A meat free society

The different substitutes for meat, their future and their environmental and health impact compared to meat

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Abstract

The worldwide consumption of meat continues to increase and in Sweden the annual consumption has gone from 24 kg/person in 1990 to about 78 kg/person in 2005. This contributes to large environmental impacts such as an increase of greenhouse gas emissions, unsustainable land and resource use and shortage of water. A solution to the problem is to change our diets to be more sustainable. The purpose with this research is therefore to study the positive environmental and health aspects of alternative protein rich products based on soya, grown meat, algae and insects in comparison with meat. The goal is then to compare the environmental impacts from these products by studying different LCA-studies. Furthermore, also to understand how the future will be developed by interviewing producers of meat substitutes in Sweden.

Some difficulties of comparing different LCA-studies are the choice of system boundaries, functional units and environmental aspects in the studies. Nevertheless, after studying a large amount of reports and articles about the products conclusions could yet be drawn. The carbon footprint from beef is up to 20 times larger than from the substitutes and the land use is up to 125 times larger for beef compared to substitutes. Pork and chicken have lower impact but the lowest impact seems to come from producing substitutes based on soya beans. Insects and algae also have a low impact, but the products are still in the stage of development in Sweden due to laws, regulations and lack of knowledge. Regarding the health aspects substitutes could possibly replace meat since both insects and soya are rich of protein. Insects are also rich on iron and other nutrition. Algae consist as well of good nutrition.

The companies interviewed in this study were Kung Markatta, Ekko gourmet and Veggi. They had some different opinions on future products, but they could all agree on that we need to eat less meat and more substitutes. The conclusions of this research are that the environmental aspects considered in the analysed LCA-studies are mostly carbon footprint and land use. They show that beef have a larger environmental impact than meat substitutes. It is however recommended to do new studies on products with the same system boundaries and functional units to get a more accurate and comparable result.

Keywords: LCA, environment, meat, substitutes, insects, vegetarian, carbon footprint
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1. Introduction

1.1 Background

1.1.1 The problem

Together with the pressure on the environment from land use, non-renewable energy use, growing population and use of resources, solutions need to be addressed to make sure that we reach our sustainability goals and a sustainable society (Jansson & Bergman, 2015). A sustainable society requires sustainable development. Sustainable development is a concept that has many definitions, but the most known is the one founded by the Brundtland Commission in 1987 (Ammenberg, 2012, p. 39). It is defined as a development that meets the human needs without compromising the needs of future generations. It consists of three main pillars that need to be coordinated together; economic growth, social equality and environmental protection. Environmental sustainability sets the utmost boundaries of a sustainable system, without it it will be difficult to achieve a sustainable development, no matter what happens to the social and economic dimensions (Ammenberg, 2012, pp. 70-71).

Sustainable development can be achieved if solutions can be found, but the environmental problems have now gone from local and well defined to global and complex (Ammenberg, 2012, p. 42). Many of the global problems is caused by emissions that comes from human consumption and the products that we use in our society, for example food consumption (Gröndahl & Svanström, 2010, p. 261). Access to resources will decrease and there will be more shortage of water if choosing the same food consumption as today (Naturvårdsverket, 2013). 70% of our land is already used for livestock and the producing of feed. This means that with a growing population rate the need to use more land increases which for example affects the deforestation of the rainforests (Dicke, 2010). The agricultural land is approximately going to be doubled by 2050 in relationship to the growth in population, which is not sustainable. Therefore, new food alternatives are being looked into, one of these are insect farming (Jansson & Bergman, 2015).

According to Naturvårdsverket (2013) every individual, in the industrial world, should by 2050 lower their carbon dioxide-equivalent/year (CO₂-eq/y) with eight tons, when consuming services and goods. One of the main five contributions to the emissions is the consumption of meat. The consumption of meat per person is 77-87 kg per year, it is the largest food group to contribute to the emissions of greenhouse gases. This figure does not however include emissions from deforestation and altered land use (Naturvårdsverket, 2013). In an English study, where emissions from deforestation and altered land use were included, the emissions increased with 66% (Audsley et al, 2009).

With the growing consumption of meat, the growth of greenhouse gas emissions has increased. Between 1990 and 2005 the consumption of meat (from cow, pig and chicken) increased with 50% in Sweden which contributed to an emissions growth by 2,3 million tons of CO₂-eq. This corresponds to an increase from 24 kg to 77-78 kg meat per person. The
reason meat increased this period, in Sweden, was because of the low prices and the fact that consumers are responsive to price change on meat supplies products. The increased import of meat from other countries was a contributing factor for the price change. The reason these prices were lower was because of the fact that these countries do not have the same environmental and animal protection requirements as in Sweden, which made it cheaper to produce the meat (Naturvårdsverket, 2013).

1.1.2 Solutions to the problem

Naturvårdsverket (2013) points out that the Swedish meat consumption has already decreased its environmental impact, but it is still big. It is therefore preferable to lower the consumption of meat, rather than to make the meat industry more efficient since it results in bigger environmental benefits. To decrease the environmental impact from meat with 70% requires a combination of solutions, for example eating more vegetarian food. However, it is important to choose substitutes with the lowest environmental impact. A study showed that the total Swedish consumption, with emissions of 10 tons CO$_2$-eq, could decrease with 10% if choosing to eat a vegetarian diet with complements of egg and dairy products. Meaning that the food sector could lower the emissions of CO$_2$-eq from two tons per person to one ton. A risk when trying to lower the meat consumption, is that the environmental impacts just change places, but are still the same amount (Naturvårdsverket, 2013). It is therefore interesting to use life cycle assessment, LCA, for different types of substitutes, trying to compare these to each other and get a better understanding for how different types of substitutes affect the environment and which ones seems like the best solution.

1.1.3 Life cycle assessment

Life cycle assessment, LCA, is an environmental instrument to measure the environmental impact goods and services have. By studying all the steps in a product's lifecycle, one gets a broad view of the total environmental impact a product contributes with. Depending on how the LCA is done the result will differ, since one may include things other would not. There are therefore different standards that can be used, for example ISO 14040 and ISO 14044. ISO 14040 is an overall standard were one need to have in mind different definitions and principles. ISO 14044 has more detail demands and guidelines of how a LCA should be made (Ammenberg, 2012, pp. 440-441). What one needs to bear in mind when it comes to LCA is the fact that different LCA’s still has different system boundaries and functional units, which can make it hard to compare results from different LCA’s to each other (Nijdam et al., 2012).

