

Technical report

The feasibility of a FoodFactory in Non Jink Thailand

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HHG16, Balancing People, Planet Profit.

Group 5

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Preface

This report is written for the module HHB16, balancing people planet profit. Based on an idea of our client Bart Hogebrink, we looked at the feasibility of a FoodFactory project, meaning industrially rearing of insects, in Non Jink in Thailand. Although this report can not give a complete investigation of all the ambitious ideas of Bart Hogebrink, we hope he can use this report well. We would like to thank him for his information in the beginning of our research and wish him more of these interesting and idealistic ideas. We would also like to thank all the teachers of the module for their interesting lectures and help. Finally we would especially like to thank Jos Theunissen, our supervisor during the project, for his comments and help.

Anna, Emily, Marieke, Renske and Winee
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Summary

The aim of this report is to see if a pilot FoodFactory project in Non Jink, Thailand, is feasible. A FoodFactory is defined as a factory in which insects are reared in large amounts to serve as a cheap and continuous food source for poor people. The main question for this research is: *'What conditions should be fulfilled for a feasible FoodFactory project in Non Jink, Thailand, taking into account the economical, social and ecological aspects?'* The sub questions are: *'What social aspects play a role in the FoodFactory project'*, *'What ecological aspects play a role in the FoodFactory project?'*, *'What economical aspects play a role in the FoodFactory project?'* and *'How can the social, economical and ecological aspects be balanced for a sustainable project?'*

Data is collected to find out what the specific requirements of a FoodFactory building were and to gain other needed knowledge. The found information was processed by dividing it into the different aspects mentioned in the sub questions and main question.

The suitable insect found for the FoodFactory is the House cricket (*Acheta domesticus*) because it is a omnivore and common in the rural area of Thailand. The suggested design of the factory is a building with separated departments for rearing, breeding and processing the crickets. The scale of the factory depends on the demand for the products by consumers. When assumed that there will be a consumption of 155 kg of crickets per day in the village, a space of 60 m³ is needed only for the living space of the crickets.

The social aspects that play a role in the FoodFactory are the stakeholders like the locals, the local government, the FAO, the local farmers, environmental organisations, local insect catchers, schools, hospitals, local shops and the cooperate group of trade. Depending on their power and interest these stakeholders have to be monitored, kept informed, kept satisfied or managed closely. Beside this, the Thai consumer protection act, the labour protection act, the public health act and the energy conservation promotion act are important. To do something extra, the FoodFactory can live up to European legislation concerning employment and social policy and food safety. Because of the differences in culture between Thailand and the Netherlands in, for example, aspects as individualism or power distance, a foreigner starting the FoodFactory project in Thailand has to consider the do's and don'ts in the Thai culture.

The ecological aspects that play a role in the FoodFactory are land use, gas emission, the food conversion efficiency, the energy use and the use of water. These aspects determine the environmental impact of the factory. In the simple environmental review made, the aspects of the use of raw materials and noise hindrance also play a role.

The economical aspects that play a role in the FoodFactory are the possible market, the price of the food, the needed subsidies and the revenues, costs and profit for the factory.

If the FoodFactory has the suggested design it is to be said that the people and planet aspects are perfectly taken into account. The project provides a continuous food supply and gives a continuous income of a good level to local people. By solving the food shortage problem during the drought in the summer season it meets the initial goal of the FoodFactory. Besides the project will reduce the unemployment rate in the local area and will educate the people about important subjects like hygiene and nutritious food. Considering the dimension planet, the FoodFactory is thought not to have a big impact on the environment. Compared to rearing livestock, crickets are far more efficient in the conversion of their food. Besides they can live on every kind of organic waste. Crickets produce less waste and consume less energy than traditional meat production. They also emit far less greenhouse gasses than pigs or cows. Because of the water shortage in summer, rearing crickets with a small amount of water needed has an advantage compared to rearing cattle.

To find a balance between these two aspects and the dimension profit however, was hard. The initial investment costs are 2,420,000. - Bath (€50,500.-). Besides, with the low price of the product, the good salary for the employees and the present market, a loss is seen of 37,760. - Bath (€788.-) per year. Only with both an investment and an exploitation subsidy the FoodFactory can be feasible. That is why the first step that has to be taken is to find out which organisation is willing to subsidize. This can for example be the Food Agriculture Organisation (FAO).

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1. Introduction

‘The FoodFactory idea, conceived by Bart Hogebrink of Amsterdam, The Netherlands, was the winner of the 2007 Not Invented Yet (NIY) competition. FoodFactory is an idea to combat hunger in developing countries using nutritional cookies made from specially reared insects. Insects are highly nutritious; they generally contain more protein and less fat than traditional meats. They also have higher food conversion efficiency than traditional meats. Furthermore, they reproduce much faster than cattle, are easy to raise and need far less living space. In many parts of the world insects are already popular as food. But the current method of harvesting, by hand in the wild, makes them expensive, susceptible for extinction, droughts and natural enemies. Furthermore, they are only available in significant quantities in specific seasons. The idea of the FoodFactory is to design highly salvable factories where insects are grown, harvested and processed in an industrial way, making the process of making insect-based food cheap and controllable. As a result, food can be produced at such low costs, that even the poorest people can obtain enough food to survive, learn and work. In this way, not only hunger, but also poverty, unemployment and environmental problems can be tackled.’¹

The idea of the FoodFactory project, to combat hunger by rearing insects in an industrial way, sounds wonderful and if it works, it could be a great solution for the food problem. The question however is how realistic this idea is. The aim of this report, written for the inventor himself, is therefore to see if a pilot FoodFactory project with crickets in Non Jink in Thailand is feasible. The main question that needs to be answered during this research is:

‘What conditions should be fulfilled for a feasible FoodFactory project in Non Jink, Thailand, taking into account the economical, social and ecological aspects?’

This main question is divided in to the following four sub questions

1. What social aspects play a role in the FoodFactory project?
2. What ecological aspects play a role in the FoodFactory project?
3. What economical aspects play a role in the FoodFactory project?
4. How can de social, economical and ecological aspects be balanced for a sustainable project?

For companies, many times it is still the economical aspect (profit) which weighs the most. However, when a project wants to be sustainable, also the social aspects (people) and the environmental aspects (planet) have to be taken into account. In fact, only when all three ‘P’s’ are balanced, real sustainability, so a quality of life now and in future here and elsewhere, can be guaranteed. For sustainability in businesses decision making, the term corporate social responsibility (CSR) is used. This responsibility goes beyond the responsibility organizations have with legislation. Responsible behaviour leads to business success and is therefore recommended for the FoodFactory. It will give acceptance by the society and continuity of the factory. With the main and sub questions mentioned, the feasibility of a sustainable FoodFactory is investigated.

Chapter 4 ‘people’ will deal with sub question 2, chapter 5 ‘planet’ about sub question 3 and chapter 6 ‘profit’ with sub question 1. But first there will be, after the methodology of setting up this report in chapter 2, a chapter about the project itself. Although the FoodFactory project was a consisting idea, the exact features and requirements were not yet defined by the client. To be able to do a feasibility study, an idea of how the factory will operate has to be formed. Therefore the following pre-question is formulated: *“What are the specific requirements of a FoodFactory building in Non Jink, Thailand, based on data about House crickets and other insect rearing projects?”* The answer to this question can be found in chapter 3. After the answering of the first three sub questions in the chapters mentioned, chapter 7 deals with the balancing of people, planet and profit. In chapter 8 a conclusion will be drawn. In this chapter there will also be some recommendations to the client.

¹ Source: The FoodFactory project. Version 0.67 Amsterdam, Drs. Bart T. Hogebrink – IniVention, Ir. Henk C. van Deventer - TNO, May 2008

2. Methodology

In the project plan the set up of the technical report was described. This chapter describes what the process is after the project plan. The data collection was done to gain knowledge about rearing insects and to answer the pre- questions. After that, the information was processed and analysed. By this process the main question is answered.

2.1. Data collection

The most information was found by literature study through internet and books. For answering the pre-question besides doing literature, help was asked from the insect experts mentioned in the literature list. The sub questions were handled with literature study and knowledge gained in the lectures of this module. Common sense and existing knowledge especially from the Thai student of the group was used to collect data.

2.2. Information processing and analyses

The information is processed by dividing it into the different aspects mentioned in the sub questions and main question. This processing went through a few phases. First that back ground information was filtered that was needed to make a design for the project. Then the information was processed further into the four main parts: people, planet, profit and balancing these three aspects.

For the dimension profit the revenues and cost are calculated. To come to this, the market potential, the price of the product and the salary for the employees had to be defined. To analyse the data, a balance sheet and a profit and loss account are made. With this the investment is assessed.

For the dimension people the differences between the cultures are described. The results are analysed with the information of the 5 dimension model of Geert Hofstede.

For the dimension planet the focus was on making an inventory of the energy users of the factory and coming up with environmental friendly aspects for the factory.

For every dimension a small look has been taken on the current situation in Non Jink.

