

MMAENGA

Mara van Welie
Merel Witteman
Anne Lylcia ten Cate
Esther Jongsma

Business plan, January 2008

PROLOGUE

Let us introduce ourselves. We are Mara, Anne Lycia, Esther and Merel. We're all in our last year at secondary school, RSG Pantarijn in Wageningen. During this last year, all students are required to construct a project about one of their chosen main subjects. We read an article about the organisation Imagine, in the magazine Explore. We knew what we wanted: we wanted to make a difference. An extensive project, with the potential to change the world!

We signed up for Imagine, with which we contracted ourselves to make a business plan, which could make a difference in developing countries. This is that business plan, with the potential to help a part of the world. Enjoy!

We would like to thank the following persons, because they were a great source of information. They helped and inspired us to write this business plan.

Rudy Rabbinge, Ms A.E. Nyanda, Bert Cesar, Gijs van Hengstum, Henk Gurp, Leo Koopman, Hendrik de Lint, Dennis Oonincx, Hans Smid, Arnold van Huis, Jan Huijsman, Bart Hogebrink, Jolanda Beerendonk, Floor van den Elsen, Ben Witteman, Rob van Haarlem, Marisa van Rijswijk, Marian Kole, Mark Snuverink, Tjandra Setiadi, Bedrijf Happy Shrimp, Phol cc, Wim Soetendaal, M. Spee, Dirk Janssen, Elte Hupkes, Joep Eding, Justin van der Graaf, Erik van Schaik, Hanneke Brouwer, Han Dijkstra, Henk-Jan Dozeman, Nico Fros, Ank Hendricks, Klaas Huijsman, Eline Eritié, Ronald van Welie, Corrie ten Cate, Corrie Nachtegaal, Pieter Jongsma, Urjan Jacobs, Esengul Yildirim, Jan Arnoud ten Cate, Hans Smid, José Witteman, Max Boehmer, Mark van Loosdrecht, Lieke Smits, Peter van Zanten, Cleo Jongedijk, Bas van den Berg, Bram van Montfort, Paul van der Helm, Jack Bogers, Willem Stevens, Diane Schaap.

... and of course everyone we forgot to mention above!¹

¹  Our Contacts

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* **Structure**; this business plan is a very simple and compact description of our plan. We have included extra information in the Annex. The different paragraphs of the annex have titles describing the subject of the paragraph and have a letter, from **A** till **N**.

INTRODUCTION

Our mission

Imagine challenges secondary-school students to solve problems of developing countries by means of a modern technology. We have made a plan to solve certain problems by the use of chitin. Our mission is therefore to help a developing country by means of modern technology and chitin.

The technique

Chitin is a common natural polymer. It is especially found in the exoskeletons of insects and in the shells of shrimps. Chitin which is isolated from these organisms can be modified into chitosan. Chitosan has several applications, e.g. water purification, the stiffening of textiles, the making of germ-free paper, and it provides one of the ingredients of some medicine.

The shrimp industries

Various companies extract chitin from the shells of shrimps. The good thing is that these companies recycle waste products and create employment. But we discovered that the shrimp industry itself is really irresponsible: harmful for the environment, destroying large fertile areas, and bad for its employees who earn little money and work under poor labour conditions. The negative effects of the shrimp industries have already become clear especially in developing countries. The chemicals used by shrimp industries have destroyed many vivid mangrove areas which used to be a food source for fish and crustaceans. Secondly, after a few years, when the shrimps are prone to be distinguished due to the chemicals used by the industry, the shrimp industry abandons the production area, leaving the employees behind without any source of income.

If we buy the waste products of the shrimp industries in order to extract chitin, we could provoke them to increase the shrimp production which may lead to further devastation of nature and an increment of the number of people who work under poor labour conditions. Therefore, we distinguish ourselves from buying waste products of the shrimp industry.

Key question

Our key question therefore is: How can we turn the high unemployment rate and the food shortage problems for people who live in the mangrove areas destroyed and abandoned by the shrimp industry?

Goals

We aim to solve the two main problems caused by the shrimp industries in mangrove areas:

- **unemployment**
- **food shortage**

Moreover, sustainability comes first, which is not the case in the shrimp industry.

In this business plan we'll show you what we want to do to reach our goals. We'll explain how, with whom, and furthermore we'll demonstrate our vision and perspectives for the long term.

WHAT?

What is our project plan?

Our plan is to set up a cockroach farm in an abandoned mangrove area in Thailand. We will use waste products from environmental (fruit) industries as food for the cockroaches. We peel the adult cockroaches and separate the meat from the exoskeletons. The meat will be used to make protein-rich cookies. We extract the chitin from the exoskeletons, which we modify into chitosan. Part of the chitosan will be used to impregnate recycled paper in order to make germ-free stiffened paper. This paper we use to make packages for the cookies. Finally, we will sell the cookies as well as the surplus of the chitosan: this way, we have two sources of income.



2



FOOD FOR OUR COCKROACHES

- recycling
- healthy food
- low cost

The production cycle starts with the recycling of waste products: our cockroaches get food from organic waste. The region we have selected for our nursery is known for its fruit production. Rotting fruit is excellent food for our cockroaches: it contains water and the cockroaches really like this food. If, however in certain periods the supply of fruit stagnates, we will collect other local organic waste product that can be used to feed the cockroaches. We have to check this collected waste on toxic elements, because our final product will be for human consumption. As a conclusion: the input for our company is (almost) freely and abundant available which reduces the production costs.



INSECTS FOR FOOD

- Full of essential fatty acids, proteins, vitamins and minerals.
- Can be applied in many products.
- Rearing insects is easy and cheap.
- A insect nursery does not produce any greenhouse gasses, ammonia, heat and only little waste.

Because of their high content of essential fatty acids, proteins and minerals, insects are a good and nutritious source of food.³ Moreover, the implementation and management of an insect farm is easy, cheap, and harmless to the environment. An insect farm can be set up even in the poorest and most infertile parts of the world. In some parts of the world insects are used as nutrient, for example people are used to eat insects in Asia.⁴



COCKROACH

- High chance of survival.
- High percentage of chitin.
- Easy to peel.
- They eat waste.
- No ethical concerns.
- Delicious!

Of all insects, we selected the cockroach for several reasons. The cockroach is a real survivor in almost any condition. This makes the use of expensive installations unnecessary and reduces the need of antibiotics and other chemicals, which can be harmful to the environment. Compared to other insects, with just an exoskeleton, cockroaches contain a high amount of chitin, due to their tough shell. The tough shell also facilitates peeling in order to separate the meat from the shell. A big advantage is that most cockroaches' species multiply easily: they are looked upon as pest animals, but for our goal this fast multiplication is an advantage. However, although they are considered pests, it is possible to keep them under control. One of the things they cannot stand is a low temperature. Another advantage is that cockroaches are not meticulous about food. With the use of bacteria they even digest cardboard. Therefore we can feed them

² <http://www.greenpeace.nl/news/garnalenkwekerijen-bedreigen-m>

³ **A** Our Contacts, Bart Hogebrink

⁴ **B** Eating insects, why?

anything organic: waste, rotting fruit, leftovers. The result is that food will be almost free of costs and the project will stimulate an almost complete waste-recycling circle.

Then, the preparation of cockroaches will not meet with ethical objections. Ethical objections are more likely to be made in domestic animals. Cockroaches score extremely low on this. And last but not least a lot of people, particularly in Asia, love to eat cockroaches!



THE ORIENTAL COCKROACH

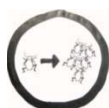
- Indigineous to Thailand.
- Pestinsect.
- Optimal chitin/protein ratio.
- Fast life cycle in relation to its size.

Most useful cockroach for our project is the Oriental cockroach (*Blatta orientalis*). The main reason is that the Oriental cockroach is common in Thailand and is subject to all the goals of the project.

The second reason is that the Oriental cockroach scores high on the ratio between size (more chitin) and multiplication rate. The Oriental cockroach is one of the larger species of cockroaches, up to 4 cm, and has a short maturation and reproduction time. The average period from birth to reproduction is a year. Once adult, a female drops an egg package every week, an egg package containing about 16 eggs, which normally all hatch within two months. Ten months later the young females are ready to start reproducing.



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NURSERY

- We can use existing nurseries.
- Average about 2000 000 cockroaches in nursery.
- Turnover about 40000 cockroaches per week.

Cockroaches are already used for human consumption, cockroach nurseries already exist.⁶ We will buy a breed or part of a breed from a local cockroach nursery. The *Blatta Orientalis* multiply extremely fast. Curious how fast our population will grow? Check the annex!⁷

After six months our company will have 1,000 cockroach tanks. There are about 2,000 cockroaches in each tank. Every week we 'harvest' 20 tanks, i.e. 40,000 cockroaches.



PREPARATION

- Smell disappears.
- Low waste of water.

We exterminate the cockroaches by boiling them in water. Boiling is the most ethical method of killing and takes away their peculiar smell. Leo Koopman⁸, chief of the insect nursery for Entomology Wageningen University, told us that another way to kill them is freezing, but this is more energy-consuming and does not take away the smell. A third advantage of boiling is the cleaning effect: sand and faeces will be removed automatically. Because of this we consume less water which meets one of our top priorities.