In the lifecycle of food, the biggest emissions occur during the process of making the food. 90-95% of the emissions from meat occurs there as for regular food 85%. Therefore, many LCA studies regarding food, chooses not to look into a foods total lifecycle, but only the production. Packaging, transport and waste management is therefore not included (Röös, 2012).
1.2 Purpose and goal

The aim of this report is to create an understanding of the different positive environmental and partly health aspects new protein rich products as, algae, insects, grown meat and soya based products has in comparison with traditional meat such as beef, pork and chicken. The goal is to be able, by studying different LCA-studies, to point out the environmental and health effects that occurs in relationship to the production of these foods. Furthermore, the goal is also to understand how the future will be developed. By interviewing companies, interested in vegetarian food, other substitutes and the environment, this study will investigate if there is an interest on the market from the producers’ side and how they believe the future will develop.

1.3 Question Formulation

The questions this report intent to answer are:

- How does the environmental impact that occurs in relationship to the industry of producing meat differ from the environmental impact from producing vegetarian and meat substitute options?
- Is it possible to choose not to eat meat and still get the nutrition humans require?
- Which environmental aspects are good and badly lit regarding meat and substitutes?
- How will the market for meat substitutes possible develop and what uncertainties are in the projections?

1.4 Method

This report is based on literature studies on different environmental analyses such as LCA-analyses, that are being judged and compared to each other. However, since the studies and reports used in this report uses different functional units and system boundaries, the comparison is not direct but more discussed. Another part of the result are interviews with different producers of vegetarian products. In Sweden, there are some companies producing substitutes for meat and Lisa Bysell (2016) researched which companies where on the Swedish market. By reaching out to nine different companies based on the report by Lisa Bysell (2016), three replied saying they were willing to be interviewed and these were Kung Markatta, Veggi and Ekko Gourmet. The ones who declined had reasons such as not being located in Sweden or were just not interested since they had a lot of other things going on. The interviews are used to look over the producer's opinions and their interest in trying new substitutes. They are also used as a discussion base to discuss the future and whether we will see more meat substitutes in the future on the Swedish market.

The sources used in this report are found through different scientific databases and search engines such as Web of Science, Scopus and Google Scholar. Many of the reports are dated from 2015 or later but some of them are older than that. Considering the large amount of reports and studies processed and compared, and where they were found, they can still be considered to be trustworthy. One issue that is hard to analyse is how well the studies match the reality and the real world. Nevertheless, many of the studies have used well known and
reputable LCA-methods that are ISO-standardized. Meaning that the results matches the reality that is known for now.

1.5 Boundaries

The selection of meat and meat substitutes is mostly based on the report by Lisa Bysell (2016). The report is focusing on meat as beef, pork and chicken when analysing the environmental impact. The substitutes that have been analysed are insects, products made from soya beans, and algae. Since there are different legislations and agricultural conditions in different countries, this report has taken into account figures from countries such as Sweden, Brazil, the Netherlands and Argentina. It is therefore possible to see how the environmental impact differs and where the lowest and highest impacts are.

When analysing figures this report has taken into account the environmental impact from the meat production and the environmental impacts regarding growing the feed to the cattle. The environmental impacts that have been taken into account in this report are land use and carbon footprint as greenhouse gas emissions, CO₂-eq. There are other impacts that could be analysed but these have been badly lit in the different studies that have been looked over. These are, for example, water use, over fertilization and acidification.

2. Result

The result involves the environmental impacts from meat and different substitutes. The different foods sectors regard facts about the food and their environmental impact. The first part in the result focuses on meat and after that the substitutes such as soybeans, insects and algae. After that there is a part regarding the different foods impact on the health. The last part in the result brings up the interviews made with the producers of meat substitutes. It brings up their view on the substitutes and how they believe the future will develop.

2.1 Meat

A report by Sonesson, et al. (2009) was part of a project called “climate labelling for food” and was made for SIK - the institute of food and biotechnology in Sweden. The aim was to identify the life cycle of beef with respect to environmental impacts through published life cycle assessments and other research on the subject. Sonesson, et al. (2009) describes that the largest part of the beef production, in Sweden, comes from products of the dairy industry, for example milk cows that are not anymore needed for milk production. In 2006 about 65% of the slaughtered volume came as a by-product from the milk production. The other part (35%) is produced from specialized production, meaning that the cows were only produced for meat (Sonesson, et al., 2009).

2.1.1 Environment

Livestock provides 14% of the global greenhouse gas emissions as CO₂-eq (Jansson & Bergman, 2015). Although, one problem regarding lowering the meat consumption, is that the environment need cows to keep the landscapes open and for biodiversity. However, since the
impact of lowering milk production is not analysed, the assumption is being made that there
will still be cows and other grazing animals. But one needs to have in mind that just taking the
grazing animals away will also affect the environment negatively (Clarin & Johansson, 2009).

The environmental impact from the land use is not often considered in relationship to meat
production. Nevertheless, a result show that production of meat in relationship to changed
land use contributes to a larger environmental impact. In a study made from 2005, different
meat and their environmental impact are being compared to each other. The comparison is
made with the kg CO₂-eq / kg slaughter weight. It does not include the impacts on change of
land use, however it includes the meat's transport until the meat reaches the store. The result
show that beef is the one with the highest environmental impact compared to pork, chicken
and boiled legumes. Swedish beef contributes to 20 kg CO₂eq / kg, Swedish pork to 3,5 kg
CO₂eq / kg and Swedish chicken with 2,2 kg CO₂eq / kg. These values are also compared to
the environmental impact regarding boiled legumes, which is 0,2-1,4 kg CO₂eq / 0,9-1 kg
boiled legumes. Meat's environmental impact is therefore 1,6-144 times bigger than boiled
legumes. If one chooses to consider the change of land use, the difference would be even
bigger. The study did not take into account the production of soy based animal food
(Naturvårdsverket, 2013).

Emissions from beef productions comes mostly from methane from the animals feed
combustion, nitrogen fertilization of feed farming, pasture land and manure management. The
methane emissions from the animals can to some extent be controlled by the composition of
the feed. Emissions can be decreased by a higher share of feed concentrate since the time of
the digestion is shortened, but also because of changes in the metabolism for the animals. This
can however be negative for the environment since the grazing animals, which are good for
the biodiversity, and the carbon storage in the grasslands, for example, are decreased
(Sonesson, et al., 2009). The environmental impacts from beef differs, depending on where it
is produced. Emissions from beef produced in Brazil comes mostly from the harvest of land
previously covered by rainforest, while this frees high amounts of greenhouse gases which
contributes to global warming. However, in Sweden, the beef production includes that cows
have a big amount of pasture which also helps contributing to the environmental goals “A
varied agricultural” and “A rich flora and fauna”. This is approximately half of the Swedish
cattle (Naturvårdsverket, 2013).