All the data that was collected is combined and compared in a Multi Criteria Analysis (MCA). In this MCA one option for the FoodFactory project is presented and compared with the current situation. This is done by looking on several criteria with different weight factors telling the importance of the criteria. The criteria and weight factors are defined in discussion within the project group keeping the priorities of the client in mind. The result of the MCA is whether a FoodFactory project in Non Jink is feasible and sustainable.

3. About the FoodFactory project

Although the idea of the FoodFactory already existed, the real features of the factory had to be defined first. With the help of insect experts and a lot of literature research the FoodFactory got its form. In this chapter the choices for the country and the insect species are explained. Based on the ecological features of the chosen insect species the technical requirements of the factory could be investigated. In this chapter the most important requirements for the factory are formulated. The feasibility study in the upcoming chapters will be based on this sketch. First, a small paragraph about the initial idea of Bart Hogebrink will follow.

3.1. What is the FoodFactory?

In the initial plan description of Bart Hogebrink several approaches for the idea of the FoodFactory were described. The two ways for the factory were: high quality, medium quantity and high quantity and medium quality. The whole initial project description can be found in appendix I. Because of the time available, the option of high quality, medium quantity is chosen to work out. To make the project suitable for this module not every wish of Bart Hogebrink could be taken into account. This is why, in good contact with the client, only some aspects of the idea will form the FoodFactory. In this report, the definition of a FoodFactory is 'a factory in which insects are reared in large amounts to serve as a cheap and continues food source for poor people'.

3.2. Location project

The country chosen to start a pilot project is Thailand. This is done for several reasons. The main reason is that there is a Thai student involved with the working group who is an important source of information for aspects important to this feasibility study. The second reason is that Thailand meets several criteria important for starting up the FoodFactory project, for example the fact that it is already common to eat insects. Although it is common, people still think that insects do not have the same nutritional values as other meat sources. A place in Thailand where there is food shortage was looked for. In regions with food shortage the FoodFactory could really mean something for continuous food supply and create jobs for inhabitants. Respecting this, the North-eastern part of Thailand is the most suitable area for a pilot study of the FoodFactory project. In this region, the village Non Jink is chosen. This village is located in the province Ubon-Ratchathani, in the sub district Non Sawan in the district Warin Chamrap. The district has an area of 619 km².

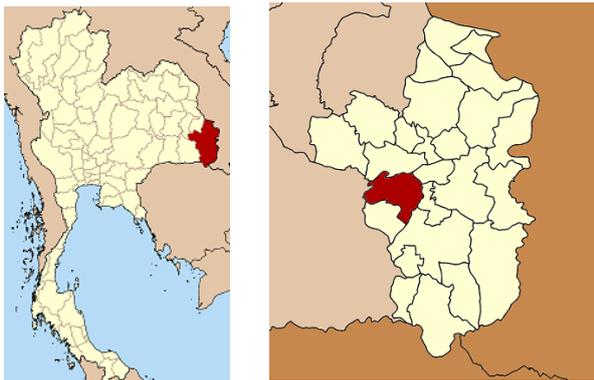


Figure 1: The province and the district for the pilot project in Thailand.

(http://th.wikipedia.org/wiki/%E0%B8%A0%E0%B8%B2%E0%B8%9E:Thailand_Ubon_Ratchathani.png)

Non-Jink is a small village with about 517 inhabitants. Most of the inhabitants are farmers. In the raining season, they grow rice and other crops. Others have pigs or chickens. In summer, they do handicraft for living. Farmers face many problems of natural disaster, for instance drought in the summer and flooding in the raining season. Besides the fact that they cannot grow rice or crop all year round and it is hard to find a job for the summer, the costs for investments as fuel, fertilizer and pesticide are high and the selling price of the products is low.

In Non Jink there is a primary school. The village itself has no hospital but in the sub district there is a public health centre. In the district Warin Chamrap there are two hospitals. A house of the poor or an orphanage is not present.

3.3. A suitable insect

With data about several eatable insects the choice was quickly made between grasshoppers and crickets, species of the order Orthoptera. Grasshoppers and Crickets are common insects in Thailand and popular to eat. Besides they are easy to rear, this as opposite to e.g. mealworms. Based on the pro's and con's table that is shown below, it can be said that the crickets have more important pro's and less con's than the grasshoppers. Besides, the existing con's can be fixed by the design of the factory. This is why the House Cricket (*Acheta domesticus*), common in Thailand, is chosen as the insect to rear in the factory.

Table 1: Pro's and con's table crickets vs. grasshoppers

	Pro's	Con's
Grasshoppers	<ul style="list-style-type: none"> • More popular to eat 	<ul style="list-style-type: none"> • Catching period more than cricket, so locals can catch them longer instead of buying • More active/ can fly • Less easy to rear • They are herbivore
Crickets	<ul style="list-style-type: none"> • Smaller catching period in wild • Long time period of living, a 26 year old colony is known. • Less active/less flying • Can eat waste from rest material dead crickets. 	<ul style="list-style-type: none"> • Chance of cannibalism • Make a lot of noise

3.4. The House Cricket, a short acquaintance

The House Cricket, (*Acheta domesticus*) belongs to the order Orthoptera. They normally feed on living or decaying plant materials. However crickets are not critical towards their food; they are omnivores and can feed on almost every organic material. With temperatures between 28 and 35 degrees, House Crickets have a life cycle of two to three months. 'Each female will lay from 50 up to 100 eggs that hatch in about two to three weeks. Adult crickets may eat their own young.'² House Crickets are common in the rural area of Thailand, especially in the raining season, from June till October. Locals already catch the crickets for food. However in the summer, especially in April and May, it is too hot and there is too little water for the crickets to survive. Crickets can hardly be found then. Therefore it is not a continuous food source.

Although there is a lot more information found about crickets, below the information interesting for the FoodFactory is summed:

- The optimal growing conditions of crickets are: temperature between 28 and 35 °C, a humidity of 55,5%;
- Crickets are active at night, in the darkness;
- With a temperature of 32,3 °C, 10-15 days (eggs to nymph) + 30-35 days (from nymphs to adult) + 2 to 3 months (live as adult) = between 100 days and 140 days;
- With a temperature of 16,7 °C, 10-15 days (eggs to nymph) + 60-65 days (from nymphs to adult) + 2 to 3 months (live as adult) = between 130 days and 170 days;
- 1200-2500 eggs per cricket, between 960 to 2250 will survive, of this 768 to 2025 will become an adult;
- 50-100 eggs per time, 40-90 will become a nymph, 32-81 will be adults. Times 24/ 25 per lifetime.³

² Source: <http://www.the-piedpiper.co.uk/th2f.htm>

³ Kleukers, R.M.J.C, E.J. van Nieuwerkerken, B. Ode, L.P.M. Willemse & W.K.R.E van Wingerden, 1997.

3.5. Suggested design

Based on the stressed data a suggestion for the factory design is made, which is presented in this paragraph.

The factory building will be divided into separate departments. These departments will be plastic containers. The crickets in different containers do not get in contact with each other. There will be a distinction between large 'breeding containers' and some smaller 'rearing containers'. In the breeding container a removable egg-laying device has to be placed. There will be stones and hiding places in the breeding container and plastic tubs used as food device. A water dispenser can be made of a plastic tube filled with an absorbing material so that small crickets will not drown. Aluminium mosquito screening will be used to cover ventilation holes. This is a material the crickets do not eat. In the breeding container no substrate will be placed in the bottom of the container, otherwise eggs will be laid everywhere. The eggs should only be laid in the special egg laying device. This removable device contains smaller plastic containers filled with sand. These containers have to be at least 5 cm deep, so that crickets can lay their eggs down below, where they will not be disturbed by other crickets. The sand in the egg device should stay damp and therefore be sprayed with water now and then. Every 1.5 week the egg device should be taken out to prevent cannibalism and be replaced by a new one. The rearing containers require more attention than the breeding containers. The sand should be sprayed more often. Once all the eggs are hatched the egg-laying device can be taken out and washed carefully to prevent mould and small, mite-like insects infecting it. Adult crickets and old nymphs should be returned to the breeding colony. To clean the breeding colony now and then, the crickets should be replaced to a second container. Cricket waste can be removed and the empty container can be washed.

Because the yield is the highest with temperatures around temperature 32 °C, this temperature has to be maintained. The average daytime temperature in Thailand is always 30 °C or higher⁴ so no (continuous) heating device is needed. It is advised to monitor the temperature though, because the temperature in the North and North East of Thailand can be warmer in the summer and cooler in the winter than in Bangkok.

The humidity in Thailand is relatively high.⁴ From November until May however, the humidity is less and it is advised to monitor the humidity. Maybe the humidity will have to be created artificially in these months. The initial breeding colony should contain more than 200 crickets and should not be used for feeding until it is well established and the first babies are adult-sized. Every few years wild-caught crickets should be introduced for variability.