PEELING

- Separate the exoskeleton and meat.
- create work options.

The second step is peeling to separate the chitin-rich shell from the protein-rich meat. The boiling water softens the cockroaches, which facilitates the peeling process. We prefer manual peeling to mechanical peeling, because of the employment opportunities it creates for the local people.

After the peeling process, we have:

⁵ www.afpmb.org/.../Images/originals/Fig.%2079.jpg

⁶ (N) Acknowledgment

⁷ (C) Method of breeding

⁸ (A) Our Contacts, Leo Koopman

The protein-rich cockroach without shell, which will be the main protein ingredient of our cookies. The chitin-rich shell, the exoskeleton, which we'll modify into chitosan. Part of the chitosan we use to make germ-free paper to pack our cookies, and the surplus we sell directly as basal product for other related industries.



COOKIES

- Cockroach flour.
- Tasty and nutritious cookies.
- Source of income.

The world food problem could be reduced if people started to eat insects⁹. Inspired by Bart Hogebrink¹⁰, with his Food Factory project¹¹ winner of the 'Not Invented Yet' Competition of TNO, we made a draft recipe of protein-rich and nutritional cookies that can be prepared in the kitchen of our factory.

We selected this recipe of cookies, because the meal made of the protein-rich meat of insects is very nutritious and cookies are easy to sell. Our cookies will be a protein-rich delicacy and are easy and cheap to make!

The meat should be dried in the sun before grinding it into flour. Dried meat is easier to grind, otherwise it becomes a wet sludge.¹³



THE COMBINED EXTRACTION PROCESS: ENZYMATIC AND BIOLOGICAL

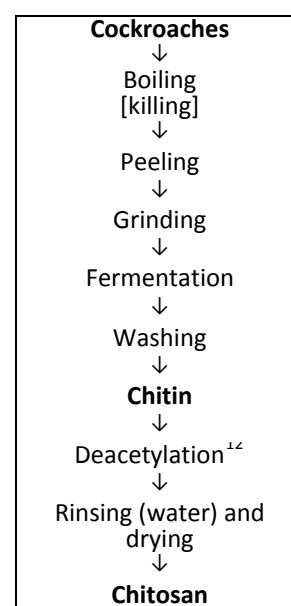
- Environmentally friendly.
- Fast and efficient.

- One time investment.

There are several ways to extract chitin from cockroaches and to modify chitin into chitosan, that apply chemical, biological and enzymatic processing. The chemical process, using HCl, NaOH and high temperatures, is harmful to the environment and for people: HCl and NaOH are toxic when inhaled, swallowed or touched. Companies that are producing chitosan are already using the several processes to make chitosan.

We will use a combination of the enzymatic and biological process. With this method we created a new harmless manner to produce chitosan:

This process can be represented as shown on the right:^{14 15}



GERM-FREE PAPER

- Recycling paper
- Anti-bacterial
- Reinforcing
- Water repellent.
- Designer

Of all the possible uses of chitosan, the most practical for our purpose seems to be the production of germ-free paper. By impregnating used paper with chitosan, we get a germ-free, water-repellent and strong type of paper. The cookies will be wrapped in the impregnated paper. This recycling of paper with chitosan is cheap and harmless for the environment. So we will get a germ-free, water-repellent, strong and cheap material for packing our cookies.

We will impregnate both sides of the papers twice with a solution of chitosan (1% chitosan, 2% acetic acid and 97% water). The chitosan makes the paper anti-bacteriological and stiff. Pui Tjan Wong¹⁶, who recently

⁹ **B** Eating insects, why?

¹⁰ **A** Our Contacts, Bart Hogebrink

¹¹ **D** Cookies

¹² In the process (deacetylation) of chitin into chitosan, the NHCOCH_3 group of chitin is replaced by a NH_2 group.

¹³ **D** Cookies

¹⁴ **E** Chitin and chitosan

¹⁵ **F** Chitin and chitosan winning

graduated on a final project about a campaign directed to persuade people to eat insects, developed several packages for insect products. She will assist us in the design of a practical package made of recycled paper.¹⁷



SALES

- Proven quality.
- Potential customer : Natagri Chitosan Fungicide
- Internet

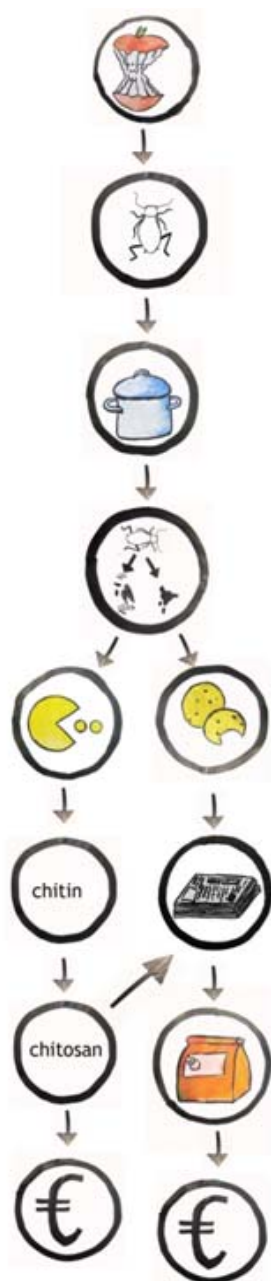
Our company will have two sources of income: the sales of cookies and the sales of the surplus of chitosan.

In order to easily market the surplus of chitosan, it is important to have a quality certification. We have found a company which is willing to test our chitosan. The company's name is Cognis, a worldwide supplier of innovative specialty chemicals and nutritional ingredients, with a particular focus on the areas of wellness and sustainability.

One of the companies in Thailand that could buy our chitosan is Nataghi Chitosan Fungicide, with Mr. Phol Kitsawad as our contact person. Maybe it is also possible to sell chitosan by internet.¹⁸

HOW?

(VISUAL VIEW)



- The *Blatta orientalis* will eat the organic waste.
- When the cockroaches are adults we cook them.
- After cooking we will peel the cockroach. After peeling the cockroaches we will have the meat and the exoskeleton.
- With the exoskeleton we will make chitosan. We will do this with an enzymatic process.
- With the meat we will make nutritious cookies.
- A part of the chitosan we will sell.
- Used paper we will recycle. In help of chitosan we will make germfree paper to make packing for our own cookies. After that we will sell the

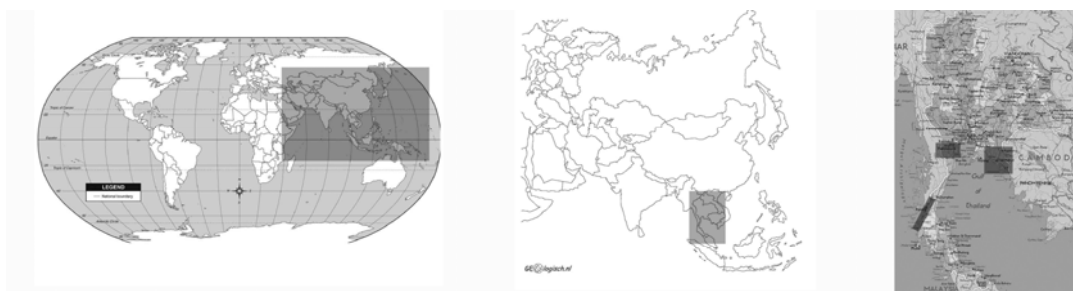
¹⁶ (A) Our Contacts, Pui Tjan Wong
¹⁷ (G) The application packing
¹⁸ (N) Acknowledgment

WHERE?

Where has our project the biggest chance for success?

There are two principal criteria for the selection of the country where to set up our company. Firstly, we want it to be a country with mangrove areas that have been destroyed by the shrimp industry and meanwhile has been abandoned by the local shrimp producing industries, leaving behind unemployment and impoverishment. Secondly, the local people should be willing to eat food made from insects.

Other criteria involve the safety of our development project, political stability and the absence of violence. The presence of other development projects would be a positive sign.¹⁹



World > Asia > Thailand > Phetchaburi, Chantaburi, Trat, Ranong

WHY THAILAND?²⁰

- The people already eat cockroaches.
- Lots of estoryed mangroves.
- tropical climate.
- Politically stable.
- Good infrastructure.

Keeping these criteria in mind, we selected Thailand, Asia. Advantages of Thailand are:

- In many Asian countries it is common to eat insects. In Thailand people eat the complete body of a cockroach as some sort of crisps (potato chips). Therefore, our cookie fits into the existing local food culture, which makes the marketing of the cookies more likely to succeed.
- Thailand is also known for its extensive mangrove areas, which have been destroyed on a large scale. There are only two types of coasts in Thailand: sand beaches and mangrove areas. Mr. B. Cesar, Executive Director of the Netherlands – Thai Chamber of Commerce, is therefore positive about the opportunities of this project in Thailand and is willing to support it.
- Thailand is one of the few South-East-Asian countries that have never been colonized by Europe. Thailand is a parliamentary constitutional monarchy. The King, of the Chakri dynasty, is head of the country, and the Prime Minister is head of the government. Thailand is a politically stable nation.
- Thailand has a tropical climate, hot and humid throughout the year, which is excellent for our cockroaches. The cool, dry season between November and February, during which our cockroaches will survive but not multiply as fast as usual.
- Thailand has a good infrastructure. The mangrove areas are situated between 20 to 40 kms from the cities. Furthermore, Thailand has a good road network.
- In Thailand many of the mangrove areas have been destroyed, especially in the province of Phetchaburi near Bangkok, in Chantaburi and Trat, provinces in the eastern part of the country, and in Ranong, province in the southern part of the country. All these regions are well suited for our farm.