The life cycle assessments from Sonesson, et al. (2009) showed that the environmental impact
can differ a lot depending on system boundaries, choice of method and functional unit but
also how the production of the meat is conducted. The environmental impact of the meat
differs between 22-40 kg CO₂ eq/kg for specialized beef production. However, for beef
produced from milk cows the values are lower, about 14-19 kg CO₂ eq/kg. The reason is
because that the milk cows are also used for other purposes than meat production and the
environmental impact is divided between the meat and the milk production.

In a report by Cederberg & Nilsson (2004) the aim was to analyse the life cycle assessment of
organic beef production in ranch operation in southern Sweden. The extent of the study is the
lifecycle of beef from the production of inputs to the farming followed by all the activities from the production at the farm. The environmental effects, included in the analysis, are energy use, resources, land use, pesticides, contribution to climate change, over fertilization and acidification. The functional unit used in the report was one kilo of bone free meat produced at the ranch excluding transport, slaughtering process, distribution and other environmental effects caused after the production. Neither is the maintenance, production of buildings and machines, medicines or water use included in the study and for the electricity consumption average Swedish data is used.

The energy use at the farm comes from fossil sources and is measured to 8 MJ/functional unit, mostly caused by the use of tractors. Emissions of greenhouse gases for the beef lifecycle are carbon dioxide (CO$_2$), methane (CH$_4$) and nitrous oxide (N$_2$O) and these have been recalculated to kg of CO$_2$-equivalents. This gives the result of 21,7 kg CO$_2$-eq/functional unit and is mostly caused by methane emissions from the animals. The land use per year is 154 m$^2$/functional unit where 60 % is arable land and the use of pesticides is 0 g/functional unit, because of the organic production. The emissions from over-fertilization are hard to calculate and therefore they are approximated to 2-5 kg NO$_3$-N/ha and is caused by nitrate and ammonium leakage. Eventually the acidification is caused by ammonium in the manure and is maximum 5,5 moles H$^+$/functional unit, and the emissions of NO$_x$ and SO$_2$ are only 0,022 and 0,031 moles H$^+$/functional unit (Cederberg & Nilsson, 2004).

In another report, by Smetana et al (2015), where a LCA was made the purpose was to analyse the environmental impact of the most known meat substitutes through life cycle assessments and compare them with meat from chicken. The method was to analyse the life cycle from “cradle-to-plate” with the functional unit 1 kg of ready-to-eat meal at a consumer. Two other functional units were also used as a part of a sensitivity analysis, the equivalent of 3,75 MJ energy content of fried chicken and 0,3 kg of digested dry matter protein content. Cradle to plate means that the products are analysed from raw resources production followed by transportation to the store, cooling on a cooling counter, additional product application and finally transportation to the consumer and frying on an electrical stove. Products that were studied was chicken, substitutes based on dairy, insects, gluten, soy meal, mycoprotein and lab grown substitutes. The report uses a characterization method called ReCiPe V1.08 which includes multiple characterization factors, such as climate change, human toxicity, eco toxicity, ozone layer depletion, acidification, land occupation, metal and fossil fuel depletion. Data used in the study are from Ecoinvent 3, LCA Food DK, different published data on processing, meat substitute production and environmental impact. Moreover, primary data are used from the German Institute of Food Technologies (Smetana, et al., 2015).

The result from the report by Smetana et al (2015) showed that the highest environmental impact was caused by lab grown meat followed by mycoprotein-based substitutes and chicken. Lab grown meat had the impact of 23,9-24,64 CO$_2$eq / kg functional unit, mycoprotein 5,55-6,15 CO$_2$eq / kg functional unit and chicken 5,2-5,82 CO$_2$eq / kg functional unit. Gluten-based substitutes had 3,59-4,03 CO$_2$eq / kg functional unit and dairy-based had 4,38-4,95 CO$_2$eq / kg functional unit. Lab grown meat had the highest impact due to the early
stage of technology development and because it has a high energy demand. Chicken, mycoprotein, dairy and gluten also had high energy demands. The last two also had high demands of transportation. The lowest impacts were for insects and soy-meal and that was for the most part because of the effective processing and growing technologies (Smetana, et al., 2015).

2.2 Soybeans

The soya bean plant belongs to the legume group. 35% of the soya bean consists of protein and 18% oil, which makes soya beans one of the plants with the highest protein content. Today most of the soya bean farms are for producing feed to livestock. The beans are crushed to extract the oil as well, which is used for consumption (Dalgaard et al., 2008). In Sweden the soy feed is imported from Brazil. The area of producing vegetables for animal feeding and the area producing of meat is larger than the area of growing vegetables for direct food consumption (Naturvårdsverket, 2013).

2.2.1 Environment

In the report by Clarin & Johansson (2009) they make the drastic move to assume that the total meat consumption such as pork, chicken, beef, lamb, wild animals and fish is replaced with vegetarian alternative such as soya beans, yellow peas and eggs for the entire Swedish population over a year. The result showed that this can lower the greenhouse gas emissions from 9,8 thousand ton CO\textsubscript{2}eq to 0,9 thousand ton CO\textsubscript{2}eq. This means that the greenhouse gas emissions in Sweden could be lowered with almost nine million tons per year (Clarin & Johansson, 2009).

Dalgaard et al. (2008) did a LCA study on the production of soybeans in Argentina. The LCA extends from Argentina to the Rotterdam Harbour in the Netherlands, taking into account transportation, resource use, emissions to water and air. They used the ISO 14044 standard. When producing protein from soya beans, soya oil is co-produced and is therefore included in the study by Dalgaard et al. (2008) as a part of the LCA. When producing soya oil, a marginal oil needs to be used. Depending on which marginal oil one uses, the result of the LCA will differ. In this study they chose to analyse using rapeseed oil or palm oil, which came to have a great impact on the result. The reason one could want to use different oils is because of the oil content. The content of fatty acids varies, which gives the different oils different effects. The result showed that soya bean meal with rapeseed oil as marginal oil had the lowest environmental impact regarding global warming, ozone depletion, acidification and eutrophication. The area required to grow 1 kg soybean meal was 3,6 m\textsuperscript{2}/year and one hectare land produced, over one year, 2630 kg soya beans. The global warming potential was 0,721 kg CO\textsubscript{2}-eq / kg soybean meal (Dalgaard et al., 2008). In the report by Smetana et al (2015) soy meal based substitutes had an environmental impact with 2,65-2,78 CO\textsubscript{2}eq / kg functional unit.
2.3 Insects

Insects are a type of animal within the arthropod group. They represent approximately 90% of the total different animal species there is in the world. They live in many different habitats and can be found almost all over the world. Most of the insect species grow rapidly in numbers since they get many offspring and do not need to have parental care (Jansson & Bergman, 2015).