To keep the costs low and profit of the advantages of the non-selective food choice of crickets, waste materials will be fed to the crickets. First of all the crickets can eat the rest material of the processing of the crickets, e.g. the removed legs and wings. Secondly waste will be collected from cities. If farmers from the village have vegetable surplus, this will be collected too. In April and May however it is so hot that the farmers will not have a lot of surplus. If also the cities further away can not provide enough food for the crickets, cheap instant pet food also gives a good food source for the crickets. The exact amounts of food needed will be monitored when the factory is in process. A surplus of food is not harmful for the crickets. Besides they are not sensitive for variation in the amount of food. Crickets do not use a lot of water. The exact amounts depend on a lot of factors. It has to be monitored that enough water is always present.

3.6. Scale

The scale of the factory depends on the demand for crickets by the consumers. In the village Non Jink there are 517 inhabitants. The percentage of people that will eat insects can only be estimated. This depends on several aspects, for example the costs of the product. If the costs will be low compared to other protein sources, people may choose to buy the crickets. If possible, people in Thailand eat three meals a day. If 50 % of the people of Non Jink will have three warm meals per day, containing 200 gram of cricket products per meal than there will be consumed 155 kilogram of crickets per day in the village. This is an average; most of the people will have more variation in their meals. However others

⁴ Source: <http://www.amazing-thailand.com/Climate.html>

will buy crickets 'now and then' for example as a snack. A mature cricket weighs about 0.4g. So this would mean 387,750 crickets per day are consumed. Per cricket an average of 0.15 litre space is needed. So for 387,750 crickets a space of 58,163 litres is needed. This means almost 60 m³ is needed only for the living space of the crickets if such an amount of crickets is reared. This space has to be divided into a larger space for good working circumstances. Besides, space is needed for processing the crickets to the end product.

3.7. Step by step process

To come from crickets to a healthy snack or nice and tasty cookies, several steps have to be taken. The first step is to catch the crickets. With a special raster device placed in the containers, the crickets can easily be caught. After that the crickets will have to be washed in boiling water. Secondly the wings and legs have to be removed. To make use of more segments of the market, different processing will follow. A percentage of the crickets will be deep fried, to serve as snack. Fresh snacks should be sold within three days, to preserve the quality. Other deep fried crickets can be vacuum packed. Another percentage of the crickets will be ground to make flour. This flour will be sold and used to bake cookies in the factory. Tasks will be washing, removal, packing and baking.

Based on these aspects the factory should contain a washing and removal room, a deep frying room and a bakery room.

The end product will be sold in different places. First the products can be bought from the factory itself. Here local shops can buy goods. There will also be distribution to a cooperate group of trade. Besides there will be a delivery service for schools, hospitals and needy people.

3.8. Employees

With this type of factory the following staff will be needed:

- 1 Boss;
- 3 Thai employees for rearing crickets;
- 2 Thai employees for processing crickets;
- 1 Thai employee for the bakery;
- 2 Thai employees for deep frying and packing;
- 2 Thai employees for selling and distribution.

Further in this report the possible subsidy provider of the project: the UN Food and Agriculture Organization will be mentioned. If the FAO will be providing the subsidy than first a FAO project leader can look after the implementation of the project. If this project leader is a foreigner, the recommendations from chapter 4 can be really useful. However often projects are more sustainable when locals are involved. Beside the Thai employees, a Thai boss can replace the FAO project leader after a while.

4. Dimension people

To be able to answer the main question, the sub question ‘What social aspects play a role in the FoodFactory project?’ has to be answered first. In this chapter the important social aspects for the FoodFactory project will be mentioned.

4.1. Stakeholders

Stakeholders are of great importance for the implementation of the FoodFactory project, because they have certain influences on the different aspects of the project. It is of great importance that no stakeholder is forgotten. In this section the different stakeholders that are directly or indirectly affected by the project are mentioned. The directly affected stakeholders will have an influence at the very beginning of the project. They may even influence the start of the project. Indirect stakeholders will have their influence when the FoodFactory is started and in process. Of every stakeholder the level of power and interest is explained. An overview can be found in figure 2. The combination of these two aspects determines the importance of the stakeholder. The person to get in contact with is mentioned as the representative.

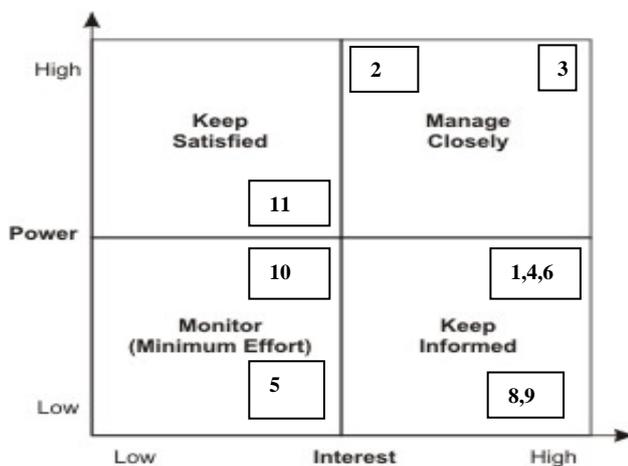


Figure 2: Stakeholder analysis with power and interest

4.1.1. Directly affected stakeholders

Positively affected

1. Locals

The locals are the people who will benefit the most from the project. The locals are stakeholders that are affected directly and indirectly in a positive way. First of all the FoodFactory programme will create jobs for the locals, both with setting up the factory (directly) as when the factory is running (indirectly). By creating jobs, the purchasing power will rise and the economic situation will be improved. Secondly the employees at the FoodFactory will get EU standard working circumstances. The locals can learn from this and tell others about it. They also receive a well balanced salary. Also the programme will teach the locals where necessary about hygiene and other subjects which may improve their means of life. Because the FoodFactory adds a cheap and continuous product to the market, even the poorest people will be able to buy this food. The advantages of this food source is that crickets contain a lot of proteins (In 41-91 gram protein per 100 g dry weight⁵), essential fatty acids, micro nutrients as iron, zinc and calcium, vitamin A, B2 and D and have a low fat content. Crickets can be an excellent and healthy alternative to meat. If the poorest people can not (often) buy meat, eating crickets can help to give these people a balanced diet. Animal proteins can be taken up by the body efficiently and this adequate food is important during pregnancy and the first years of life. It

⁵ Bukkens S. G. F. (1997) The nutritional value of edible insects. *Ecol. Food. Nutr.* 36, 287–319.

will also prevent to get diseases. 100 grams of crickets contain about 75 % of an individual's daily protein requirement and 100% of the daily requirements for many of the vitamins and minerals⁶. Besides the crickets are not just food for poor people, in Thailand they are popular to eat and they taste like nuts.

The representative of the locals is the head of the village. This head of the village can decide in many things. If a lot of locals will be positive towards the FoodFactory projects and if the head of the village sees that the FoodFactory can have a positive influence on the economic situation in the village, he will be positive too and make good promotion for the FoodFactory. The locals and their representative are thought to have a very high interest and an average power. The power they have will be that because it is a small village, opinions about it will spread fast through the whole village. The locals should be kept informed by good communication.

2. Local government

The power of the local government is really high. They make the laws and regulations and will monitor if the rules are followed. They have the power to cancel or continue the project. Moreover they may have a bit of interest in the project because the FoodFactory can improve the economic situation. It is important that this stakeholder with all its rules is managed closely. The representative is the mayor of district Warin Chamrap.

3. UN Food and Agriculture Organization

The goal of this organization is to defeat the hunger in the world. This new way of producing food may increase the way of life for the inhabitants in the village. The FAO is the most important stakeholder for this project. Because it is the possible investor in the project it has both high interests as high power. If they do not want to invest, the project cannot start; therefore contact with this stakeholder should be managed closely.⁷ The point of contact has to be found yet.

Negatively affected

4. (Meat) farmers and other food producers

Farmers may be affected in a negative way. Because there is another meat source, farmers may lose profit and have a competitor/rival. However, the new food may just be an addition and the farmers might not suffer from it. Because of the problems with farming and having no job in summer, farmers can also choose to work in the FoodFactory. There might be a positive effect too if the FoodFactory buys the surplus of organic materials from the farmers. Because the farmers and other food producers are highly interested they should be kept informed so that no negative opinion is spread. An important representative of the farmers is the Warin-chamrap agricultural office. This agricultural office supports, develops and controls agricultural activities and relevant activities in the district. The head of the village may also be a point of contact.

5. Environmental organization

Environmental organizations in Thailand may have their concerns about the project. There is a small chance that the insects will escape and form a plague. However with good communication that the FoodFactory will do anything to prevent this and monitoring of this stakeholder, this stakeholder is not thought to be a problem for the project.

6. Local 'insect catchers'

These insect catchers will not be able to compete with the FoodFactory. Therefore they will be forced to do something else to support themselves. For the same reason as with the farmers, they should be kept informed about the project. They may get involved in the project as employees. The FoodFactory could also hire these people for catching new crickets for the colony.

⁶ Santos Oliveira J. F. S., Passos de Carvalho J., Bruno de Sousa R. F. X. and Madalena Simão M. (1976) The nutritional value of four species of insects consumed in Angola. *Ecol. Food. Nutr.* 5, 91-97.