Mr. B. Cesar²¹ is willing to help us find a piece of land near a destroyed mangrove area. The province of Phetchaburi seems most suited because of its fruit production. As said before, fruit waste makes excellent food for cockroaches.²²

¹⁹ **H** Which country?

²⁰ **I** Thailand

WHAT, WHERE?

For the execution of our plan a building should be constructed with all the space and equipment we need for the production process: our own little company. This building should:

- Be easy and cheap to construct;
- Have a separate nursery, lunch room, laboratory and store room;
- Have a dark room as a nursery, and windows in all other rooms;
- Have an easy passageway between all these rooms, except to the nursery;
- Have a chimney in the bakery;
- Have enough space to store all our equipment;
- Be easy to clean (especially the nursery).

Together with third-year student Mariska van Rijswijk in Architecture at Delft University of Technology, we have designed a building that meets with all these criteria.

According to Thai regulations, a Thai investor has to be the owner of the company for at least 51%, if we buy the piece of land. Therefore, we need to find a Thai investor, e.g. by means of www.samuiforsale.com. Another option is to lease the land, at an annual cost of 5 to 8% of the ownership rights.^{23 24}

WHO?

Our company will create employment because of the following stages in the production process:

- The care for the cockroaches in the nursery;
- The peeling of the cockroaches;
- The enzymes and the enzymatic processing;
- The baking of the cookies;
- The promotion, marketing, administration: this will be the task of the general manager. The General manager is responsible for the employees.

In order to make the work in our company attractive, we will offer the employees good employment conditions and a good salary. We think of paying 130% of the minimum local salary, which is a good salary according to Mr. B. Cesar, Executive Director of the Netherlands – Thai Chamber of Commerce. We intend to pay the manager with a higher level of education 160% of the minimum local salary.

PROMOTION

- a brand new product
- a task for our manager: a promotion campaign

Our product, a cookie made of cockroach meal, is new on the market. It is therefore important to make people enthusiastic. We will have to set up a good promotion campaign, to make people eager to buy our cookie. This promotion campaign will be the responsibility of the general manager. This campaign should focus on the good taste and nutritional value of the cookie and the recycling of waste products. Maybe nutritional claims are possible. Other important elements will be the humanitarian and ecological value of the project, making it worthwhile to be supported by eating our cookies.²⁵

²¹ (A) Our Contacts, Bert Cesar

²² (N) Acknowledgment

²³ (J) Factory

²⁴ (N) Acknowledgment

²⁵ (N) Acknowledgment

FUTURE

Our company has two sources of income:

1. the sales of the surplus chitosan;
2. the sales of the cookies made from cockroach meat.

The running expenses will be for:

- wages;
- water, gas, electricity;
- enzymes for the extraction of chitosan;
- acidic acid for the deacetylation of the chitin and for the germ-free paper;
- ingredients for the cookies;
- maintenance and stationery
- Monthly payment of rent for the leasing the land.

One of the positive aspects of our project is the possibility to set it up on a small or large scale. We have decided upon a small-scale start.

First months: start-up of the nursery

We start with three employees and with a cockroach nursery that we buy from another company. These cockroaches should be in different stages of development.

We will use the first months to increase the cockroach population, meanwhile learning, trying things out, and fine tuning. Therefore, during this implementation period we will not make any profit.²⁶

During this implementation period we plan to increase the cockroach population to 2,000,000. The moment we have reached this optimum, to be expected after six months, we will double the number of employees to 6 or 7.

After six months: the optimum nursery

With these 6 or 7 employees we are going to manage the company, a nursery with 2,000,000 cockroaches, a weekly production of 3,400 cookies, and weekly sales of 20 kg chitosan.

Perspectives

Our company can continue on this small scale, with stable annual finances after the implementation period. But we can also expand and therefore we think of three options:

1. Producing a bigger cockroach population. We will produce more chitosan, more cookies and therefore more profit;
2. Set up a similar small company in another deteriorated mangrove area, with a part of our cockroach nursery.
3. A combination of 1 and 2: big companies in several mangrove areas.

When the cockroach farm is running and we are producing a lot of cookies, it is an option to export the cookies to the western world.^{27 28 29}

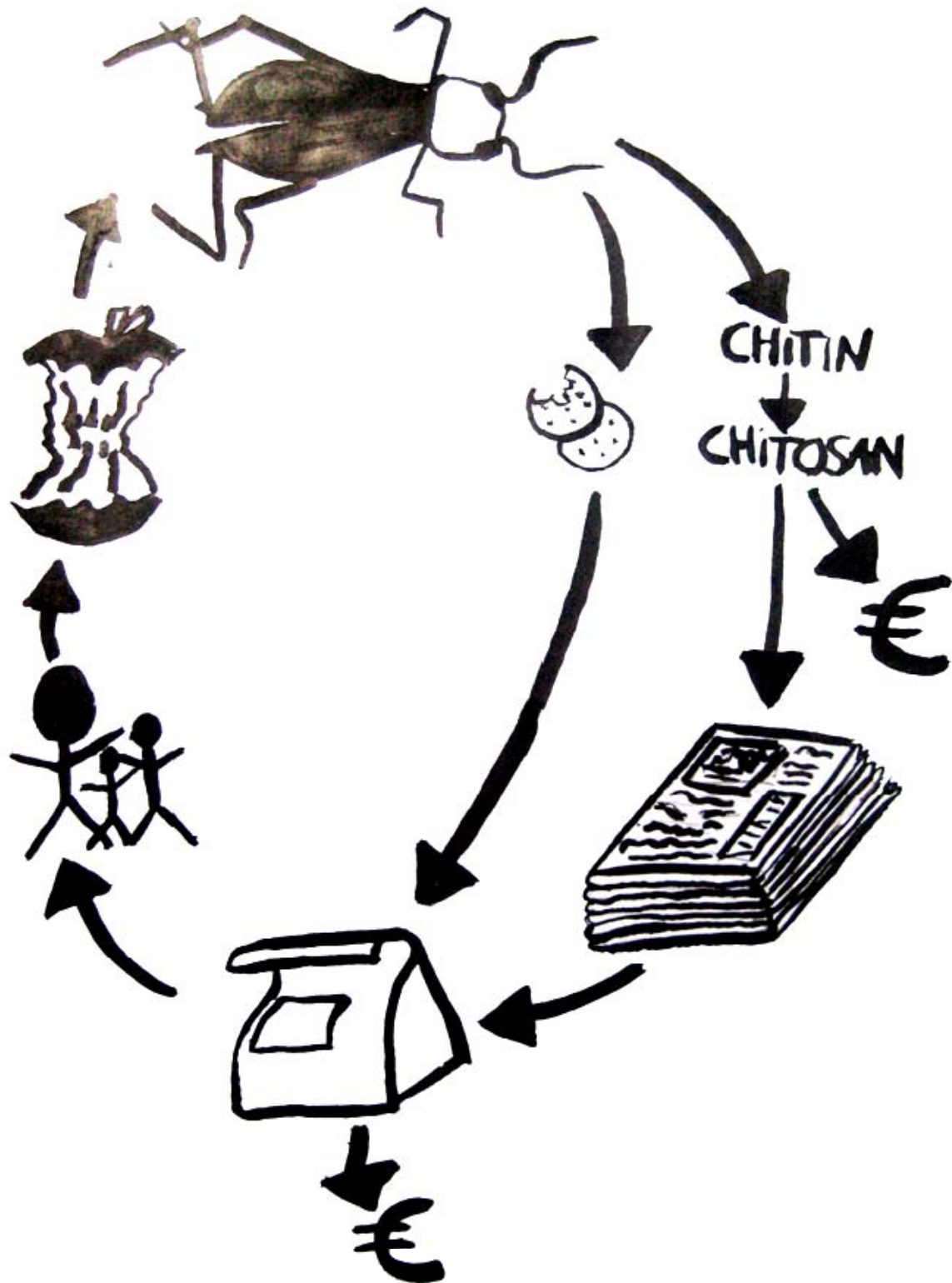
²⁶ (K) Budget

²⁷ (K) Budget

²⁸ (L) Problems

²⁹ (M) Acknowledgment

OVERVIEW



CONCLUSION

Our main question was: "What can we do to improve the problems of unemployment and food shortage in mangrove areas which have been destroyed and abandoned by the shrimp industry?"

In our opinion, the best solution to both problems is a cockroach nursery. We realise that some people may consider this idea strange or awkward. But we are convinced of its merits in solving the two principal problems in these abandoned and deteriorated areas.