There are 2-3 million different species of insects in the world and of these, 1900 different species are used in or as foods. Of these species the most consumed are as following, 31% are some sort of beetles, 18% are caterpillars, 14% is a combination of bees, wasps and ants, 13% are grasshoppers, crickets and locusts, 10% are cicadas, leafhoppers, planthoppers, scale insects and true bugs and the last 3% are termites, dragonflies and flies. (Jansson & Bergman, 2015). Depending on where you are in the world, the view on insects is different. In the Western societies, especially Europe and North America, insects come across as weird and gross. However, in other parts of the world, insects are considered a delicacy. The reason we do not eat them in Europe and North America today, is because they are unknown to us (Dicke, 2010). This means it is possible to make insects a part of the food sector, it is partly a question regarding people's attitude towards it. One country that stands out in Europe is the Netherlands as they have been promoting insects since the 1990s. Insects can be consumed whole, but they can also be peeled and processed which people can find more appealing. Insects can be turned into some sort of flour, granules and pastes. It is also possible to extract the protein, fats, chitin, minerals and vitamins from the insects. The negatives side of this extraction is that these processes requires more energy and are more expensive (Jansson & Bergman, 2015).

One of the reasons insects has not yet been established in other European countries, is because it is not fully legal to serve insects as food in the European Union (EU). This is because there is still lacking information regarding risk assessments. According to Jansson & Bergman (2015) it is possible that insect species will be approved one at a time. Jansson & Bergman (2015) thought that during 2016 some insects would be approved. According to Livsmedelsverket (2017) insects are still not allowed to be sold in Sweden, and no company has filed for an application. The EU regards insects as a new food, which means that since it is new on the market it needs to be investigated regarding the risks it could contribute to. It is however possible to define insects as traditional food from a third country. To do this, there has to be proof that the food has been used and consumed for at least 25 years. This would be an easier way to implement the insects as food comparing to investigate the risks it could contribute to (Livsmedelsverket, 2017b).

The concept of farming insects is relatively new, but have been found in Thailand, Laos, Vietnam, the US and the Netherlands. Most of the insect farming that exist in the world today are for food to pets and zoos. When choosing to have insect farms it is important to have in mind the consequences they can bring. Insects have a tendency to rapidly grow which means one has to have a successful rearing system. But if the insects somehow would be released
into the wild, it is important that the insects already are native in the country, to lower the risk of affecting ecosystems. In Sweden this means the farming would probably encompass the species house crickets, mealworms, the larvae of beetles and honeybees (Jansson & Bergman, 2015).

The house crickets have been a part of the Swedish nature for hundreds of years. They are easy to farm, can eat many different types of organic material, live in crowded areas and their ideal temperature is above 20°C. House crickets’ farms are today mostly common in Thailand, there are 20 000 farmers there. Something positive with house crickets is that they contain a lot of nutrition that humans require. However, in the farms that exist today, studies have been made showing that large populations often get affected by a virus, which affect the cricket population negative (Jansson & Bergman, 2015).

Mealworms are also easy to farm since they have a short life cycle and are endemic in temperate climates. The existing mealworm farms today are mostly in the pet feed industry. Unlike house crickets, mealworms require moisture in the feed since it affects the productivity and fat content. Mealworms feed on wheat, flour, soya and skimmed milk. It would not be sustainable to feed mealworms with this, since this could be directly consumed by us humans instead. Although, mealworms are capable of recycle low quality organic waste material to high quality feed (Jansson & Bergman, 2015). Regarding honey bees, on the other hand, there is more information about farming, population health and ecology. A parasite that is common in honey bee populations is Varroa. This can nevertheless be handled by making sure the queen lays drone larvae in a special comb. The larvae can then be harvested and used in cooking (Jansson & Bergman, 2015).

The nutrition in insects varies between different types of spices, but is high in general, see Table 1 below. The values in Table 1 are from whole intact insects. However, when humans eat insects’ legs and wings are often removed, meaning that the amount of nutrition humans get is a bit lesser than the values shown below. Insects meets the amino acid requirements for humans and have high values of mono- and polyunsaturated fatty acids. It can even be compared to the amount that occurs in fish. Insects are also rich in micro-minerals that humans require, for example copper, iron, magnesium, manganese, selenium and zinc. They also contain the vitamins riboflavin, pantothenic acid and biotin. A study where animals was fed with insects compared to soybeans, showed that the protein in crickets is equal to the amount protein in soybeans when it comes to the growing aspect of the animal. The conclusion in the study were that feed, based from insects’ protein from crickets and mealworms, were similar to the feed based on soybeans (Jansson & Bergman, 2015).
Table 1 Showing the content of crude protein and fats in different insects measured in % of dry matter

<table>
<thead>
<tr>
<th></th>
<th>House cricket</th>
<th>Silkworm</th>
<th>Mealworm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>55-67</td>
<td>55-71</td>
<td>47-60</td>
</tr>
<tr>
<td>Fats</td>
<td>10-22</td>
<td>6-37</td>
<td>31-43</td>
</tr>
</tbody>
</table>

2.3.1 Environment

Another advantage with insects is that if you have 10kg of feed, it gives you 9 kg of insects compared to giving 1 kg of beef or 3 kg of pork or 5 kg of chicken. This also means that there are lower amounts of manure which means lower amounts of ammonia and greenhouse gas emissions (Dicke, 2010). Compared to livestock animals, insects have a higher feed conversion rate, they do not require as much water and land and they emit less greenhouse gases, meaning that insects seem to have a smaller environmental impact compared to meat. Another difference between insects and livestock is the fact that the feed some insects requires is not in a competition with what human food needs. Insects are mostly herbivores, they can eat feed that do not have a big value for humans such as by-products from the food or forest industries (Jansson & Bergman, 2015).

