoils.co.za/neem-oil.htm>

¹⁴ <http://faostat.fao.org/site/570/DesktopDefault.aspx?PageID=570#ancor>

Therefore we have to use the Piteba oil expeller again. You can press 3,4 kg sesame seeds/hour. This means you will have to work 98 hours to process all sesame seeds we use to oil. 98 hours/3 months = 33 hours/month. Together with the Neem seeds this will be 22+33=55 hours of work/month. We can now estimate how many Piteba Oil Expellers we need. This will be 2, one for the Neem seeds and one for the Sesame seeds. We would like to buy 3 Piteba Oil Expellers, because if we expand just a little, we will already need another oil expeller. Besides, the process can possibly be more efficient, so we can press all seeds in just two months.

The monthly minimum wage in Burkina Faso is 30.684 CFA Francs¹⁵, which is \$59,52¹⁶. We would like to pay our employees more, for example 10%. This means their salary will be \$65,47 a month if they work 40 hours/week. To give as much people as possible a job, we will only have part-time jobs. This means we will have 2 employees who will sell products in the shop, 5 employees who will pick the Neem fruits and 4 employees who will use the Piteba Oil Expeller. As they work part-time we have 5,5 full jobs. The total salary costs we have to pay will be 5,5×\$65,47 = \$360,09.

Below you can see a table of the costs and revenues we will have during the three months we will operate at full capacity. We do not want to harm the planet too much, so we have also taken down the costs and revenues for the people and planet.

Cost Structure		Revenue Streams	
<i>Financial</i>		<i>Financial</i>	
Rent of property of 1 ha	\$150	Selling Neem oil in portions of 200 ml (recur-rent income)	\$1,20*390 = \$468
Salary	\$360,09	Bottles for Neem oil (non-recurrent income)	\$1,41*390 = \$549,9
Sesame seeds	459*\$0,70=\$321,30		
Extra washers	6*\$0,30=\$1,80		
Savings for repair and expansion	\$84,71		
Savings to pay back investments	\$100		
Total costs	\$1017,90	Total income	\$1017,90
<i>People</i>		<i>People</i>	
		Better health	
		Reduction of people who have malaria	
		Employment	
<i>Planet</i>		<i>Planet</i>	
Interference in the open nature		Biological herbicides	

¹⁵ http://www.minimum-wage.org/international/en/Burkina_Faso

¹⁶ Exchange rate on 8 January 2012

Conclusion and recommendations

Our initial aim of this project was to decrease the chance of getting malaria with the use of Neem oil. Our main goal was to develop a business in which we would use the medicinal action of Neem oil. The Neem oil contains azadirachtin, which wards off mosquitoes and other insects.

We want to start our project with a small plantation of 15 Neem trees, a shop, a production and storage area in Burkina Faso. Due to the number of malaria cases, the political situation and the climate, Burkina Faso is quite a suitable country for setting up our first plantation.

Some of the inhabitants of the village, in which our plantation will be located, will be our employees. We want to introduce a refillable bottle for the Neem oil, which will hopefully make sure that the customers will come back to our business.

To extract the oil from the Neem seeds we will use the Piteba Oil Expeller. This is an oil expeller that can be of great value in developing countries. The expeller is easy to use, small and has a high yield, therefore we think this is the best technology for expelling oil from Neem seeds.

We think the Burkinabe's will use our Neem oil because it will decrease the chance of getting malaria in a relatively cheap and easy manner. They have to apply the oil to the skin or use it in a lamp oil burner.

To make them aware of the dangers of malaria and our solution to this problem, we will give the inhabitants lectures.

Neem oil can be of great value fighting against Malaria. It is easy to use, natural and a business for the Burkinabe's eventually. The assumptions we have made to create this outline of our business, should be validated before our project could be realized. Besides, more research should be done about Neem oil and its effective ingredients. If this research is done, our idea can be realized.

We hope to fight malaria and the Neem tree offers a perfect way to protect an entire country from a deadly disease!

Epilogue

We really enjoyed writing this 'Profielwerkstuk'. The Imagine project was an opportunity for us to do something original and challenging. We learned how to use and write a business model, everything you need to know before setting up a business in a developing country and think about the three P's, people, planet & profit. At first, we thought it might be difficult to write our 'Profielwerkstuk' in English, but during the writing process it became easier.

We can use the things we have learned during this project in our future life. We would like to thank all the people from the Imagine competition, especially Jelmer Tamis and Lotte van den Berg, and everyone else who helped us.

Thank you for reading!