People who have read this plan appreciate its simplicity and sustainability in solving some problems of humanity and understand the advantages of this plan. We are convinced that after reading, nobody will consider it strange or awkward anymore. On the contrary, anybody will say that this plan will have a big chance of success!

We have been inspired by this quotation from George Bernard Shaw:

*"A lot of people see what is happening and ask 'why?'
Some people see what could happen and ask 'why not?'"*
George Bernard Shaw

We are going to:

- grow, kill and peel cockroaches;
- make cookies from the cockroach meat;
- make chitosan from the chitin in the cockroach shell;
- sell part of the chitosan;
- Use another part to make germ-free, stiffened paper as package of the cookies; in an abandoned, deteriorated mangrove area in Thailand.

The main advantages of this project are:

The financial input is very low. The cockroaches get waste products as food, and the package paper will be made from waste products as well: recycled paper;

We will not produce any waste products, because we will use the complete cockroach;

We will turn something without economic value (the cockroach) into something with a high economic value (meal and chitosan)

The company can be set up on a small or large scale project and has many expansion prospects;

The company recycles waste products;

Our project is sustainable;

The killing of cockroaches will not meet with any ethical objections;

The company has two different sources of income: cookies and chitosan.

"Do you see what could happen, too?"

APPENDIX

Mara van Welie
Merel Witteman
Anne Lycia ten Cate
Esther Jongsma

Appendix, January 2008



Our contacts

Name: **Rudy Rabbinge**

Position: Rudy Rabbinge is a member of the Eerste Kamer (Dutch House of Lords) and of the PvdA, a Dutch political party. In addition, he's a professor of Sustainable Development and System Innovation at Wageningen University, counselor of Wageningen Graduate Schools and advisor of numerous organizations and institutes. This is only a partial list of his positions.

Contact: Rudy Rabbinge taught us a lot about setting up a business plan and about how we should set up our plans. He pointed out that we should clearly state our objectives, that we aim too high and that it's important to write down our plans elaborately step by step as well as explain how we think our plan is going to work out. He also pointed out the strengths of our project.

Name: **Mrs. A.E. Nyanda**

Position: Coordinator of the Mwanza Rural Housing programme

Contact: Mrs. Nyanda gave us a presentation about her project. In this programme she builds houses in Tanzania in a sustainable way. She was awarded the ASHDEN Award for this project, as well as a United Nations award on World Habitat Day. We had a meeting with her in which she told us about the important things we should take into consideration regarding development work in general. We've learned that a good project should be sustainable as well as participative. A big advantage of this project is the use of waste as a resource. Furthermore, Mrs. Nyanda told us not to be afraid to change things, but that we must do this by using training. We should be patient and dedicated, visit a lot and evaluate every aspect of our project.

Name: **Bert Cesar**

Position: Executive director Netherlands - Thai Chamber of Commerce

Contact: Bert Cesar told us that he supports our project and also gave us information about Thailand's culture. He has provided useful information about areas in Thailand where we could set up our factory and some things that we should take into consideration when starting a business in Thailand.

Name: **Gijs van Hengstum**

Position: Editor of the scientific youth magazine *Explore*

Contact: Gijs van Hengstum has given us a unique opportunity to make our project known to a larger audience by offering to write three articles about our project for *Explore*.

Name: **Henk Gulp**

Position: Teacher at IJsselstijn College

Contact: Henk Gulp stirred up our enthusiasm to research what insects had to offer and he told us a lot about the possibilities of preparing insects as food. He gave us several cookbooks and took us to the *Horecava market* in the RAI on January 8th. It was through him that we got in contact with numerous experts who convinced us that eating insects has a future.

- Name: **Leo Koopman**
Position: Chief of Nursery Entomology Wageningen University
Contact: Leo has given us lots of information about how to grow insects and about growing cockroaches in particular. He provided us with the necessities for growing insects safely, and showed us around several insect farms.
- Name: **Dr. Norbert Maak**
Position: Director Regulatory Affairs and Technical Relations Henkel KGaA
Contact: He may be able to facilitate quality testing on our chitosan.
- Name: **Hendrik de Lint**
Position: Information and Service Desk of Greenpeace Netherlands
Contact: Hendrik told us about the ruined mangroves and about the role the shrimp industry played in the destruction of these mangroves.
- Name: **Dennis Oonincx**
Position: Enthusiastic reptile owner
Contact: Dennis feeds insects to his reptiles and knows a lot about these insects. He shared some of his knowledge with us.
- Name: **Hans Smid**
Position: Laboratory of Entomology Plant Sciences
Contact: Hans told us about the problems we can encounter when working with cockroaches and which kind of cockroaches we could best use for growing. He also gave us permission to use some of his insect photos.
- Name: **Dr. Ir. Arnold van Huis**
Position: Laboratory of Entomology, Wageningen University
Contact: Arnold redirected us to Leo Koopman.
- Name: **Jan Huijsman**
Position: Works at a pest control company
Contact: Jan told us about the most efficient way to counter a possible outbreak of cockroaches.
- Name: **Bart Hogebrink**
Position: Working on a project on developing insect farms
Contact: Bart won TNO's 'Not Invented Yet' contest with his project. He showed that there are many people who think that eating insects has a future. Bart supports our project.
- Name: **Willem Stevens**
Position: The chitin expert who lives in Thailand.
Contact: Gave us detailed information about the production of chitin en chitosan.
- Name: **Jolanda Beerendonk**
Position: Project manager of the national work group on India
Contact: Jolanda pointed out that cockroaches aren't eaten in India.
- Name: **Floor van den Elsen**
Position: Laboratory of Entomology, Wageningen University

Contact: Floor let us know that she was enthusiastic about our project, she gave us some e-mail addresses and told us to go to Wageningen University's literature archive.

Name: **Rob van Haarlem**

Position: Studium Generale Wageningen UR

Contact: Rob has invited us to come by for an evening to tell something about our project.

Name: **Mariska van Rijswijk**

Position: Third year architecture student at the Technical University in Delft

Contact: Mariska advised us about using the right materials for our factory and the costs of these materials. She also developed our sketches of the factory into orderly 3D drawings.

Name: **Marian Kole**

Position: Breeder

Contact: Marian gave us information about cockroaches and provided us with cockroaches to set up an experimental breeding-facility.

Name: **Mark Snuverink**

Position: Student at Wageningen University

Contact: He showed us how he breeds cockroaches and gave us some tips about how to do it ourselves.

Name: **Tjandra Setiadi**

Contact: Tjandra told us that Indonesia isn't a suitable country for our project, as there are no abandoned mangroves there and the local population doesn't eat cockroaches.

Name: **Happy Shrimp Company**

Contact: Employees from this company told us in which countries the shrimp industry is most active. The countries they named were mostly Asian.

Name: **Phol Kitsawad**

Position: Director Technical & Engineering Department, Natagrj Chitosan Fungicide

Contact: Possible buyer of chitosan, one of our products.



Eating insects, why?

Hunger

Hunger: a worldwide problem that costs millions of lives every year.

How do we address this? Donate money? Food transports? Yes, that might help. But it doesn't solve the problem in the long term. A solution must be found that enables people to produce their own food. But how can this be done?

Hunger stems from another major problem: poverty. Poverty is often an issue in places that aren't suitable for agriculture and cattle breeding.

A solution to fight hunger therefore has to be a long-term solution that can take place in areas that have barren soil. Preferably, such a solution also has low start-up costs.

Insects

For people in poor areas, food needs to be found that's very nutritious, but much easier to obtain than the conventional breeding of pigs, cows and goats for meat.

The solution: an insect factory. Insect meat is high-quality food, full of essential fatty acids, proteins and minerals. Also, insects can be processed in many different ways. There are about 1400 kinds of edible insects.

Easy and cheap!

Setting up an insect nursery is easy and inexpensive.

Insects multiply very quickly, so the yield of an insect farm is very high. Insects don't need a specific type of food, which makes it possible to set up a nursery in infertile areas. A nursery can be kept running all year, because insect breeding is not seasonal.

Breeding also in poor areas

Insect food has to meet only a few criteria. Organic waste can be used as food for the insects. This is very cheap and might even be free. The insects can just eat what is available in the region, even if the region is very poor.

Insects require relatively little food. One kilo of insect meat requires far less plant foods than one kilo of conventional meat. Insects use their food in a much more efficient way than cows and pigs do.

Because a large part of the insect can be eaten and only a small amount of food is needed, the return is high and little waste is produced.

Low production costs

Insects require little space. The amount of living space per kilo used by a cow is far bigger than the living space used by one kilo insects. This reduces the production costs even more. Using the same space, much more food can be produced.

No environmental objections

The production of conventional meat causes worldwide problems. Those problems will only increase as the world's population, and thus the food demand from China and India, continues to grow. Various types of greenhouse gases are emitted due to cattle breeding, and it is one of the main causes of acidification of the environment due to the emission of ammonia. Insect nurseries do not have these problems. Insects do not emit greenhouse gases or ammonia.

It's already a delicacy!