A risk with insects is the big scale production. If not handled with caution, there is a risk the farms could have a negative effect on the biodiversity and biological control since the farms probably is going to require some pesticides and fertilisers (Jansson & Bergman, 2015). However, Jansson & Bergman (2015) points out that it is possible to farm insects in a sustainable manner by growing feed on unfertilised meadows and wet grazing areas as crops areas to produce feed for insects. This contributes to an efficient use of the resources and help providing the biodiversity. Another likely positive advantage with insects, compared to conventional livestock, is that insects do not produce methane which is one of the greenhouse gases (Jansson & Bergman, 2015).

In a LCA, made at a mealworms farm in the Netherlands, showed that compared to conventional livestock the land-, water use and global warming potential was lower. The energy use was however higher. This is because mealworms, and other insects, are cold-blooded and depending on their thermal conditions. The energy is mostly used during the process of producing mealworms. For mealworms and crickets the ideal temperature is 25-30°C. Nevertheless, by using sustainable renewable energy sources, this will not be a problem regarding sustainability and the environmental impact (Jansson & Bergman, 2015). In the report by Smetana et al (2015) the lowest impact was caused by insect-based substitutes with 2,84-3,02 CO₂eq / kg functional unit. The reasons it is lower than meat is because of the effective processing and growing technologies.

When looking into feed conversion rate, meaning the amount kg feed needed to produce an amount kg of a product (insect or animal), insects requires less kg feed / kg growth. This
means they have a high growing rate (kg growth / kg feed). The growing rate for crickets is 80% compared to different livestock cattle 40%, chicken 55% and pigs 55%. Meaning that insects are more efficient than chickens, pigs and cattle by converting feed to meat. When looking at the amount of protein, crickets needs six times less feed than cattle to produce the same amount (Jansson & Bergman, 2015). Since insects do not use energy to regulate their body temperature, they do not require as much energy in their food as cows, pigs and chickens. They have therefore a lower environmental impact than meat (Nijdam et al., 2009).

If we assume insects are going to be a substitute for meat, they are going to be produced in big scales and continuously. Meaning that the process needs to be automated. It is therefore important to make the process efficient and safe. The steps of the insect industry would involve breeding, feeding, feed production and including a system for health, diseases and hygiene. There is however not much information about different large scale breeding at the moment and how different feed affects the insects. Studies have however showed the insect can have different types of feed. Since insects are herbivores, meaning they eat plants, they can compete with us humans regarding feed. The question is then how to feed the insets in a sustainable way. There is still a lack of information of this part, but Jansson & Bergman (2015) thinks it is possible for instance to use by-products from the food and forest industry since this is already being used to other animal feed. This is however also a question regarding safety and how that will affect the insects that are going to direct human consumption (Jansson & Bergman, 2015).

Moreover, insect welfare needs to be taken into account during farming and slaughter. Since insects naturally live in crowded conditions the advice is to provide an environment close to the one in the wild so they can express natural behaviour. The slaughter techniques that are being suggested are based on doing it as quick as possible, an instant death. For example, freezing or frying (Jansson & Bergman, 2015).

2.4 Algae

Algae are a large group of photosynthetic organisms, mostly aquatic, which has been on this planet for more than 2 billion years. There are about 40 000 different species and can be found in rivers, lakes, in the sea, on walls and soils and even in animals or other plants. The different types are pond scums, snow algae, terrestrial algae, freshwater and marine phytoplankton and seaweeds. Marine macroalgae, more known as seaweeds, are found in coastal areas and consist of three types; red algae (phylum Rhodophyta), brown algae (phylum Ochrophyta) and green algae (phylum Chlorophyta) and there are about 10 000 different species (Guiry, 2017).

2.4.1 Environment

When farming seaweed oxygen is added to the water through photosynthesis which cleans the water from excess nutrients. Seaweeds are also carbon sinks which means that by their uptake of CO₂ the acidification can be reduced in the oceans. Moreover, it has been shown that the biodiversity and fisheries improves by farming seaweeds in coastal areas, but if the scale of
the farming is too large there is also a risk that natural biological activities can be harmed (Tiwari & Troy, 2015).

Seaweed is often imported from Asia but lately there has been attempts trying to cultivate seaweed in the colder European waters. A study made by Taelman & Sfez (2015) analyses a life cycle assessment of algae production in North West Europe for animal feed, as wastewater treatment and finally seaweed production for human consumption. The LCA of the seaweed production is from cradle-to-gate and includes the process related to the hatchery and the grow-out phase at sea. The method used for the LCA is the Cumulative Exergy Extraction from the Natural Environment (CEENE) which means that the consumption of natural resources is calculated in terms of their exergy content. The seaweed that is studied in the report by Taelman & Sfez (2015) is the large brown seaweed, Saccharina latissima, and the functional unit is the consumption of natural resources used when producing this species converted into the exergy content (1 MJ$_{\text{ex}}$ of Saccharina latissima).

Furthermore, Taelman & Sfez (2015) describes that the resource footprint of producing seaweed comes mainly from fossil-based fuel for the transport between the facilities and for electricity. Moreover, the processes for cultivation and harvesting seaweed are very energy-intensive which affects the result. The footprint varies between 1.7-8.7 MJ$_{\text{ex}}$ for the content of 1 MJ$_{\text{ex}}$ seaweed biomass which can be compared with the production of terrestrial plants (sugar beet, maize and potatoes from Switzerland) where the numbers vary between 0.9-3.9 MJ$_{\text{ex}}$.

2.5 Health

Health problems are different all over the world. One of the biggest nutritional disorders in the West world is iron deficiency. 45% of Swedish girls are at risk of iron deficiency. In developing countries people are suffering from malnutrition. Hopefully can substitutes and a lower meat consumption have positive effect on people's health (Jansson & Bergman, 2015).

The consumption of meat is large in Sweden. It is an important iron source for humans. However, since we eat so much meat today, we could lower our consumption and still get enough iron (Livsmedelsverket, 2017a). According to Naturvårdsverket (2013) we can lower our meat consumption with 25-30% without not getting the nutrition we need. They also point out that lowering the meat consumption could decrease the chances of getting cancer, eating less than 500g meat a week decreases the risk of getting colon and rectum cancer (Livsmedelsverket, 2017a).

If the choice is made to eat a substitute Livsmedelsverket (2017a) recommend substitutes such as beans, chickpeas, lenses and tofu which are rich sources of iron, protein and other nutrients. In legumes as soya beans it is however, harder to reach the iron in the legumes. The substitute should therefore be combined with C-vitamin since it makes it easier for the body to pick up the iron. Insects are rich sources of high quality protein, fatty acids, vitamins and minerals. Insects even have a higher iron content than meat (Jansson & Bergman, 2015). According to
Taelman & Sfez (2015) algae also contain a lot of nutrition. Some species of algae contain 6-52% protein, 5-23% carbohydrates and also a lot of omega-3 and 6 polyunsaturated fatty acids, minerals and vitamins. Seaweeds are also proved to give good health effects for humans. The benefits include better immune response system, anti-inflammatory, anti-cancer and anti-depression effects (Tiwari & Troy, 2015) (Taelman & Sfez, 2015).