Pien Venema
Myrthe Bussink

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- Bouchardon, P. (1999). *Bomen en hun genezende krachten*. Rijswijk: Uitgeverij Elmar B.V.
- Vogel, A. (1998). *De kleine dokter*. Harderwijk: Mix Media B.V.
- Oxfam, Cool Planet (undated). *Geography*. Consulted on December 8th 2011, <http://www.oxfam.org.uk/coolplanet/ontheline/explore/journey/burkina/geography.htm>
- World Atlas (undated). *Map of Burkina Faso*. Consulted on December 8th 2011, <http://www.worldatlas.com/webimage/countrys/africa/bf.htm>
- Wikipedia (2012). *Burkina Faso*. Consulted on December 8th 2011, http://en.wikipedia.org/wiki/Burkina_Faso
- Encyclopedia of the Nations (undated). *Burkina Faso*. Consulted on December 8th 2011, <http://www.nationsencyclopedia.com/Africa/Burkina-Faso-CLIMATE.html>
- Southtravels (undated). *Weather and climate in Burkina Faso*. Consulted on December 15th 2011, <http://www.southtravels.com/africa/burkinafaso/weather.html>
- U.S. Department of State (2011). *Background note: Burkina Faso*. Consulted on December 15th 2011, <http://www.state.gov/r/pa/ei/bgn/2834.htm>
- Central Intelligence Agency (undated). *Burkina Faso*. Consulted on December 15th 2011, <https://www.cia.gov/library/publications/the-world-factbook/geos/uv.html>
- Wikipedia (2011). *Economy of Burkina Faso*. Consulted on December 15th 2011, http://en.wikipedia.org/wiki/Economy_of_Burkina_Faso
- World Health Organization (2011). *Malaria*. Consulted on October 6th 2011, <http://www.who.int/mediacentre/factsheets/fs094/en/>
- Roll Back Malaria (2008). *Key malaria facts*. Consulted on October 6th 2011, <http://www.rbm.who.int/keyfacts.html>
- Neem Holland (undated). *Actieve ingrediënten*. Consulted on October 13th 2011, http://www.neem-holland.nl/neem-holland.nl/index.php?action=extra&extra=A_actieve_ingredienten&lang=NL
- Piteba (undated). *Piteba*. Consulted on October 13th 2011, http://www.piteba.com/nld/index_nld.htm
- Moore, S. (2011). *Malaria Journal*. Consulted on October 13th 2011, <http://www.malariajournal.com/content/10/S1/S11>
- Pub Med (1993). *Mosquito repellent action of neem (Azadirachta indica) oil*. Consulted on October 27th 2011, <http://www.ncbi.nlm.nih.gov/sites/entrez/8245950?dopt=Abstract&holding=f1000,f1000m,isrcn>
- Wisegeek (2012). *What is Cold Pressed oil?*. Consulted on January 4th 2012. <http://www.wisegeek.com/what-is-cold-pressed-oil.htm>
- ViewsWire (undated). *Social unrest*. Consulted on October 13th 2011, <http://viewswire.eiu.com/index.html?rf=0>
- World databank (undated). *Database*. Consulted on October 12th 2011, <http://databank.worldbank.org/ddp/home.do>

Appendix 1

Country index	Area (km ²) (2006)	Population (2009)	Infant mortality rate in 1 year by 1000 born (2006)	Health care in number of people by doctor (2002)	Population living in a high transmission area (2009)	Suspected cases (tested + probable) (2009)
Mali	1 240 192	13 010 000	108	20 000	82%	1 633 423
Democratic Republic of the Congo	2 344 858	66 832 000	89	14 286	97%	7 839 435
Niger	1 267 000	15 290 000	118	25 000	57%	4 716 312
Angola	1 246 700	18 498 000	185	20 000	100%	3 726 606
Gabon	267 668	1 475 000	55	5 000	100%	113 803
Cameroon	475 442	19 522 000	64	14 286	66%	1 883 199
Nigeria	923 768	154 729 000	97	5 263	100%	4 295 686
Côte d'Ivoire	322 463	21 075 000	89	11 111	100%	1 847 367
Burkina Faso	274 000	15 757 000	91	33 333	100%	4 537 600
Ghana	238 533	23 837	55	16 667	100%	3 694 671

	Reported malaria deaths, per 100 000 population All ages (2009)	Reported malaria deaths, per 100 000 population < 5 years (2009)	Need the project the most, based on number of malaria deaths	Political instability index Rated on a scale of 0 to 10 (10 is most unstable, 0 is most stable) (2009/2010)	Most stable country ranking	Roads, total network in km (2004)	Best infrastructure Km road per km2
Mali	2 331	1 612	8	7.0	4	18 709	8 (0,0151)
Democratic Republic of the Congo	21 168	no information	1	8.2	8	153 497	6 (0,0655)
Niger	2 159	1 579	9	7.5	5	18 387	9 (0,0145)
Angola	10 530	5 510	3	7.6	6	No information	-
Gabon	197	109	10	5.1	1	9 170	7 (0,0343)
Cameroon	4 943	3 331	6	6.9	3	51 346	5 (0,1080)
Nigeria	7 522	4 126	5	7.0	4	193 200	4 (0,2091)
Côte d'Ivoire	18 156	4 406	2	7.8	7	80 000	2 (0,2480)
Burkina Faso	7 982	4 707	4	6.9	3	92 495	1 (0,3376)
Ghana	3 378	1 505	7	5.9	2	54 311	3 (0,2277)

Appendix 2

The experiment

Introduction

Before we can write a business plan to set up a Neem Tree plantation, we have to know which method is the best to get the most oil from the Neem seeds. With this experiment we want to get answers on the following questions:

- How does the Piteba expeller work?
- How much oil can be extracted from 100 grams of Neem seeds?