In large parts of the world people already eat insects. It is however a misconception that people eat insects only because there's no other food available. Eating insects is inexpensive, but in many parts of the world, it is also a delicacy! Eating insects should become a habit in many parts of the world: it is a solution to food shortage and doesn't have lot of the problems that conventional meat has.

Insects as food

Eating insects would thus be a great solution to food shortage and hunger. Insects are very nutritious and many different species can be eaten.

Setting up an insect nursery and keeping it running is cheap, easy and has a high yield. A nursery can be set up in poor areas and produces no greenhouse gases, ammonia and heat, and very little waste.

In various parts of the world, insects are already eaten as a delicacy, so they're not necessarily bad-tasting and they can be processed in lots of different ways.

Therefore, to fight the growing problem of hunger and the increasing demand for food, eating insects is a great solution!



Method of breeding

After consulting insect breeding expert Leo Koopman of WUR University, we decided to set up our own nursery with various tanks for cockroaches in various life stages. The advantage of this system is that it is easier to determine when the cockroaches are fertile, and when they are almost dead.

We want to breed the cockroaches 'dry'. This means that we won't keep them on sand or some other material, but rather on the bottom of the tank, which is easier to keep clean. To create a nice living environment, we put old paper, egg cartons, and other things in the tanks so that the cockroaches can find shelter. Although most of the cockroaches can't fly, we close the tanks with strong wire netting to prevent them from escaping (see Appendix M 'Problems').

The tanks will be hung in racks. In this way, the floor will remain free of tanks, allowing a good overview and making it easier to keep the room clean. The tanks are easy to empty by taking out the bottom, and letting all the cockroaches fall out of their tank into another one.

We will need about 100 tanks; there is space for approximately 2000 cockroaches in a 50x30x50 cm tank. Cockroaches like to live very close to, over, and under each other. To make the factory run smoothly we shall have to kill one tank of cockroaches every week, or a few times a week, and keep them for subsequent processing.

The region where we want to set up our factory is known for its fruit production. There is a good chance that we can obtain rotting fruit from fruit farmers in the region. This fruit contains a high percentage of fluid. By putting a few pieces of this rotting fruit in the cockroach tanks, the roaches will have good, healthy food and extra fluid, so that there is no need to put other fluid-installations in the tanks. If it appears that the rotting fruit doesn't contain enough fluid, or if we can not buy enough rotting fruit, we could put wet wood in the tanks and occasionally sprinkle it with water. According to Dennis Ooninx and Mark Snuverink, experienced cockroach growers, cockroaches are able to absorb fluid themselves because of the way in which wood takes up and repels moisture. This works better than putting a can of water in the tanks.

The nursery itself

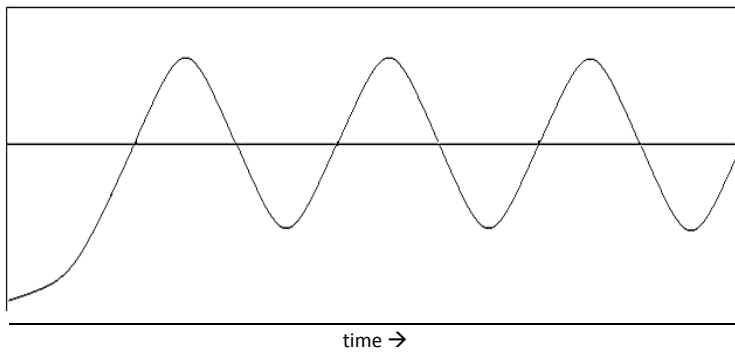
We start with some cockroaches in each of several life stages. The number of cockroaches with which we start depends on the size of the nursery we can buy. A notion of the set-up and running of our nursery can be obtained by looking at the description below, which uses the example of 1000 adult-cockroaches: 800 female and 200 male.

Weeks after starting	Number of egg-packages
1	800
2	1600
3	2400
4	3200

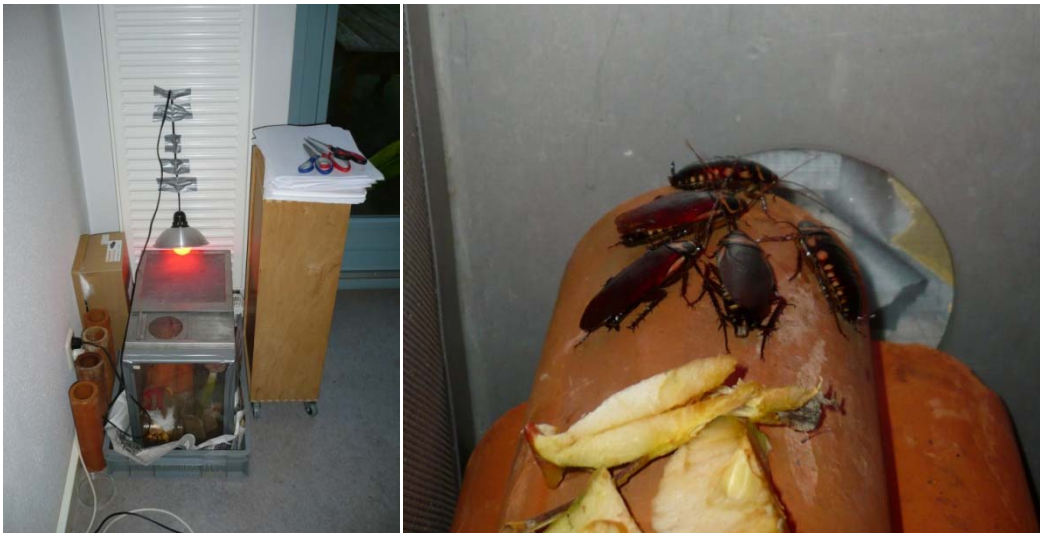
5	4000
6	4800
7	5600
8	6400

After eight weeks the cockroaches in the eggs laid in week one will hatch from their egg-packages.
After another eight weeks all the egg-packages will have hatched into cockroaches.
So after another eight weeks there are $1000 + 6400 \times 16 = 103,400$ cockroaches.

Because cockroaches multiply very quickly, it will be necessary to kill a large number of them every few weeks. There will be approximately 2.000.000 cockroaches in our factory. The increase in number of cockroaches graphed as a function of time will look like this:



Our own house breeding (!!)





FoodFactory

Bart Hogebrink participated in a contest called “Not Yet Invented” by TNO, in which young people were challenged to think of ideas that can change our future in a positive way. His plan is to set up a Food Factory to fight hunger in developing countries by making high-protein nutritious biscuits from bred insects. The jury members (Alexander Ribbink of TomTom, Peter Werkhoven, Fietje Vaas, Ben and Celeste Indeed Ponsion) picked his idea as the best plan to change the future in a positive way; it may seem obvious, yet it’s new and creative. As a part of the winner’s prize, TNO is going to realize his idea. The project’s status can be followed at www.inivention.nl.

Our biscuits

We had a similar idea and e-mailed Bart immediately. In our e-mail contact he told us he would enjoy working with us and think about what such a factory should look like and how it should be built. As for now, we have developed a recipe for a basic cookie. In practice, we hope to be able to process fruit, nuts and various other regional products in order to develop a nutritious high-protein biscuit made of cockroach flour.

Production of our cakes

We are counting on about 40.000 cockroaches per week that can be used for cookies. After peeling, drying and grinding of the cockroach meat we should have 16 kilos of flour.

Requirements for 500 cookies

- 2500 g flour (minimum amount of flour from cockroaches)
- 1500 g butter
- 1000 g sugar
- Some salt
- 30 minutes in the oven at a temperature of 180 degrees C.

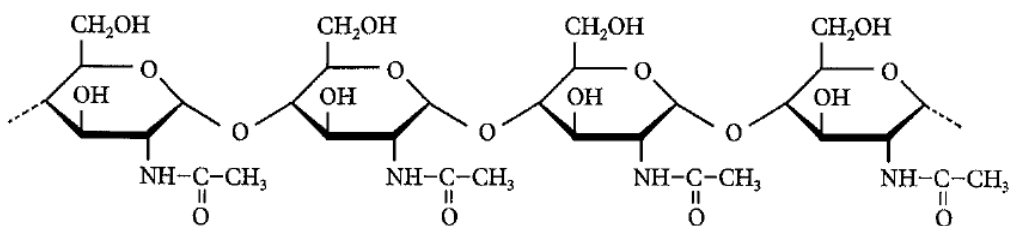
We can therefore produce 3200 biscuits every week. These biscuits can be sold at the local market.



Chitin and chitosan

CHITIN

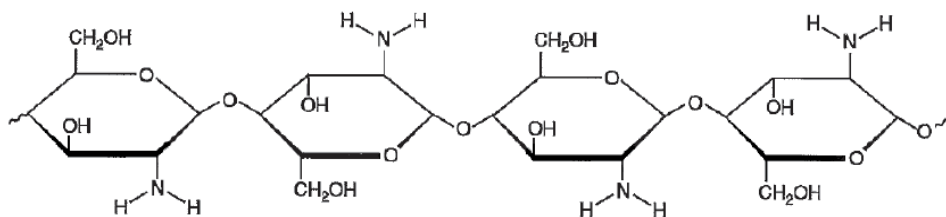
Chitin is (after cellulose) the second most frequently found polymer on our planet. It can be biologically broken down, and is not poisonous. Chitin is the main component of the exoskeletons of crab, shrimp, lobster, and insects. Under normal circumstances, chitin is a solid substance. Its colour varies from white to brown, depending on the organism in which it is present.