Another important nutrition we require is protein. When choosing to eat an all vegetarian diet, one requires a 30% increase in the protein intake, since the protein quality often is inferior to the one in meat. However, the western world already consumes more protein than needed (Nijdam et al., 2009). According to an article by Bolla (2015) soy is a source of high quality protein which means that it contains the same quality protein as meat, eggs and milk but less bad cholesterol and saturated fat. Foods made of soy are also rich in minerals, fatty acids and vitamins. Furthermore, eating soybeans can for example lower the risk of different kinds of cancer, bone diseases, heart diseases and hot flashes during menopause.

Since insects are new on the market, it is hard to know their impact on people's health. It is unknown what kind of diseases they can transfer to humans (Livsmedelsverket, 2017b). Dicke (2010) and Jansson & Bergman (2015) points out that insects are very different from humans genetically, meaning that the risk of infections being transferred are small. Dicke (2010) continues to compare insects with pigs. Pigs are similar to the human body and they are being used in researches and tests. It is known that pigs have transferred diseases to humans, for example in the 1990s in the Netherlands people got infected with the swine fever virus (Dicke, 2010). However, there are still some components in the insects that needs to be further examined, for example chitin. The effects of chitin in humans has both showed positive and negative effects (Jansson & Bergman, 2015).

2.6 Comparative tables

To be able to see if it is possible to compare the different results from the life cycle studies two tables have been made from different LCA studies and reports. Table 2 shows different environmental impact figures from meat and Table 3 shows different environmental impact figures from meat substitutes. The figures are based on the different studies and reports mentioned earlier in the result. Almost all of the reports used carbon footprint as a measuring unit, some also used land use and one report used resource footprint. The reports have used different system boundaries, functional units and have been taken different environmental aspects into account. See Annex I for the full information regarding the system boundaries and functional units of the different sources.
Table 2 Shows the carbon footprint and land use from different kinds of meat. The figures are based on four different studies. The table and the figures as comparison between each other is being discussed on page 17

<table>
<thead>
<tr>
<th>Environmental impact</th>
<th>Beef</th>
<th>Swedish Beef</th>
<th>Pork</th>
<th>Swedish Pork</th>
<th>Danish Chicken</th>
<th>Lab grown meat</th>
<th>Poultry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon footprint</td>
<td>9-129 kg CO$_2$eq / kg boneless retail meat $^1$</td>
<td>20 kg CO$_2$eq / kg slaughter weight $^2$</td>
<td>4-11 kg CO$_2$eq / kg boneless retail meat $^4$</td>
<td>3,5 kg CO$_2$eq / kg slaughter weight $^5$</td>
<td>2,2 kg CO$_2$eq / kg slaughter weight $^6$</td>
<td>5,2-5,82 CO$_2$eq / kg ready-to-eat meal $^7$</td>
<td>23,9-24,64 CO$_2$eq / kg ready-to-eat meal $^8$</td>
</tr>
<tr>
<td>Land use</td>
<td>7-420 m$^2$ y / kg boneless retail meat $^{10}$</td>
<td>154 m$^2$ y / kg bone free beef $^{11}$</td>
<td>8-15 m$^2$ y / kg boneless retail meat $^{12}$</td>
<td>5-8 m$^2$ y / kg boneless retail meat $^{13}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$^1$ Nijdam et al (2009)  
$^2$ Naturvårdsverket (2013)  
$^4$ Nijdam et al (2009)  
$^5$ Naturvårdsverket (2013)  
$^6$ Naturvårdsverket (2013)  
$^7$ Smetana et al (2015)  
$^8$ Smetana et al (2015)  
$^9$ Nijdam et al (2009)  
$^{10}$ Nijdam et al (2009)  
$^{12}$ Nijdam et al (2009)  
$^{13}$ Nijdam et al (2009)
Table 3 shows the carbon footprint, resource footprint and land use from different meat substitutes. The figures are based on five different studies. The table and the figures as comparison between each other is being discussed on page 17.

<table>
<thead>
<tr>
<th>Environmental impact</th>
<th>Soya bean meal (PO)</th>
<th>Soya bean meal (RO)</th>
<th>Insect based sub.</th>
<th>Vegetables</th>
<th>Legumes</th>
<th>Mycoprotein based sub.</th>
<th>Soy meal based sub.</th>
<th>Gluten based sub.</th>
<th>Algae</th>
<th>Terrestrial plants</th>
<th>Dairy based substitutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon footprint</td>
<td>0,721 kg CO₂eq / kg¹⁴</td>
<td>0,344 kg CO₂eq / kg¹⁵</td>
<td>2,84-3,02 CO₂eq / kg ready-to-eat meal¹⁶</td>
<td>1-2 kg CO₂eq / kg boneless retail meat¹⁷</td>
<td>0,2-1,4 kg CO₂eq / kg ready-to-eat meal¹⁸</td>
<td>5,55-6,15 CO₂eq / kg ready-to-eat meal¹⁹</td>
<td>2,65-2,78 CO₂eq / kg ready-to-eat meal²⁰</td>
<td>3,59-4,03 CO₂eq / kg ready-to-eat meal²¹</td>
<td>4,38-4,95 CO₂eq / kg ready-to-eat meal²²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource footprint</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Land use</td>
<td>3,6 m² / year kg²⁵</td>
<td>3,0 m² / year kg²⁶</td>
<td>2-3 m² y / kg boneless retail meat²⁷</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

¹⁴ Dalgaard et al (2008)  
¹⁵ Dalgaard et al (2008)  
¹⁶ Smetana et al (2015)  
¹⁷ Nijdam et al (2009)  
¹⁸ Naturvårdsverket (2013)  
²³ Taelman & Sfez (2015)  
²⁴ Taelman & Sfez (2015)  
²⁵ Dalgaard et al (2008)  
²⁶ Dalgaard et al (2008)  
²⁷ Nijdam et al (2009)
2.7 Company view

Three producers on the Swedish market were interviewed in this study, Lennart Olsson (Kung Markatta), Jared Christensen (Ekko Gourmet) and Christer Bengtsson (Veggi). They all started working with vegetarian alternatives because of their passion for food and the goal to eat and live healthier (Olsson, 2017) (Christensen, 2017) (Bengtsson, 2017). The different companies have various trademarks and products. Kung markatta, founded 1983 by Lennart Olsson, has several products all from tofu, tea, rice and drinks and the common denominator of the products is that they are all ecological (Kung Markatta, 2017). Ekko gourmet however, was founded in 2006 by Jared Christensen and sells prepared meals (Ekko Gourmet, n.d.). Moreover, Christer Bengtsson, founder and CEO of Ekko Gourmet, started 2003 working with a chef, interested in soy protein (Christensen, 2017). Veggi's trademark is that it is all vegan by working with soy protein as a substitute for meat. They offer soy burgers, stripes, cubes and mince (Bengtsson, 2017).