⁷ The focus was on FAO as investor because the FAO already has projects in Thailand. It is also possible that for realizing the project, another NGO has to be selected.

4.1.2. Indirectly affected stakeholders

Positively affected

7. Locals

Locals are both directly as indirectly affected. See 1 for explanation.

8. Schools

Schools are indirectly affected stakeholders because the FoodFactory project is going to give a percentage of the food to local schools. Schools may be really positive towards this gesture which is good to prevent hunger and gives children sufficient food. For the FoodFactory it may be a promotion, children may tell their parents about the crickets they ate at school and how healthy they are. Therefore keep the representative, in this case the head of the school, informed.

9. Hospitals

Hospitals will get a percentage of the food from the FoodFactory project too and are as important as the schools (see 8).

10. Local shops

Local shop keepers can buy cheap projects from the FoodFactory to sell in their shop. Their interest and their power is average. If they do not want to buy the products, this can affect the FoodFactory. However, the products are also sold in other ways and the local shops should only be monitored.

11. Cooperate group of trade

The cooperate group of trade is a small organisation in the village. Farmers can sell their product to this cooperate organisation. Because it is popular in the village it has some power on the project and the head of cooperate group of trade should be kept satisfied. The FoodFactory is planning on selling some food to this group.

12. Environmental organisation (see 5)

Environmental organisations may also be positive about the project if they see that the emissions of greenhouse gasses are less than with other food production manners.

Negatively affected

The stakeholders mentioned as directly negative affected, can also form a problem during the project due to negativism. They can influence the opinion of the locals. For example, if someone loses his job, the whole family will be against the project. However if FoodFactory will communicate with the possible negatively affected people and offer them a new job for a good salary, the opinion of the locals towards the project will stay okay.

4.2. National law of Thailand

When starting the FoodFactory project, the following relevant Thai legislation and laws have to be taken into account:

1. Consumer Protection Act⁸

The Consumer Protection Act covers goods, service, production, consumers and all kind of things that are involved in consumer protection. Respecting to this, the quality and safety of goods are important.

2. Labour Protection Act⁸

This employment act includes welfare, salary and working safety.

3. Public Health Act⁸

This act describes public health, e.g. sanitary facilities and disposal of sewage and solid waste.

4. The Energy Conservation Promotion Act⁸

This act describes the energy conservation in the factory for building, machinery and equipment. It promotes the use of energy efficient material.

⁸ <http://www.lexadin.nl/wlg/legis/nofr/oeur/lxwetha.htm>

4.3. European legislation

Although Thailand is not a member of the European Union, the important European legislation has to be looked into. For good corporate social responsibility, the FoodFactory can do something extra, on top of the legislation of Thailand to increase for example the circumstances for employees and the hygiene of the food. Because a complete overview is too large for this report, the most important aspects are stressed. Further information can be found on: <http://europa.eu>. When the FoodFactory wants to meet the European requirements the following has to be taken into account:

4.3.1. Employment and social policy

1. Employment rights and work organisation, including organisation and working time;
2. Health, hygiene and safety at work, including protection of specific groups of workers like pregnant women, a safe workplace and regulations towards exposure to noise;
3. Equality between men and women;
4. Social measures for target groups as disabled and old aged people.

Examples of important directives and regulations for this topic:

- Council Directive 96/34/EC of 3 June 1996 on the framework agreement on parental leave concluded by UNICE, CEEP and the ETUC;
- Council Regulation (EEC) No 1365/75 of 26 May 1975 on the creation of a European Foundation for the Improvement of Living and Working Conditions;
- Council Directive 75/117/EEC of 10 February 1975 on the approximation of the laws of the Member States relating to the application of the principle of equal pay for men and women;
- Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time.

'Member States take the measures necessary to ensure that every worker is entitled to: a minimum daily rest period of 11 consecutive hours per 24-hour period; a rest break, where the working day is longer than six hours; a minimum uninterrupted rest period of 24 hours for each seven-day period, which is added to the 11 hours' daily rest; maximum weekly working time of 48 hours, including overtime; paid annual leave of at least four weeks.'

- Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.

4.3.2. Food safety

Most of the directives or regulations deal with fresh meat of mammals, molluscs, fishery products or milk and dairy and are not important for the FoodFactory. However there are still several things that have to be taken into account. For example:

1) Food safety: general provisions:

- a) Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

This food law covers all stages of the food production chain. Food must not be placed on the market if it is harmful to health and/or unfit for consumption. Besides feed must not be placed on the market or given to any food-producing animal if it is unsafe. The traceability of food, feed, food-producing animals and all substances incorporated into foodstuffs must be established at all stages of production, processing and distribution. Transparent public consultation is important.

2) Veterinary checks, animal health rules, hygiene of food:

- a) Regulation (EC) No 183/2005 of the European Parliament and of the Council of 12 January 2005 laying down requirements for feed hygiene.

3) Product labelling and packaging;

4) Animal nutrition, animal welfare;

5) Contamination and environmental factors:

- a) Council Regulation (EEC) No 315/93 of 8 February 1993 laying down Community procedures for contaminants in food.

4.4. Thai culture and religion

Because the FoodFactory project will be placed in Thailand, a closer look has to be taken at the cultural differences between the Netherlands and Thailand. In this chapter the cultural differences will be described with the help of the 5D-model of Geert Hofstede. In this model, five dimensions of cultural aspects are described. Per aspect the values per country are mentioned and explained.⁹ In this the focus will be on the working sphere. This is the most important when implementing the factory. It should be stressed that a description of a culture is a general description, it may differ for individuals.

4.4.1. 5-D model of Geert Hofstede

- *Aspect 1: The Power Distance Index (PDI)*

This aspect stands for the inequality in the society. Some people have more power than other. Some people are given more status and respect than others. The PDI says something about the power of the 'boss'. High PDI means workers want to have a boss who makes the rules and takes decisions. In large power distance countries there is considerable dependence of subordinates on bosses. Salary systems show wide gaps between top and bottom in the organization. Low PDI means there is limited dependence of subordinates on bosses. Subordinates are not dependent on bosses to make decisions. The PDI in the Netherlands is low (38) and in Thailand quite high (64). In the Netherlands employees are free to complain and their opinion counts. People are used to work independently. In Thailand the boss is very important. He will tell what the employees have to do. The boss does not have direct contact with the employees but with the head of the departments. There is also a wide salary gap.

- *Aspect 2: Individualism versus collectivism (IDV)*

High IDV means individualism. Employees in an individualist culture are expected to act according to their own interest. Management in an individualist society is management of individuals. Low IDV means collectivism. In a collectivist culture an employer never hires just an individual. The employee will act according to the interest of the group. Management in a collectivist society is management of groups. The IDV in The Netherlands is high (80) and in Thailand low (20). In the Netherlands the interest of the individual is important. There is a direct communication between people. The boss has to manage with individuals. The consequence of this is that people are linear active. They are highly organised and data circulated. In Thailand the group is more important. The contact with other people is with high context communication. Employees work as a whole group. The boss has to manage the whole group. Keeping the harmony in the group is of great importance. The consequence is that people are reactive. They are introvert, respect orientated and listening. Body language is important.

- *Aspect 3: Masculinity versus femininity (MAS)*

High MAS means masculinity. The masculine manager is assertive, decisive, and aggressive. Low MAS means femininity. The manager in a feminine culture is less visible, intuitive rather than decisive. The MAS in the Netherlands (14) and Thailand (34) does not differ that much. However in the Netherlands the gender roles overlap more. In management this means that intuition and consensus are important. Many times compromises and negotiations are used to keep everyone happy. In the Dutch culture people work to live. Thailand has a slightly higher MAS. Especially in the rural area tradition is still important; men work outside home and women work at home. Failing is considered as a disaster.

- *Aspect 4: The Uncertainty Avoidance Index (UAI)*

High UAI means there are many formal laws and/or informal rules controlling the rights and duties of employers and employees. In high UAI society, people like to work hard or at least to be always busy, life is hurried and time is money. In a low UAI society rules are only established in case of absolute necessity. People are quite able to work hard if there is a need for it. The Netherlands has an average UAI (53). In the Dutch culture there are many rules, but these rules are not very specific. People use their common sense when making decisions. Thailand has a bit higher UAI (64) compared to the Netherlands. It is important to stick to the rules. Moreover, expert and technical solutions are wanted.

- *Aspect 5: Short term versus long term orientation (LTO)*

High LTO means long-term orientation. Leisure time is not important. On the other hand long-term profit and a large saving quote are important. Low LTO means short-term orientation. Leisure time, this year's profit and a small saving quote are important. Managers and workers are in two camps and

⁹ Values derived from lecture 'intercultural communication'. For this lecture the book of Geert Hofstede and Gert-Jan Hofstede is used.

personal loyalties vary with business needs. The Netherlands has an average LTO (44). They are quite 'black and white' in deciding what is right or wrong. Beside work, leisure time is important. It is also important that where you work is a company where you feel at home. Thailand has a higher LTO (56). Compared to scores of other countries this is also an average. Maybe leisure time is less important, but long term profit is.