Materials

- 2 beakers
- Piteba Oil Expeller
- Neem Seeds
- A funnel made of a plastic bottle
- Lamp oil
- an elastic band to secure the lamp oil cup

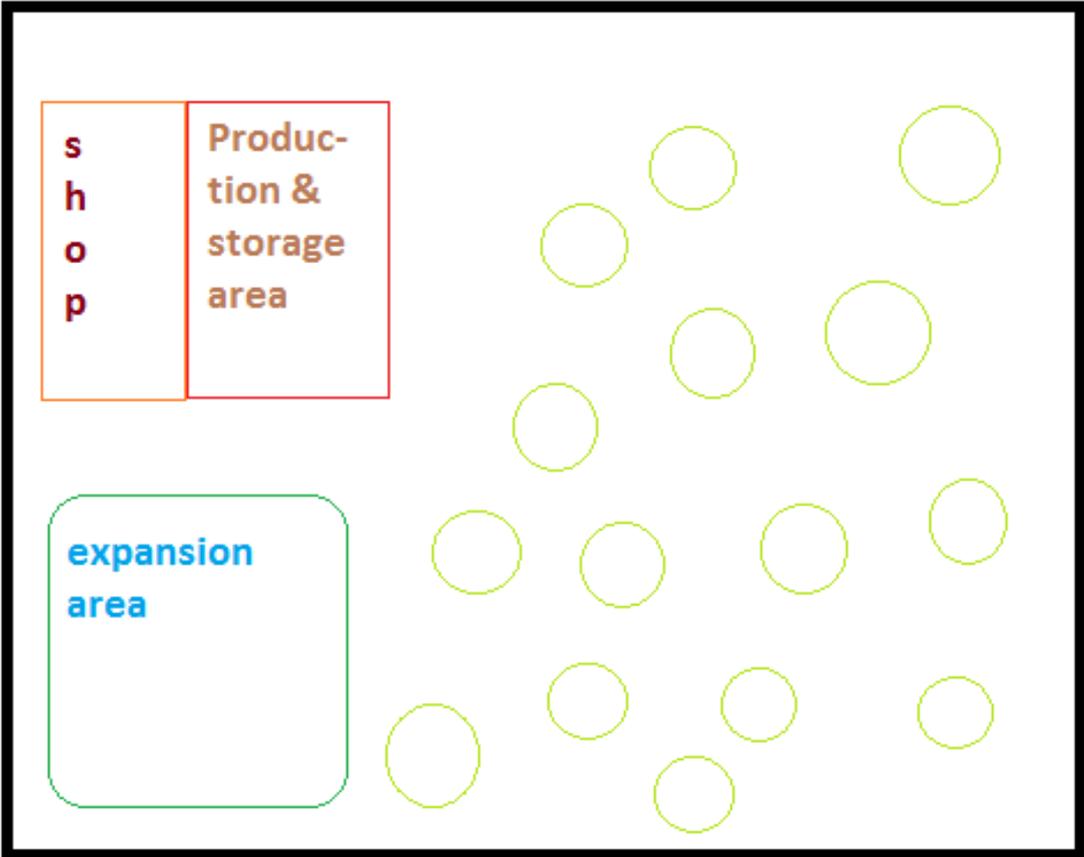
Report

A few weeks before the experiment we decided we needed the Piteba expeller for the experiment. On the 6th of December we went to Delft to do the experiment with the Neem seeds. The Neem seeds were already in Delft and other groups also brought peanuts and pistachio nuts. We did not know how the expeller would work and we did not have a lot of Neem seeds, so we decided we would do the first experiment with peanuts. We were divided into different groups, one group would screw up the peanuts and another group would work with the expeller. It did not go as planned because the oil was mixed up with the lamp oil and the press was supposed to secrete the cake and this was not happening. After doing the first experiment we had to clean the Piteba expeller. You are supposed to do that immediately, otherwise the press cake cools down and becomes rock solid. We forgot to clean it immediately, so it took a long time to remove the hardened press cake. We then wanted to do the experiment with the Neem seeds. We started with 100 grams of Neem seeds and with the help of a funnel we put the Neem seeds into the expeller. After a few seconds some oil dropped into the beaker and a few seconds later the press cake was released. We had a problem with the press cake when the expeller cooled down, but we discovered that the sooner you clean the expeller, the easier the press cake can be removed. There were some Neem seeds left, and we repeated the experiment. After those two experiments we took the two beakers with the press cake and weighed them. The amount of oil we could read from the beakers. For us it was important to know how much press cake would be secreted, because the cake can be used as dung. Also we wanted to know how much oil we could expel from the Neem seeds.

Results

100 grams of Neem seeds	± 30 ml of Neem oil	50 grams of cake
56,4 grams of Neem seeds	± 18 ml of Neem oil	28 grams of cake

Appendix 3



Appendix 4

Seeds	% total oil to seed
Neem	25-50
Sesame	60,4
Linseed	40
Pumpkinseed	45.5
Hazelnut	68
Rapeseed	44
Cocoa beans	56,8
Niger seeds	43
Almond	65