Regarding the future, all three companies want to expand and continue working towards more vegetarian options. Bengtsson (2017) even point out that we do not have a choice “It is not a question regarding if we want to, we have to. We have to eat more vegetarian for our planet”. One problem they all have is that they are quite small, and it is a large industry to break into. However, some producers are more willing to try things other would not. Veggi for example can only imagine to possibly start working with algae in the future, since they are a vegan company insects are out of the picture. Christensen (2017), like Bengtsson, could imagine working with algae but not insects. Not because it is not vegetarian but for the fact he thinks it still is too weird to eat insects here in Sweden “Algae is normal to eat in Asia, insects too but insects are too weird. Insects could possibly work in New Zealand where people are more open minded, but I think it will be harder to apply in Sweden”. However, Olsson (2017) is more open towards working with insects, he is even committed to a project that is researching on insects. Olsson (2017) even points out that it is weird that insects are not allowed in Sweden “Regarding insects, I’m participating in a small project at the university were one studies farming of crickets. However, in Sweden we are not allowed to sell or even offer it as human food. But it is however okay to travel to Belgium or England and buy mealworms or crickets in any health store, which is a little strange”. 
3. Discussion

3.1 Environmental aspects on different food

Table 2 and Table 3 shows that different food gives different environmental impacts when it comes to carbon footprint and land use. However, these figures are based on different studies with different functional units. Is it therefore possible to compare these figures with each other? If we start by looking at only the meat sector we can see that it varies a lot, regarding carbon footprint 9-129 kg CO₂-eq/ kg meat. This is not weird since the studies are different and so will then the result be. As mentioned in the result, depending on where the meat is produced the environmental impact is different, we can also see that depending on which type of meat that is produced the environmental impact differ. Swedish meat for example seems not that high in comparison to the highest value. Swedish beef has a carbon footprint of 20-21,7 kg CO₂-eq/kg meat according to the result. The highest value, 129 kg CO₂-eq/kg, in Table 2, is from a country where factors have been included that is not included in Sweden, for example deforestation of the rainforest in Brazil. This leads us to the land use. The different studies values regarding the land use also differ a lot from each other, the interval is 5-420 m² y/ kg meat.

Since beef has the highest values regarding environmental impact when looking into Table 2, we decide only to analyse and compare beef with different substitutes. The total range of the substitutes regarding the carbon footprint is from 0,344 kg CO₂eq /kg to 6,15 CO₂eq / kg ready-to-eat meal. However, since these numbers are based on different studies they have different system boundaries and functional units. This range is more to show that even though one does different studies on different substitutes, the carbon footprint is still less than the carbon footprint from beef. The highest value from meat is twenty times larger than the highest value from the substitutes in Table 3 when it comes to carbon footprint (129/6,15). The lowest meat value is still larger than the highest substitute value (9/6,15). This is something interesting, it shows that it is very likely that the environmental impact is smaller for substitutes than for meat regarding carbon footprint.

The land use from the different substitutes in Table 3 varies from 2 m² / year kg boneless retail meat - 3,6 m² / year kg. This is not such a big interval, however when comparing to the land use for the meat the difference is a lot bigger. The highest value for meat is 125 times larger than the highest land value for substitutes. The lowest land use value for meat is still larger than the highest value for the substitutes. We believe one of the reasons this difference is this much is because of the fact that when producing meat, the animals need to have a lot of space to live equal to their natural habitat and they also require land for the growth for their food. The substitutes on the other hand can be produced on a smaller area. Another difference compared with insects is also that insects likes to live more crowded compared to cattle and other animals in the meat sector. This is very useful and means that the land use for producing different substitutes seems to be smaller than when producing meat.
As **Table 2** and **Table 3** shows, the environmental impacts that have been discussed and analysed in this report is mostly the carbon footprint and the land use. There are several other important environmental impacts from the production of meat and substitutes and also external effects that has not been lit. However, since this report is based on different studies it is hard to take into account environmental impacts that is not that good lit and the most common ones were the carbon footprint and land use. Other environmental impacts that can be taken into account is the water use, over fertilization, acidification and also how the beef production and substitutes affect different environmental goals, for example the united nations sustainable development goals. To be able to do this, the easiest way would be to make a study on different food at the same time. This is further discussed below on page 19 under 3.4 Further studies.

### 3.2 Health aspect

What is positive with the substitutes in comparison to meat is the health benefits. The result shows that it is possible for people to eat substitutes and still get the nutrition they need. The results also show positive aspects as lowering the risk of getting cancer and other diseases when choosing to lower the meat consumption. However, insects are still new and therefore brings unknown risks such as diseases, on the other hand diseases has been transferred from animals we eat today. Nevertheless, the substitutes such as soya beans and algae shows no risks.

As mentioned earlier, many girls in the west societies suffers from iron deficiency and a lot of people in the development countries suffers from malnutrition. The girls with iron deficiency could perhaps be helped or lower their deficiency by choosing to eat insects since they consist of a lot of iron. Insects could possibly also help in the developing countries since insects are rich of high quality protein, fatty acids, vitamins and minerals. They are easy to farm and they exist in plenty of spices which contributes to many choices.

### 3.3 Obstacles for a meat free society

From the results in this study a conclusion is that the environmental effects caused by the beef production are a lot higher than by the meat substitutes and other types of meat. One exception is the lab grown meat which has about the same carbon footprint as Swedish beef. However, there are a few obstacles that needs to be dealt with to be able to live in a meat free society in the future. According to some of the producers of meat substitutes that were interviewed in this study their business is currently too small to be able to expand their supply of products. The demand needs to be increased first and some of the producers were also sceptic to new products, such as insects, because they are controversial.