4.4.2. Do and don'ts in Thailand

If the FoodFactory project is implemented by a western boss, the following do's and don'ts are important. If the boss and other employees that are coming to Thailand take these into account, the implementation may go more smoothly.

Religion

- Disrespectful behaviour toward a Buddha or Royal Family (image) is a crime.
- Do not touch people, even kids, on the head, as this is a sacred place.
- The bottom of one's feet is considered a "dirty" place, so do not show the soles of your feet to others, and do not sit with your feet pointing at someone.

Greeting

- The traditional Thai greeting of placing one's hands together, a wai, is usually returned by you. The exception is with children, whose wai you usually do not return. Do use the wai correctly and say 'sawadee'. A Westerner should never wai first and anyone who is paying for any service is the boss and the bosses do not wai first. Do wai an elderly person.

Public manners

- Public displays of affection between men and women are frowned upon.
- Do not feel let down if you have done a favour for a Thai and he does not seem to bodily express his thanks.
- Do offer and receive anything with your right hand always.
- Pointing at ones face is considered rude. People point at someone to curs or to call names.
- As a younger, always respect the elderly.

Clothing

- Do not walk into someone's house with footwear on.
- Clothes should be clean. That is the most important for a Thai. It is not important that it is the latest fashion. (Older) men in shorts can be found weird, only young men wear them. Women in airy clothing or without bra can be looked upon, by law women have to wear a bra!¹⁰

4.5. Recommendations

For starting the FoodFactory the local government and the FAO, who will give the subsidy, will have to be managed closely. Locals, farmers, cricket catchers and other food producers have to be kept informed with a good communication strategy. Besides it is recommended to start education projects for the whole community about important themes as hygiene. Also information about using insects as food has to be made widely spread. Some people still think only meat provides the essential nutrients. Through open days or festivals the whole community can be involved in the factory. Moreover the corporate group of trade should be kept satisfied whereas the schools, hospitals and the small shops only have to be monitored. The factory has to, at least, live up to the mentioned Thai legislation. Besides it is recommended to take into account the EU standards for working circumstances and food hygiene. When establishing a factory with EU standards, local people can learn from it and tell this to others. For example they can learn about the importance of good working circumstances and hygiene. To get good working circumstances in the factory there has to be thought about lunch rooms where for example the temperature is less than needed by the crickets. If a western boss will be employed in the FoodFactory it is recommended to follow a course about cultural differences. His family should do this as well. It is good to remember that in Thailand the boss always makes the decisions. It is normal that he gets a higher salary and he has to dress differently to show a higher social class. He has to be careful not to be too rude in the eyes of the Thai.

¹⁰ Source: <http://www.thaicongenvancouver.org/DoandDont.htm>

5. Dimension planet

This dimension deals with the sub question ‘What ecological aspects play a role in the FoodFactory project?’ This chapter will look further than only the ecological impact of the factory. It will also deal with the differences between rearing crickets and common cattle. Because the FoodFactory will to be compared with the current situation, a look is also taken at the environmental aspects of the current situation.

5.1. *Environmental impact*

Land use

The estimated land use for pig and chicken farms in Non Jink is 500 m². How much cattle are reared is unknown. In general it can be said that ‘livestock requires a lot of land, occupying 26% of Earth's ice-free land. Their pastures account for 70% of deforested areas in the Amazon, and their feed occupies one-third of global cropland.’¹¹ Because of the fact that crickets can live on waste, there is no extra land use needed to produce their food. Besides the crickets themselves also need less space and the containers can be placed upon each other. If seen in proportion the FoodFactory needs much less space for producing the same amount of food than a cattle farmer.

Gas emission

The gas emission of crickets is minimum. Some NH₃ and CH₄ emission can be expected. This comes from the waste and from rearing the crickets. In large scale bio industry the emission of methane gas is a big problem. It is found that globally ‘the livestock sector accounts for 18% of global greenhouse gas emissions, that is more than transport, which emits 13.5%.’¹² It is a big contribution to the greenhouse gasses which are produced.

Food conversion

‘Insects generally have higher food conversion efficiency than traditional meats. For example, studies concerning the house crickets, when reared at 30°C or more and fed a diet of equal quality to the diet used to rear conventional livestock, show a food conversion twice as efficient as pigs and broiler chicks, four times that of sheep, and six times higher than steers when losses in carcass trim and dressing percentage are counted.’¹² The real conversion efficiency of crickets in the factory will even be higher because of the high fertility the FoodFactory will have as standard.¹³ The production of insects asks for resources for food, but for the large part this can be organic waste.

Energy use

The use of energy for farming pigs and chickens is high in western countries. However in the rural area of Thailand it is less. When looking at raising cattle the amount of energy use in the FoodFactory is much less. This is because of the scale of the factory. Many crickets can be contained in a smaller place which will use less energy than a cattle farmer. In the factory, the heat produced when processing the crickets, can also be reused to keep the factory on the right temperature.

Water use

The amount of water needed in the current situation is high. Although there are not exact amounts it is found that: ‘to raise 150g of grasshoppers only very little water is required, where cattle require 3290 litres to produce a same amount of beef.’¹³ In the factory the largest amount of water will be used for cleaning the factory. A small amount will be needed to keep the humidity high enough for the crickets.

In the current situation in Non Jink, the low scale of farming may not have that big impact on the environment, because there is no industrial way of producing meat. If in the future the demand for protein grows however, bio industry may be considered. In this case industrially rearing insects on a large scale may be an even better alternative for producing protein because of the limited environmental impact.

¹¹ <http://environment.newscientist.com/article/dn10786-cows-pigs-and-sheep-environments-greatest-threats.html>

¹² Source: The FoodFactory project. Version 0.67 Amsterdam, Drs. Bart T. Hogebrink –IniVention, Ir. Henk C. van Deventer - TNO, May 2008

¹³ Capinera, John L. (2004). Encyclopedia of Entomology. Kluwer Academic Publishers.

5.2. Simple environmental review

The environmental feasibility of the project is based on a so called ‘simple environmental review’. This review gives the opportunity to investigate what the environmental effects of the project are. A look at the legislation is taken to see if action has to be taken. In table 2 the simple environmental review for the FoodFactory project is shown.

Table 2: Simple environmental review

Activity	Might have an effect on environment	Possible effect	Probability	Action require by law	Decline possible?	Risk on project	Complaints by stakeholders?	Actions taken
Building factory	Raw materials	Depletion resources	Low	Yes ¹⁴	Yes	No	Maybe	Use only durable and environmental friendly materials or use existing building
	Construction	(Air) pollution	Medium	Yes ¹⁵	Yes	No	Yes	Idem
	Use electrical tools	Depletion resources	Medium	Yes ¹	Yes	No	Maybe	Idem
	Occupancy land	Deforestation	Medium / low	Yes ¹⁶	Yes	Yes	Maybe	Idem
	Noise	Decline biodiversity	Low	No	Yes	Yes	Yes	Idem

¹⁴ <http://www.environnet.in.th/evdb/law/national/resources/index.html> (law related to natural resources)

¹⁵ <http://www.environnet.in.th/eng/evdb/info/air/index.html> (air pollution)

¹⁶ <http://www.environnet.in.th/eng/evdb/info/forest/forest13.html> (forestry conservation)

http://www.environnet.in.th/eng/evdb/policy/world/pw_ch11.html (deforestation)

A FoodFactory in Non Jink, Thailand

Keeping crickets	Escaping crickets and eggs	Plague / damage agriculture	Low	No	Yes	Yes	No	Build structure so chance of escaping is minimised
	Food from environment	Depletion resources	Low	Yes ¹	Yes	Yes	No	Use waste from process: legs and wings
	Noise	Hindrance	High / medium	No ¹⁷	Yes	Yes	Yes	Insulation
Processing crickets	Waste water	Water pollution	Low	Yes	Yes	No	No	Make connection to sewage system
	Consumption energy	Depletion resources	Medium	Yes ¹	Yes	No	No	Use equipment which doesn't use much electricity
	Oil for deep frying	Eutrication	Low	Yes	Yes	No	No	No contact with water
	Cricket waste	Nitrification / eutrication	Low	Yes	Yes	No	No	Feed to crickets
Packaging	Materials	Depletion resources	Medium	Yes ¹	Yes	No	No	Use items which can be use more then once
	Waste production	Solid pollution	Medium	Yes ¹⁸	Yes	No	Yes	Use cotton bags
Distribution	CO ₂ emission	Air pollution / resource depletion	Medium	Yes ¹⁹	Yes	Yes	Yes	Use green vehicle for transportation
	Consumption fuel	Resource depletion	Medium	Yes ¹	Yes	Yes	No	Idem
Cleaning	Waste water	Eutrication	Medium	Yes	Yes	No	No	Make connection to sewage system

¹⁷ <http://www.environnet.in.th/evdb/law/national/managment/2801.html> (noise)

¹⁸ <http://www.environnet.in.th/eng/evdb/info/waste/waste5.html> (prevention and resolution of waste)

http://www.environnet.in.th/eng/evdb/policy/world/pw_ch20.html (hazardous waste)

¹⁹ http://www.environnet.in.th/eng/evdb/policy/world/pw_ch9.html (protection of the atmosphere)

5.3. Explanation and recommendations

Energy use and greenhouse gas emissions

The energy used for the FoodFactory is minimal. Energy will be used for: heating the compartments where the crickets are reared, boiling water to wash the crickets, deep frying and packing the crickets and products. The heating will not be a problem because the average climate in Thailand is favorable. Besides that, the factory contains a washing, removal room, deep frying and a bakery room. These rooms can be linked in a way that the warmth of processing will heat the room with the breeding and rearing containers. Processing the crickets and packing them, will cost more energy but this not a considerable amount that will harm the environment.