This is our homemade chitosan: chitosan from shrimps and insects.

CHITOSAN

Chitosan is produced (commercially) by deacetylation of chitin. Just like chitin, it can be broken down, and again, is not poisonous. A useful characteristic of chitosan is that it has anti-bacterial properties.





Chitin and chitosan winning

Our process

Every explanation below corresponds with one of the steps in the process above.

From exoskeleton to chitin.

Each explanation below corresponds with one of the steps in the process above.

Grinding

We grind the hard parts of our cockroaches with a mortar. Grinding these parts enlarges the surface area, ensuring that the enzymes are able to remove the proteins more effectively, and making the acid more effective at removing the calcium carbonate. This results in a purer chitin than without first grinding the hard parts.

Fermentation

We put the ground parts of the cockroaches in a sealed reaction vat with a stirring device, then we add a solution of 1,5% acetic acid and Lactobacillus.

Lactobacillus is a microorganism that can withstand acidic environments very well.

Lactobacillus produces protease, an enzyme that can break down proteins into amino acids, thereby producing lactic acid.

De acetic acid is necessary to remove the calcium carbonate. Acetic acid is far less dangerous than hydrochloric acid and is also less of a burden for the environment. After this step only the chitin remains.

Washing

After the fermentation step, the pH-value of the mixture in the reaction vat is lower than 7 due to the acetic acid and the lactic acid. Deacetylase can't handle acidic environments, so it is necessary wash the chitin to provide a neutral environment.

From chitin to chitosan

Deacetylase

We add deacetylase to the chitin, an enzyme that facilitates the conversion from chitin to chitosan. The chitosan is made by deacetylising chitin, this means that acetyl groups need to be 'taken off' of the chitin molecules. Deacetylase works in plain water, so it is sufficient to add water with the enzyme to the chitin. Chitosan is worth far more than chitine, because chitosan is better known.

Washing and drying

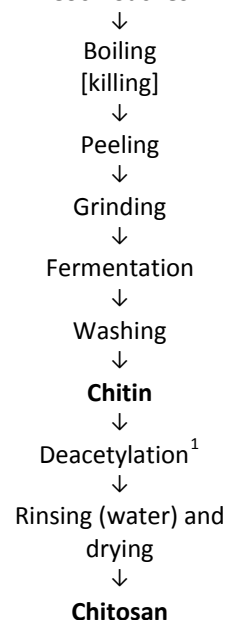
Washing and drying is necessary to obtain pure chitosan. This part of the process will be done as efficiently as possible, to conserve valuable water.

Other processes

Chemical process:

From insect & shrimp to chitosan

Cockroaches



¹ In the process (deacetylation) of chitin into chitosan, the NHCOCH_3 group of chitin is replaced by a NH_2 group.

As is mentioned in the business plan, we use an enzymatic method to process the cockroaches into chitosan. This manner of processing is environmentally friendly and poses no danger at all to our factory's employees. During the 'experiment days' in Delft we used another means of extracting chitin, using a chemical process. Below is a schematic rendering of this process:

Shrimp scales & insects:

- |
- 1) Washing and grinding.
- |
- 2) Removing proteins [Add lye (NaOH) and leave in a 60° C bath of water for two hours]
An average of 5.02 liters of lye is used per kilo shrimps and insects
- |
- 3) Wash
An average of 24.44 liters of water is used per kilo shrimps and insects
- |
- 4) Demineralise [Add hydrochloric acid (HCl) and leave in a 40° C of water bath for 1 hour.
An average of 5.02 liters of hydrochloric acid is used per kilo shrimps and insects.
- |
- 5) Wash
An average of 28.00 liters of water is used per kilo shrimps and insects.

|
Chitin

- |
- 6) Chitosan production [Add lye]
- |
- 7) Wash and Dry
- |

Chitosan

The advantages of our enzymatic process as compared to the chemical process are:

-We combine points 2 and 4. By applying fermentation, steps 2 and 4 are combined and we can save all the water needed in step 3, which is 24.44 liter per kilo insects and shrimp.

-We don't use dangerous and harmful chemicals like hydrochloric acid and lye.

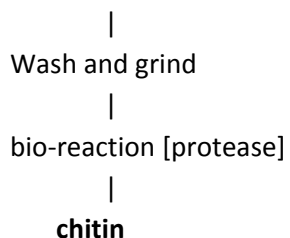
These advantages mostly mean that we save money and are more environmentally friendly. In addition, we waste less valuable water, which is scarce and should be used for human consumption.

Below is a schematic rendering of the biological process of extracting chitin from insects and shrimp.

Biological

From insect and shrimp to chitin

Shrimp scales & insects



We do utilize a bioreaction with protease, but we don't do this by adding the enzyme itself. The reason for doing this is that the enzyme is expensive and hard to produce. Instead, we use a microorganism, lactobacillus, that produces the protease. Adding this organism means we don't have to add the expensive enzyme anymore, as that is done by the lactobacillus.



The application: packing

Using an application

We are going to use chitosan for the production of gemfree, water-repellent and strong paper. This is one of the applications of chitosan. The cookies will be wrapped in the impregnated paper.

The paper will be produced by this method: chitosan has to be solved in a solution.

This solution contains: chitosan, acetic acid and water. The verhouding van these stoffen is:

chitosan : acetic acid : water = 1 : 2 : 97

When the solution is ready, the old-paper will be impregnated on both sides with this solution. We have tried this out (ourselves) at the TU Delft. There is possibly a beter method when we will have to produce on bigger scale. For example immerse (onderdompelen!) the paper in a bath of the chitosan solution or maybe we can use a uge (sproeier)

Packages

The graduation paper of Pui Tjan Wong was

Therefore she invented a campaign. She designed posters, carts, advertisements, brochures, receptcarts and last but not least packages for insect food. Below this page there are some examples of these packages.

She would like to develop special packages with our gemfree, water-repellent, strong paper, in cooperation with us.

Her site is www.ptwong.nl





Which country?

We had the chance to change the whole world. The whole world, which implies anywhere: Africa, Asia, America, Australia, Antarctica or Europe. Using the world atlas, the internet of course, and Wikipedia, we took a closer look at third world countries.

After having oriented ourselves, we went on to study Africa. We set up a meeting with Mama Nyanda, from Tanzania, who had just received a prize from the United Nations for her development work at 'The World Habitat Day' on the 1st of October.

Mama Nyanda told us about development work to help third world countries, and informed us about Lake Victoria, where a lot of shrimp is farmed. We gathered information about Lake Victoria, and about the shrimp farming. Looking at the negative press surrounding the shrimp farms, we thought of something else, a new plan. We decided to look for countries in Africa where eating cockroaches is the norm, but after some research and talking to an Indonesian woman, we found out that people living in certain parts of Asia do eat insects. We shifted our attention to Asia.

The following countries were of interest: India, Sri Lanka, Malaysia, Indonesia, Thailand, Cambodia, Vietnam, Burma, Bangladesh, China and North Korea. We studied these countries. Do the inhabitants eat cockroaches? What is it like there?

Using the newest technology, the World Wide Web, or *Internet*, we *e-mailed* and phoned embassies in these countries. After having done some research, we found out that cockroaches are eaten in Thailand, where they are even considered a delicacy! Using the internet, we found dishes which used cockroaches as ingredients, along with people's opinions of these dishes. B. Cesar (Christine of info@ebook-thailand.nl) confirmed this in his *e-mail*, and the infamous YouTube contributed with various videos.

Furthermore, Thailand is a country with many destroyed mangroves. After getting the green light and full support from the executive director of the Netherlands – Thai Chamber of Commerce, there wasn't any doubt as to which country to choose.

The biggest setback, however, is the language. None of us speak Thai, so any meeting will have to be set up through a translator. On the other hand, this is a problem we would have experienced in all the other Asian countries as well, and we're sure there is a good translator somewhere in Thailand. We think it is a good idea to employ a Thai with a bachelor of science, about which more in Appendix M. All in all, we think now that the language barrier is not a big problem and certainly one which can be overcome.



Thailand

General information

Area	514,000 km ² (14 times the size of the Netherlands)
Capital	Bangkok
Population	65 million (2006)
Population Density	125.7 inhabitants per km ²
Languages	Thai, Chinese, English, Karen, Mon and various Hill Tribe-languages
Climate	Tropical

Social situation

Thailand has done well with realizing the international Millennium Goals. Doing a good job on fighting poverty, shortage of food, the social difference between sexes, HIV/AIDS and Malaria, Thailand is ahead of schedule in terms of the goals set in 2000. Thailand is now looking to improve further, trying to complete more ambitious goals. Here are some figures to show the improvements: 1990 counted 27,2% of the Thai population living in poverty, whilst 2002 has seen this number shrink to 9,8%. Despite these major improvements, around half of the population are active in the informal economy, which results in the lack of full time job opportunities remaining a big problem. *Many poor Thai feel forced to accept hard and poorly-paid labour, their low income creates a vicious circle of poverty.*

Electricity

Just like the Netherlands, Thailand uses 220 Volt sockets, but the sockets Thailand uses are often different (3 flat poles opposed to the two round poles the Dutch use).