Insects do not produce a lot of greenhouse gasses compared to cattle. From that end there is no worry as to the production of greenhouse gasses. The other end is the distribution of the products. This can cause an emission of greenhouse gasses. This is why the use of bicycles is recommended to distribute the products. Bicycles do not produce any harmful greenhouse gasses.

Waste production and impact

The waste of keeping the crickets is mostly water from cleaning the containers and the building. This waste water should be treated before it is disposed on the surface water. It will be disposed in the sewage system which carries it to a sewer water purification installation. The impacts on the water quality can be minimized when biodegradable and phosphates and sulphur free soap is used. The waste of processing the crickets is all organic. The stress on the environment is rather small because the organic waste can be reused in the process of rearing crickets. The waste, legs and wings, can be used as food for the crickets. To limit the amount of waste produced during frying the crickets, hygiene lessons are important. The oil can be reused several times if worked hygienically. Old oil will be collected and can be disposed with the solid waste. Another waste source is the packing material. It is recommended that the FoodFactory uses materials that can be reused e.g. bamboo containers, paper bags and/or cotton bags. Plastic bags will only be used for the deep fried crickets that have to be conserved. To prevent disposal there will be a deposit for collecting these bags. Also, the FoodFactory reuses waste from the farmers and city to feed the crickets. This makes that the FoodFactory uses waste to produce food.

Depletion of resources

The consumption of raw materials for building, collecting food from the environment for the crickets, the use of packing material and the use of energy can all lead to depletion of resources. The ways to limit energy use and packing material are described above. Another recommendation is to use an existing building for the FoodFactory, although materials are needed for insulation.

Air

The quality of the air is not declining due to the factory. The little amount of air pollution will be decreased by making less use of energy.

Noise hindrance

The large amount of crickets may cause noise hindrance. The only way to stop the hindrance is at the source. This can be done by insulation. Insulating the building can have a second advantage. It may also prevent the crickets from escaping. The way to do so is to build a second wall around the area where the crickets are kept. The employees will wear ear protection if needed.

Impacts on biodiversity

The crickets that will be reared are common in Thailand. The first colony (200 crickets) will be caught from the wild. The chance that taking this amount of insects out of the wild will be harmful is not likely. A problem may be a plague when the crickets may escape. Whether this is likely or not depends on how the employees handle the safety regulations concerning the crickets. The last thing that can have an affect of the biodiversity is the possible deforestation. This is only a problem if the FoodFactory is built on a piece of land containing trees. To avoid this problem using an existing building is recommended.

6. Dimension profit

Sustainability is not only about environment or people, a real sustainable organization has to make some profit as well. In this chapter a better look is taken at the economical aspects that play a role in the project.

6.1. Description of market

All the inhabitants of Non Jink are the potential consumers of the FoodFactory products. The target group are the poor people in Non Jink and the institutes that do not have much money like schools and hospitals. In the village, the head of the village and the cooperate group of trade can decide about the selling opportunities of products. Local farmers also sell their products to the group of trade.

The most people are age 18 – 60²⁰. The whole village from age 2 up to 90 is the potential consumer of the product. If all the people of Non Jink (517 inhabitants) will have three warm meals per day, containing 200 grams of cricket products per meal than there will be a consumption of 310,200 gram crickets per day. This amount is not realistic and is not based on reliable facts. Because the real amounts can only be seen when the factory is in practice, an assumption has to be made. The assumption is made that half of the 310,200 grams will be consumed per day in the village Non Jink. This means a sale of 155 kilogram per day. This is divided into different end products.

6.2. Description of competitors

The competitors of the FoodFactory products will be farmers, other food producers and local insect catchers. The farmers will produce products containing proteins too. Instead of eating crickets, people can choose to buy meat or other products from the farmers. They can also choose to buy food from other food producers like fishermen or insect catchers. Before the FoodFactory will be established, people bought their products from these locals. They are familiar with them and may have family or friend bonds with them. Although the products of the Food Factory will be cheaper, they may continue buying from the locals.

6.3. Market price of product

The price of the products is based on several aspects, namely the salary of the employees and what the prices of other insect products are and the price of other meat sources. The income of the local farmers is high in the growing season because they are employed than. The income is around 250-300 Baths per day (฿.22 - ฿.27²¹) (national housing authority). On the other hand, the income is low in the summer. The income is not stable because farmers and insect catchers do not have a job year round. The price for insects at the local market is 20 Bath (฿.24) per bag.²² Pork costs about 100 Baths (฿.11) per kilogram, beef costs around 120 Baths (฿.34) per kilogram, chicken costs about 55 Baths (฿.16) per kilogram²³ and fish costs about 40 Baths (฿.48) per kilogram.²⁴

The goal of the FoodFactory is set to sell cheap food. In addition, providing the employees a continuous good income would be preferable. With the information stated above, the following calculations are made for the wanted salary and price of the food:

There will be 10 employees getting a salary of 300 Baths (฿.27) per day, 1 boss getting 750 Baths (฿5.66) per day. This sets the total costs of the salaries on 3750 Baths (฿78.36) per day.

Because the FoodFactory is built to supply everybody with food, the price of the product is kept low. This means 20 Baths (฿.42) per kg of deep fried crickets or flour and 15 Bath (฿.31) per 10 cookies.

6.4. Subsidies

In the stakeholder analyses the suggestion for taking FAO as the possible investor was already mentioned. 'The FAO helps developing countries and countries in transition to modernize and

²⁰ Source: http://www.dopa.go.th/cgi-bin/people2_stat.exe?YEAR=50&LEVEL=3&PROVINCE=34%23%CD%D8%BA%C5%C3%D2%AA%B8%D2%B9%D5&DISTRICT=%C7%D2%C3%D4%B9%AA%D3%C3%D2%BA&TAMBON=%A4%D9%E0%C1%D7%CD%A7

²¹ Rate: 1 bath =฿.02088 of exchange at 1 October 2008, source: www.wisselkoersen.nl

²² Source: http://news.bbc.co.uk/2/shared/spl/hi/picture_gallery/07/asia_pac_eating_insects_in_thailand/html/3.stm

²³ Source (in Thai): http://www.matichon.co.th/khaosod/view_news.php?newsid=TUROd01ERXdOREF4TVRFMU1BPT0=§ionid=TURNd01RPT0=&day=TWpBd055MHhNUzB3TVE9PQ

²⁴ Source (in Thai): <http://www.fisheries.go.th/it-network/knowledge/type%20of%20fish%20in%20kacuhng/kacuhng.htm>

improve agriculture, forestry and fisheries practices and ensure good nutrition for all.²⁵ An email is sent for more information about the conditions, however until now the FAO did not respond yet. If the FAO is willing to subsidize the project the subsidy will be divided in an investment subsidy and exploitation subsidy. The investment subsidy will be used to cover the initial investment costs at the start of the project. This is shown as reserves on the credit side of the Opening Balance sheet. The amount needed is: 2,419,873. - Bath (€50,526.95). This total amount will be received in the beginning. Besides there will be an exploitation subsidy. With this exploitation subsidy the loss between the revenues of selling the products and the depreciation costs for the inventory and the yearly costs can be covered. If the FAO does not want invest for 100% in the project, other investors have to be found for co-financing.

6.5. Balance sheet of enterprise

To be able to create a balance sheet a list of investments has to be made first. In the following table the assets for the factory are listed. Because the depreciation of these assets is needed in the next paragraph for the profit and loss account, the table will also contain a column used for the depreciation per year. The depreciation of the building is not taken into account. The lifetime is that long that if in the end a new building is needed, a new subsidy plan can be written.

Table 3: The assets of the factory

	Bath	€	Life time (years)	Depreciation per year Bath	Depreciation per year €
Existing building	2,369,106.85²⁶	49,466.95			
Inventory:	45,977.01	960.-			
- Plastic containers (large/small)	4,789.27	100.-	5	956.93	20
- Egg laying devices	1,436.78	30.-	5	287.08	6
- Water dispenser	239.46	5.-	5	47.84	1
- Mosquito screen	1,915.71	40.-	5	382.77	8
- Thermometers	2,873.56	60.-	10	287.08	6
- Pans/pottery	4,789.27	100.-	15	318.97	6.67
- Grinder	11,973.18	250.-	20	598.08	12.5
- (Air tight) packing machine	11,973.18	250.-	15	797.44	16.67
- Bicycles (3x)	1,436.78	30.-	10	143.54	3
- Bags for recycling	957.85	20.-	5	191.38	4
- Oven	2,394.64	50.-	15	159.64	3.33
- Cleaning devices	956.93	20.-	10	95.69	2
- other	239.46	5.-	-		
Cash/Bank	4,789.27	100.-			
Total	2,422,142.24	50,526.95		4,270.43	89.17

With the known assets and the subsidy as credit, the opening balance sheet, table 4, can be made

²⁵ Source: <http://www.fao.org/about/about-fao/en/>

²⁶ Source: <http://www.homeaway.nl/thailand/s/63/fa/find.squery/urvs/29>

Table 4: Opening balance sheet FoodFactory

Opening balance sheet (Date: start of project)					
<i>Debit</i>			<i>Credit</i>		
	Bath	€		Bath	€
Assets					
Building	2,369,106.85	49,466.95	Investment subsidy	2,419,873.-	50,526.95
Inventory	45,977.01	960.-			
Cash/Bank	4,789.27	100.-			
Total	2,422,142.24	50,526.95			

6.6. Profit and Loss account

The difference between the revenues and the total costs will give the profit of the FoodFactory. There has to be a balance between revenues and costs in order to keep the factory going. To be able to make a profit and loss account, beside the costs for depreciation, table 5, other costs have to be mentioned.

Table 5: Cost calculation

	Bath per day	€ per day	Bath Per year	€ Per year
Food for crickets	23.95 ²⁷	0.50	8,741.75	182.5
Water	16.7 ²⁸	0.35	6,095.5	127.3
Electricity and gas for machines and heating oil and water	28.3 ²⁹	0.59	10,329.5	215.7
Oil to fry the crickets (50 litre per week)	178.6 ³⁰	3.7	65,189.-	1,361.15
Packing materials	359.20 ³¹	7.50	131,108.-	2,737.5
Cookie ingredients	850 ³²	17.75	310,250.-	6478.-
Salary	3,750 ³³	78.3	1,368,750.-	28,579.5
Total	5,206.75	108.72	1,900,463.75	39,681.68

The revenues on the other hand are calculated as followed. The total amount of sold product is divided into the expected selling rate. The price is set low compared to the price of meat and insect products on local markets. Table 6 gives the outcome of the calculation. The last column gives the revenues per year.

Table 6: Revenues calculation per day and per year

Selling rate	Weight (kg per day)	Price per kg		Total per day		Total per year	
		Bath	€	Bath	€	Bath	€
40% deep fried	62	20.-	0.42	1240.-	25.89	452,600.-	9,450.29
50% flower	77,5	20.-	0.42	1550.-	32.36	565,750.-	11,812.86
10% cookies	15,5	150.-	3.13	2325.-	48.55	848,625.-	17,719.29
Total	155	190	3.97	5115.-	106.80	1,866,975.-	38,982.44

In the profit and loss account, seen in table 7, the expenditures (depreciation and other yearly expenditures) and revenues are compared. It can be seen that without exploitation subsidy the expenditures are higher than the revenues. There will be yearly loss of 37,759.18 Bath (€788.41). That is why the FoodFactory needs an exploitation subsidy of this amount or more. Extra profit can be used for expanding the factory. The surplus of products will be given to the local schools and hospitals. This will be just an extra to them and a promotion for the FoodFactory.

²⁷ Sometimes enough surplus available, sometimes pet food has to be used.

²⁸ An average household (6 people) pays per month for water use: 500 bath.

²⁹ An average household uses 200 bath for electricity and 250 bath for gas per month.

³⁰ 25 bath per litre oil.

³¹ Only for plastic bags.

³² For sugar, salt and other ingredients. An estimation

³³ See calculation in report page 22

Table 7: Profit and loss account FoodFactory (per year)

<i>Debit</i>			<i>Credit</i>		
	Bath	€		Bath	€
Expenditures			Revenues		
Depreciation inventory	4,270.43	89.17	Sold products	18,66,975.-	38,982.44
Yearly costs	1,900,463.75	39,681.68	Exploitation subsidy (yearly)	37,759.18	788.41
Total expenditures	1,904,734.18	39,770.85			
			Profit:	0	

6.7. Assessment of the investment

As can be seen in the balance sheet and the profit and loss account, the FoodFactory is dependent on subsidies. So with the guaranteed low prices of the products for the locals, the continuous good level salary and only sales in Non Jink, the FoodFactory cannot be self supporting. This may be okay because the FoodFactory has a higher goal than making profit. The factory may have a positive economic impact on the region. First of all the introduction of the FoodFactory has an effect on the unemployment during the summer. This unemployment will decline. The factory offers stable jobs. This may have an indirect economic effect on the education because more people can afford to send their children to school. Besides the FoodFactory also has a direct effect on education because of the planned workshops on hygiene and healthy food. By giving away products to schools and hospitals, children and others will get sufficient healthy food. This can be positive for their learning and work abilities. Because of a continuous salary for some locals and therefore more money for whole families, the purchasing power will increase. This is good for the economy of Non Jink. It is not thought that because of the FoodFactory many people will lose their job. Locals may still want to eat meat sometimes. However this will be, as it is now, not often. The cricket products can be eaten as an extra protein source. With the FoodFactory the locals can eat a healthy protein-rich meal more often. Because the salary for the employees is just slightly higher than the average income in Non Jink, the FoodFactory will not have a negative relation on the relation between the locals.

Of course, it will be a big risk to be totally dependent on subsidies. What if the subsidies fall off? Besides, no depreciation of buildings is taken into account. This means that no reservations can be made for setting up a new plant at the end of the life time of the building.

6.8. Recommendations

With the suggested design and the present goals the FoodFactory is not self supporting. If the FAO is willing to pay exploitation subsidy for about five years, it is recommended that the management of the FoodFactory investigates in these years how to become self supporting. This can be done by enlarging the market. Besides it is recommended to look if and how the costs can be declined and the revenues can be enlarged.

7. Balancing people planet profit

This chapter deals with the sub question ‘How can the social, economical and ecological aspects be balanced for a sustainable project?’ This is done with the use of a Multi Criteria Analyses (MCA). MCAs are used to be able to compare different situations to each other. As in this situation, the implementation of the FoodFactory project will be compared to the current situation in Non Jink. To be able to do so, several criteria are mentioned. Some criteria however, may be more important than other. That is why a weight factor for the criteria is given. This is done on a scale from 1 to 4. If a criterion is very important, a weight factor of 4 is given. If a criterion is not so important, a weight factor of 1 is given. To justify the weight factors, a discussion about this can be read. In the weight factors the demands of the client will be taken into account. The criteria are assessed with a scale of pluses and minuses. The scale is as follows:

+ + = Very good effect + = Good effect - = Bad effect - - = Very bad effect 0 = No effect

First the criteria will be described and the weight factor will be discussed. After that, the matrixes of the MCA will be filled in. Then an explanation will be given as to why these values are given. At the end a conclusion of the MCA will be given.

7.1. Criteria

7.1.1. People

1. Food shortage (4)

To what extent will the food shortage be solved? This criterion is valued very high, because it is the main goal of the FoodFactory project.

2. Level of salary (3)

How much money do the local people earn with their current jobs, and what about jobs in the FoodFactory? This criterion is valued quite high, because it is the goal of the FoodFactory to improve the welfare of the local people.

3. Number of employed people (3)

How many people have a stable job? The value of this criterion is quite high because a goal of the FoodFactory is to fight unemployment.

4. Educational level (2)

Will there be more people highly educated after the implementation of the FoodFactory? This criterion is valued lower than the other criteria for people, because it is an additional effect of the project and not a main goal.

7.1.2. Planet

1. Efficient use of waste (4)

The reuse of the domestic or farm waste. This criterion is valued high, because a goal of the FoodFactory is to use the surplus of waste that is useless for people to produce food.

2. Production of greenhouse gasses (3)

Rearing crickets versus rearing pigs and chickens. This criterion is valued quite high, since if rearing crickets will be much less than the emissions with the current situation, this would be much beneficial to the earth on the issue of global warming.

3. Limited energy use (3)

This is about the energy used in the buildings (farms and the factory) for rearing crickets and pigs or chickens. This criterion is valued quite high because energy saving has become a big part in the contribution to limiting global warming.

4. Limited Use of water (3)

Water used for the production process from base to end product. This criterion is valued quite high, because the water supply in Thailand is problematic. The less water used, the fewer problems it gives.

5. Limiting of waste production (2)

What is the waste at the end of the production process? This criterion is valued average because compared to the other criteria, waste production in Thailand is not thought to be the biggest environmental problem.

6. *Limiting land use*(2)

This criterion deals with the amount of land used to produce food. This criterion is valued not so high because there is no problem with space in Non Jink.

7. *Food conversion efficiency*(4)

In this criterion deals with the difference between the food conversion efficiency between normally used cattle and crickets. This criterion is valued high because it's possible to produce a highly nutritious food without a lot of resources. This has a big effect on the food production chain.