Why invest in Thailand?

"The most important thing for foreign investors in Thailand would be the people and the culture. The people are very friendly, which makes it easy and makes it a nice working place. Besides that, Thai people are very dedicated."

Ronald de Hann
Managing Director, Grampian Food Siam Limited

"We need to make sure that when we put a big investment in any country, it will be a stable situation that we can rely on the rules and the way that business is done. And we have felt that confidence in Thailand."

David Levy
Chairman and Managing Director, ExxonMobil Limited

"The top three attributes that clearly differentiate Thailand from many other countries in the region and throughout the world are: government support, the work ethic and attitude of the people and the skilled resource pool."

Brent Lee Bargmann
Vice President, Seagate Technology (Thailand) Ltd.

"The very stable social and economic situation of recent times, the very strong political stability, are the hallmark of Thailand at the moment. Also, Thailand is obviously a very strategic location - part of Indo-China and the rest of Asia."

James Howard
Managing Director, Katoen Natie Semcorp (Thailand) Ltd.

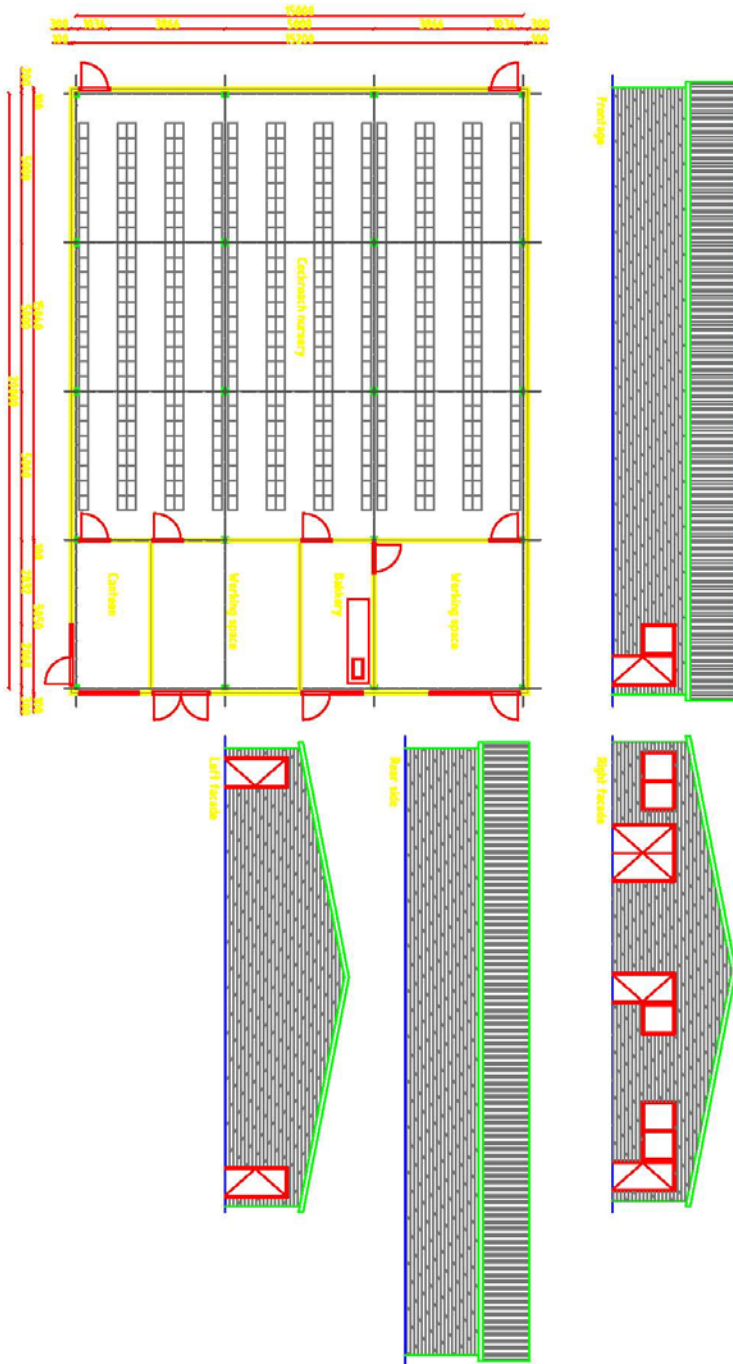
"There are lots of strengths in Thailand. The top three, I would say, are supporting industries strengths, quality labor and social and economic stability. I should not forget the strong support of the Thai government, which is also very important."

Ryoichi Sasaki
President, Toyota Motor Thailand Co., Ltd.





Factory

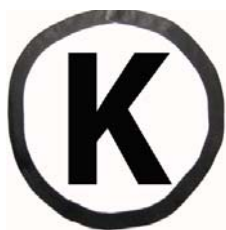


Description

Our factory can be seen as three small factories: a seed-bed, where cockroaches will be efficiently produced; a space where the cockroaches are peeled and then processed into chitosan; and a bakery where the flesh of cockroaches will be made into flour from which the nutritious cookies are made. There are also two other rooms: a canteen where our employees will have their breaks and where materials can be stored, and a storage room for sacks of flour, sacks of chitosan, ingredients, tools and other things.

Work Environment

To create a nice work environment, there has to be a radio. Work will be much easier and people will be much happier and more joyful with background music.



Budget

One-time costs

OUT	COSTS (€)	IN	INCOME (€)
Building Ground Infrastructure	15.000	Imagine contest money	25.000
One-time costs	8.000		
Materials	2.000		
Total	25.000	Total	25.000

Annual costs

OUT	COSTS (€)	IN	INCOME (€)
Ground	700	Chitosan	5.200
Salary	2.000	Cookies	pm.
Unexpected costs	100		
Total	2800	Total	2600

Budget 1 year

*In our budget, we did not include the prize money. In this scenario, we can pay off our start-up costs in 5 years. If we win the contest, these costs can be removed from the budget.

Detailed budget

- **Building**

Building surface 300 m² height 3,5 m; interior space +/- 1000 m³. The building is of stone, has a roof of corrugated iron, 1 big room and four small rooms.

- **Land**
600 m², the costs for such a surface is €25,00/m²/jaar, which means 15,000 m² of euro/jaar.
- **Infrastructure**
Electricity/water/sewage.
- **Onetime costs**
Cockroach tanks: €1000 x 5 = €5000,00
Gas stove: €100,00
Pots and pans: €100,00
- Storage tanks / sieves / buckets / stirring vats: €500,00
2 stirring vats: €500,00
Costs for enzymes: €900,00
Oven: €100
- **Materials**
Work clothing: €250,00
- **Salary**
We pay our regular employees 4 x 1,3 x minimum wage.
We pay the manager 1 x 1,6 x minimum wage.
For 5 employees this will be €2000 monthly.
- **Unexpected costs**
We do not want to make a profit with our company, so we will use our profits as a buffer for unexpected costs.



Problems

Travelling eggs

If a cockroach escapes, it could get squashed. Eggs can then stick to shoe soles and travel along until they have reached a good spot to release themselves. If one of our employees happens to squash a roach, chances are there that the employee will have a major cockroach invasion in no time.

Solution: We will lay down a mat (like the ones used for avian flu etc.) at the exit of our nursery, to make sure that all the eggs will be killed, and the shoes of our employees will be disinfected.

Outbreak

What if, despite all of our precautions, some cockroaches manage to escape? What does it take to make sure that the surrounding area isn't infested by roaches in no time?

Solution: There is a wonderful gel called 'Premise Gel'. This product contains a lure that attracts roaches and all other sorts of insects. As soon as they smell it, they will do anything to feed on the gel. After that, they will die in an instant. It is an effective little thing, because it remains "solid". The gel doesn't evaporate, it is not poisonous for humans, and is easy to use if an outbreak were to occur. We don't have to evacuate the entire building, and the bugs can be swept up and thrown away. Piece of cake.

Not enough cockroach flour

If the production of our own nutritious and protein rich flour lags, then our cookie production will stop. How can we continue to produce our cookies?

Solution: We will buy flour, so that we can continue to bake cookies with a mix of our own and purchased flour. This way the cookies remain nutritious, and our production continues, until we reach a point when we are able to produce enough flour ourselves.

Chitosan sale doesn't flourish

It could happen that our chitosan doesn't sell as well as we thought it would. What can we do to retain our factory?

Solution: Once again we will try to improve our chitosan, find other solutions, and look for help elsewhere. If all fails, but the sale of the cookies goes well, we can switch to just producing cookies. Perhaps it is even possible to increase our cookie production, and get all of our needed income from that.

All the cockroaches are sick

Though cockroaches are notorious for resisting nearly everything and for rarely suffering from disease, we must take into account the possibility of an epidemic spreading among the cockroaches. In that case it would be too risky continuing to breed the roaches and bake cookies from their meat.