7.1.3. Profit

1. *Profit for the employees* (3)

How much better is a FoodFactory for the income of the locals compared to the income in the current situation. This criterion is valued quite high because the FoodFactory wants to improve the living circumstances in the village.

2. *Profit for the FAO* (1)

How much does the FAO have to invest in the situation? In addition to only spent money, it is a good opportunity for the FAO to promote themselves. This criterion is valued not so high, because the profit of the FAO is not the main point of interest in the FoodFactory project.

3. *Long term profit* (3)

The long term is defined as five years. The income of the farmers is now depended on a lot of external factors. The FoodFactory will be a continuous source of income. The criterion is valued quite high.

4. *Selling price of food* (4)

How high is the selling price of all the end product of the factory? The criterion is valued high, because one of the main goals of the FoodFactory is to produce cheap food.

7.2. Matrix

Table 8: MCA matrix

Criterion		FoodFactory Project	Current situation	Weight factor	FoodFactory Project	Current situation
People	1. Food shortage	++	+	4	+++++++	++++
	2. Level of salary	++	+	3	+++++	+++
	3. Number of employed people	+	-	3	+++	---
	4. Educational level	++	0	2	++++	0
Planet	1. Efficient use of waste	++	+	4	+++++++	++++
	2. Production of greenhouse gasses	++	--	3	+++++	-----
	3. Limiting energy use	++	-	3	+++++	---
	4. Limited use of water	++	--	3	+++++	-----
	5. Limiting of waste production	++	-	4	+++++++	----
	6. Limiting land use	++	0	2	++++	0
	7. Food conversion efficiency	++	--	4	+++++++	----- -
Profit	1. Profit for the employees	++	+	3	+++++	+++
	2. Profit for the FAO	+	0	1	+	0
	3. Long term profit	--	--	3	-----	-----
	4. Selling price of food	++	--	4	+++++++	----- -
Total	+	26	4		82	14
	-	2	13		6	44

The sensitivity of the MCA is tested by looking at the results with all the weight factors set on 1. This can be seen in the third and fourth column of the table above. As a result it can be seen that compared to the outcome with the weight factors, the result is the same.

Below an explanation will be given as to why the values are given in the MCA matrix.

Food shortage: The FoodFactory has a positive effect on the food shortage. The FoodFactory provides very cheap continuous food source for local people. Also the schools and hospitals are involved. In the current situation there is another food source, but this is expensive and once a year farmers deal with natural disaster like flooding or drought.

Level of salary: The FoodFactory has a very good effect on the salary level because it is high compared with the salary that the farmers earn now. It is also a stable income. In the current situation the income varies through the different seasons.

Number of employed people: The number of unemployed people will not decrease very much, because the factory does not need a lot of employees. In the current situation, the unemployment rate is higher especially in the dry season.

Education level: After the implementation of the FoodFactory, the education level will increase a bit because the knowledge will grow about hygiene and the nutrition value of food. The current situation does not contribute to the education level.

Efficient use of waste: Surplus waste from farms and households will be used to feed the crickets. Also the waste from the crickets (legs and wings) will be reused as food. In the current situation some waste from households is used as fertilizer or to feed pigs and chickens. Both ways are good for reducing waste but the FoodFactory will collect the waste from the cities where this waste is disposed and not reused.

Production of greenhouse gasses: The crickets will produce less gas than conventional meat sources. In the current situation the cattle produce a lot of gas. The FoodFactory will therefore have a positive effect on minimizing greenhouse gasses.

Limiting energy use: The FoodFactory will use much less energy than current conventional factories. Thus the effect will be positive. In the current situation the energy use is higher due to the way of food production.

Limited use of water: Crickets need little water. The humidity must be high, but this does not cost much water. Also water will be needed for cleaning and preparing the crickets. But compared to cattle it is much less.

Limited waste production: Certain waste is reused, for instance the cricket's legs and wings. Other waste is not produced by using cotton bags or something like that. This has a positive effect. The amount of waste is reduced, reused or recycled. In the current situation the excretion from cattle is used as fertilizer on the fields.

Limiting land use: As can be seen in chapter 5 the FoodFactory needs much less space for producing the same amount of food than a cattle farmer.

Food conversion efficiency: In chapter 5, the higher efficiency of food conversion in crickets compared to the food conversion efficiency for traditional meats was explained.

Profit for the employees: When the FoodFactory is implemented the profit for the employees has a positive effect on the whole village by boosting the local economy. The employees also have a steady job year round. In the current situation the locals do not have a lot of work during the summer and so, no profit.

Profit for the FAO: The FoodFactory will receive subsidies from the FAO. This is an opportunity for the FAO to promote themselves. The current situation does not have an effect on the FAO because it's not active in the region yet.

Long term profit: The long term profit is not assessed well because it is defined as profit in five years. With the described factory, only after five years, when expanding, they may start making profit. In the current situation there is also no long term profit due to the uncertainty of the income.

Selling price of food: The FoodFactory provides very cheap food. Compared with the current situation the price of flour and deep fried crickets is lower than of conventional meats. The cookies are more expensive than beef, pork and chicken. By selling cheap food all people can profit from it and that way have access to meat. This is one of the biggest positive effects of the FoodFactory. The current price of meat is too expensive for the locals. Not all the people can buy it.

8. Conclusions and recommendations

The first social aspect that plays a role in the FoodFactory are the stakeholders like the locals, the local government, the FAO, the local farmers, environmental organisations, local insect catchers, schools, hospitals, local shops, the cooperate group of trade. Other aspects are the Thai and European laws. For Thailand these are the consumer protection act, the labour protection act, the public health act and the energy conservation promotion act. Although Thailand is not a member of the European Union, if the FoodFactory wants to implement CSR, they can do something extra by living up to European legislation concerning employment and social policy and food safety. If a foreign person will implement the FoodFactory project in Thailand it is also good to consider the habits in Thailand.

The ecological aspects that play a role in the FoodFactory are the land use, gas emission, the food conversion efficiency, the energy use and the use of water. These aspects determine the environmental impact of the factory. In the simple environmental review, the aspects of the use of raw materials and noise hindrance also play a role.

The economical aspects that play a role in the FoodFactory are the possible market, the price of the food, the needed subsidies and the revenues and costs for the factory. The target group is the poor people in Non Jink and the institutes that do not have much money. The competitors for the market are farmers, other food producers and local insect catchers. The initial investment costs are 2,420,000. - Bath (€0,500.-). With the low price of the product (20 Baths (€0.42) per kg deep fried crickets or flour and 15 Bath (€0.31) per 10 cookies), the good salary for the employees (300 Bath (€6.27) per day and for the boss 750 Bath (€15.66) per day) and the present market, a loss is seen. The differences between the revenues of 18,66,975.- Bath (€38,982.44) per year and the yearly costs of 1,904,734.18 Bath (€39,770.85) is 37,760 - Bath (€88.-) per year. Without a subsidy the FoodFactory will therefore not be feasible.

So it is to be said that in the current design of the FoodFactory, the people and planet aspects are perfectly taken into account. By solving the food shortage problem during the drought in Non Jink it meets the initial goal of the FoodFactory. Besides the project will reduce the unemployment rate and will educate the people about important subjects. To find a balance between these two aspects and the dimension profit however, was difficult. The fact that the project depends on subsidy makes it a vulnerable project. Even after the investment subsidy, a yearly exploitation subsidy is needed in order to keep the factory going. The low price of the food may be a cause of this problem. If the FAO wants to support the FoodFactory with an exploitation subsidy to cover this loss for about five years, the management of the FoodFactory can use these five years for expanding the factory and increase the revenues. This could be done by selling the products outside Non Jink. When the main goal of the FoodFactory, supply cheap food, is not taken into account, the price of the products can of course be increased and with that the revenues. It is not found realistic to limit the other costs.

Al together, the conditions that should be fulfilled for a feasible FoodFactory project in Non Jink, Thailand, are as following: make use of an existing building with the elements described in the design suggestion. In this building good insulation, prevention of escaping, connection to sewage system has to be taken into account. Besides, the energy use should stay low by making use of bicycles and produced warmth. Waste should be used as food and the products will be sold in reusable bags. The course to learn the culture differences should be taken and the described laws of Thailand and Europe have to be lived up to. The mentioned stakeholders should be dealt with carefully. Because the FoodFactory of the described design is not feasible without subsidies, the first step that has to be taken is to find out if the FAO is willing to subsidize the FoodFactory. If the FAO does not want to subsidize the project, another money source has to be found. If the money problem is tackled, the next step is to talk with the head of the village and the local government in order to get an approval to start the project. Then an existing and suitable building in Non Jink can be bought to start the factory. In the mean while local people will be informed about the project and the employees will be picked out. The inventory mentioned in chapter 3, plus the inventory listed in table 3 in chapter 6, has to be bought. When the project is in process, education programs have to be set up.

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Appendix I Plan description

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THE FOODFACTORY PROJECT

PLAN DESCRIPTION

Plan description for WUR, HHG16 (Balancing People, Planet, Profit)

Amsterdam, September 2008

Drs. Bart T. Hogebrink – IniVention