Solution: we kill all of our cockroaches and use only our chitosan application. We disinfect our entire breeding installation and make a fresh start.

Communication problems

Communication with the Thai turns out to be problematic. Though we are located near a city, we do not succeed in communicating effectively in English with our employees.

Solution: there are several ways to tackle this problem.

1. Employ an interpreter.
2. Have the non-Thai-speakers who start up the project attend a Thai language course.
3. Provide a basic English language course for our employees.
4. Employ a Thai BSc in Food Technology. He or she will possess technical know-how that comes in handy and will speak English.

Fruit

Perhaps we are not able to buy enough fruit from local farmers due to low production.

Solution: Cockroaches eat nearly everything, so it shouldn't be difficult to find alternative food for them. A promising plan is to ask neighbours to bring fresh kitchen and garden refuse to the factory. We wouldn't use any old waste because it must be hygienic and free of pathogens.



Publicity

Promotion and solid networks are two vital ingredients for the success of our project. We took this subject very seriously while writing our business plan. Our contacts list (Appendix A) shows those with whom we worked.

'Explore'

We have already produced articles in 'Explore', a Dutch science magazine.

Website

At the start of our project, we launched the website <http://pwsimagine.wordpress.com>. This website contains the details of the competition, as well as a log, pictures, and written articles.

Future promotion plans

If our project is to be approved, we will make sure that we get more publicity. We have already made a deal with Movie W, a small cinema in Wageningen, to play a movie about cockroaches. We will provide background information by means of presentation, and details considering our project. On top of all this, we will continue to write articles for Explore magazine, and we hope that 'Bionieuws' and the newspaper de Volkskrant are willing to publish our articles.

With Pui Tjong Wang, an advertising expert, we made an appointment to evaluate possible scenarios for our campaign.



Acknowledgment

*The most of our information we get from people who you can see in the face book.

BAD SHRIMP INDUSTRIES & DESTROYED MANGROVES

Site's:

- <http://www.mangroveactionproject.org>

Author: unknown.

Date: 21 July 2007.

Title: Shrimp business faces woes on three fronts – Thailand,

- http://www.mangroveactionproject.org/news/current_headlines/shrimp-business-faces-woes-on-three-fronts-thailand/?searchterm=vietnam

Author: G. Murray.

Date: unknown.

Title: Thailand's Disappearing Mangroves: Factors in the Destruction of a Resource,

- <http://www.umich.edu/~esupdate/library/99.3-4/murray.html>

Author: P. Erftemeijer

Date: 10 June 1997.

Title: Community Participation in Mangrove Forest Management and Rehabilitation in Southern Thailand

- http://www.ramsar.org/wn/w.n.thailand_mangroves.htm

Author: unknown

Date: 29 July 2003

Title: Garnalenkwekerijen bedreigen mangroven, de regenwouden van de kusten-

<http://www.greenpeace.nl/news/garnalenkwekerijen-bedreigen-m>

Magazine's:

Author:

Date: June 2004

Title: Shrimps with a nasty taste,

Magazine: Goede Waar

- www.goedewaar.nl/magazine/11-Goede%20Waar%2011.pdf

THAILAND

- google earth

Site's:

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Author: RTL-news

Date: 12 December 2007

Title: Elections in Thailand

[http://www.rtl.nl/\(/actueel/rtlnieuws/buitenland/articleview/\)/components/actueel/rtlnieuws/2007/12_de](http://www.rtl.nl/(/actueel/rtlnieuws/buitenland/articleview/)/components/actueel/rtlnieuws/2007/12_de)

cember/23/buitenland/1223_0900_Verkiezingen_Thailand.xml

Books:

Author: Sjon Hauser

Title: on a visit in Thailand

Publisher: KIT Publishers, Amsterdam 2007

Author: Valerie Hill

Title: Thailand

Publisher: KIT, Amsterdam

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EATING INSECTS & THE FOODFACTORY PROJECT

Paper's & Magazine's

Author: de Standaard Date: 23 January 2008

Title: Like a plate cockroaches?

- <http://www.standaard.be/Artikel/Detail.aspx?artikelId=2D1MSPK0>

Author: Bodytalk Date: October 2007

Title: Proteins on pootjes?

Magazine: Bodytalk

- http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Author: NRC Date: December 2007

Title: Less meat is necessary

Paper: NRC Handelsblad

- http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Author: Ode Date: January/February 2008

Title: We should eat insects

Magazine: Ode

- http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Author: Olmo Linthorst Date: 9 January 2008

Title: Dutch people eat more out of their house – introduction bugs

Paper: NRC Handelsblad

- http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Author: Agraaf Date: 12 January 2008

Title: Dutch insects as vervanger? of meat

Magazine: Agraaf

- http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Author: Arnold van Huis Date: 2007

Title: Insects as food

Magazine: Insects and society

-http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Site's:

Author: Horecava Date: January 2008

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-http://www.bugsacademy.nl/index.php?option=com_content&task=view&id=5&Itemid=5

Author : Mas Yoris de Vaal Date: 17 January 2008

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- <http://www.oneworld.nl/index.php?page=2&articleId=13367> (look over foodfactory)

- http://www.bugsacademy.nl/images/pdfs/insecten_spektakel_horecava_2008.pdf (Us promoting insects as food)

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Cookery Books:

Author: Ronald L. Taylor, Barbara J. Carter

Title: Entertaining with Insects.

Publisher: Woordbridge Press Pub, 1976

Author: David George Gordon

Title: The Eat-A-Bug

Publisher: Ten Speed Press, 1998

COCKROACHES

Site's:

- <http://en.wikipedia.org/wiki/Cockroach>

- <http://nl.wikipedia.org/wiki/Kakkerlak>

- <http://www.youtube.com/watch?v=lkywoXNteOE> (eating cockroach)

Books:

Author: Eugène Bruins

Title: illustrated terrarium encklopedy

Publisher: REBO productions, 1999

Author: Peter de Jong ea. From Wageningen University – Entomology

Title: Muggenzifters en Mierenneukers

Publisher: unknown, 2007

CHITIN AND CHITOSAN

Articles:

Author: Majeti N.V. Ravi Kumar Date: January 2000;
Title: A review of chitin and chitosan applications

Author: M.S. Rao, J. Muñoz, W.F. Stevens Date: 2000
Title: Critical factors in chitin production by fermentation of shrimp biowaste

Author: Urjan Jacobs

Title: - Important numbers
 - production processes

Books:

Author: Wolters-Noordhoff
Title: Binas (table 67)
Publisher: Wolters-Noordhoff, 2004

Site's:

- <http://nl.wikipedia.org/wiki/Chitosan>
- <http://en.wikipedia.org/wiki/Chitin>
- http://www.chitosan.no/site/maler/x/?case_vis=inquiry
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Author: Rachel A. Brennan Date: 2005-2006
Title: Passive Remediation of Acid Mine Drainage Using Chitin--
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Author: France chitin Date: unknown
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Site's:

- http://www.tradekey.com/buyoffer_view/id/107211.htm
- <http://buy.ecplaza.net/search/1s1nf20sell/chitin.html>

Author: Environnement Magazine, France
- http://www.centexbel.be/NI/research_project_chitexII.htm

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Site's:

Land choice:

- <http://www.lonelyplanet.com/worldguide/destinations/africa/benin/>
- nl.wikipedia.org/wiki/Benin
- benin.startpagina.nl/
- www.minbuza.nl/nl/reizenlanden/landen,beninhtml
- www.aktiebenin.nl
- www landenweb.net/benin
- www.mfa.nl/cot
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- <http://www.lepont.nl/4e%20uitgave%20lepontactuel.pdf>
- http://www.isonline.nl/?node_id=62531

Shrimps:

- <http://www.kreeftengarnalen.nl/site/>
- <http://www.rug.nl/intrabe/nieuws/archief/060612PromotieVoThiThanhLoc>

How to write a businessplan:

- www.bidnetwork.org

Visualising of building:

- Visualization by Mariska van Rijswijk, third years student building engineering University Delft



Important numbers

Mass of cockroach	4 gram								
Water percentage of a cockroach	40%								
Mass dried cockroach	2,4 gram								
Chitin percentage in a dried cockroach	35%								
Chitosan extractable from chitin	60%								
Chitosan extractable from a cockroach	12,6%								
Market price chitosan	€50,00 per kilo								
Minimum wage	184 Baht = 3.76 euro								
Cost ingredients	<table border="1"> <thead> <tr> <th>ingredient</th> <th>price/ kilo baht or euro?</th> </tr> </thead> <tbody> <tr> <td>Flour</td> <td>0,68</td> </tr> <tr> <td>Butter</td> <td>0,60</td> </tr> <tr> <td>Sugar</td> <td>0,70</td> </tr> </tbody> </table>	ingredient	price/ kilo baht or euro?	Flour	0,68	Butter	0,60	Sugar	0,70
ingredient	price/ kilo baht or euro?								
Flour	0,68								
Butter	0,60								
Sugar	0,70								
Price gas/water/electricity	Price gas: 1,5 – 5 Baht per KWh Price water: €0,20 per m ³ Price electricity: €1,10								