The development of producing insect-based substitutes in Sweden is also prevented by laws and regulations. It is not yet fully legal to sell insects as food in EU and there seems to be a tough process for small companies to try to convince the authorities. Investigations needs to be done on which insects are suitable for production in different countries without setting the local ecosystem at risk. Both insects and algae have been eaten in for example Asia for many
years and both products contain high nutrition which is good for us. So why do we not eat it in Europe? Maybe it is just a matter of culture and human behaviour. We are not used to it here and therefore it is hard for us to see it as good food.

3.4 Further studies

With this report in mind it would be interesting to do further studies about some subjects. To get more accurate results on the environmental impacts from different products it would be interesting to make a life cycle assessment with a large variety of products such as meat, insects, soya beans and algae, and use the same functional unit and system boundaries. A cost-benefit-analysis could also be done to study what the cost would be for the society to pass over to being meat free compared to the benefits of it.

When it comes to new untested products, such as insects and algae, a study could be done on how other products have been established historically. What processes contributed for the establishment of sugar, shrimps and sushi for example? What could be learned from that? In the end it is always up to the consumer to choose the product in the supermarket. We therefore hope to further studies regarding insects as legal food in Sweden. It would also be interesting to study the behaviour of consumers and what factors are involved when choosing meat versus choosing meat substitutes.

4. Conclusion

The environmental impact that occurs in relationship to the production of meat is mostly, according to the studied reports, carbon footprint and effects from the land use. However, there are many other environmental impacts such as fertilization, acidification and the water use. This is however harder to study and is not analysed in this report. But what one can assume is that the environmental impacts from meat substitutes are smaller than from the meat production. It is nevertheless hard to compare the results, made in this report, since they are based on different studies. However, the environmental impacts regarding carbon footprint and land differs so much that it is hard not to say that it is not better to eat the substitutes. The lowest meat value, regarding carbon footprint, is larger than the highest substitute value with 9 CO₂ eq /6,15 CO₂ eq while the highest value from meat is twenty times larger than the highest value from the substitutes. Nevertheless, we do recommend doing a study with different food with the same system boundaries and functional unit. Another positive aspect of choosing not to eat meat is the lowering risk of getting different kinds of diseases. The substitutes even consist of the nutrients humans need.

Even though it is clear that meat substitutes are better for the environment, producers and the society still faces some obstacles such as the right mindset and regulations regarding new products. The knowledge and demand needs to be increased first to be able to influence the market and the society. This should however not be a problem since controversial products such as sushi, shrimps and sugar has been implemented on the Swedish market before. It would therefore be good for the environment if we could see both insects and algae on the menu at Swedish restaurants and in the stores in the near future.
Thanks to

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Annex

Annex I - References to figures in table 2 and table 3

Nijdam et al (2009) has made a study where they compare different LCA studies for different food. They however make sure to transform all functional units to the same, kilogram of boneless retail meat. The studies are not a full LCA but from a cradle to farm gate. They added an emission of 0.2 kg CO₂ / kg meat for the slaughterhouse and 0.1 kg CO₂ / kg meat for the transport. The studies used in the report has described their production system and method in detail. By analysing all the LCA they come up with an interval which can be seen in Table 2 and Table 3.

In Naturvårdsverket (2013) the functional unit is one kilo slaughter weight of Swedish beef, pork and chicken. It is also compared with the environmental impact of boiled legumes with the functional unit 0.9-1 kg boiled legumes. It does not take land use into account, but the transports from the farm to the store are included.

In Cederberg & Nilsson (2004) the functional unit used is one kilo of bone free beef produced at a Swedish ranch. The report analyses the environmental impact in terms of energy use, resources, land use, pesticides, contribution to climate change, over fertilization and acidification. Transport, slaughtering process, distribution and other environmental effects caused after the production are not included in the system boundaries.

In Smetana et al (2015) the system boundaries are from “cradle-to-plate” and the functional unit is 1 kg of ready-to-eat meal. In this report Danish chicken is compared with different kinds of substitutes; dairy based, insect based, mycoprotein based, gluten based and lab grown meat. The environmental aspects included are climate change, human toxicity, eco toxicity, ozone layer depletion, acidification, land occupation, metal and fossil fuel depletion.

Dalgaard et al (2008) is a study of the production of soybeans in Argentina. The system boundaries include the area from Argentina to the Rotterdam harbour in the Netherlands with transport, emissions to water and air and the resource use. The functional unit used in the study was 1 kg of soybean meal.

In Taelman & Sfez (2015) a LCA is made about the resource footprint when producing seaweed. The functional unit is per 1 MJₜₑₓ seaweed biomass, which means that the consumption of natural resources is calculated in terms of their exergy content in the production of seaweed. It is also compared with the exergy content consumed when producing terrestrial plants. The study includes the life cycle from cradle-to-gate. That includes everything in the process from the hatchery to the phase when the seaweed grows out at sea.

Annex II - Interview guide

Inledning och bakgrund till studien / Introduction and background to the report
- Presentera oss själva / Introduce our selves
- Syftet med studien / The purpose with the study
- Tydliggöra vilka produkter det handlar om / Clarify which products it regard
- Urvalet (från en tidigarestudie) / Selection (from previous study)
- Tillåtet att spela in intervjun? / Allowed to record the interview?
- Frågor, Synpunkter? / Questions, comments?

Bakgrund hos intervjupersonen och företaget / The background of the interviewed person and the company
- Skulle du vilja börja med att presentera dig själv och berätta vad du jobbar med på företaget? / Would you like to introduce yourself and tell us what you work within the company
- Vad är unikt med era produkter i jämförelse med de andra vegetariska alternativen? / What is unique with your products in comparison to other vegetarian options?
- Vad är målet med er verksamhet? / What is the goal with your operation?
- Varför startades företaget? / Why was the company founded?

Hur ser det ut nu? / What does it look like now?
- Vad består era produkter huvudsakligen av? Varför har ni valt detta? / What does your product mostly contain of?
- Vad är målet med era produkter / What is the goal with your products?

Utvecklingen / The development
- Har variationer på produkter ändrats med tiden? Hur och varför? / Have variations on products changed over time? How and why?

Framtiden / The future
- Tror ni utbudet kommer att ändras? / Do you think the assortment is going to change?
- Det har prata som mycket om att eventuellt använda svampar, alger eller insekter, skulle ni kunna tänka er att producera alternativ med dessa ingredienser? / There has been a discussion about using fungal mycelium, algae or insects, could you imagine working with these ingredients?
- Ser du några möjligheter med dess produkter eller hinder? / Do you see any possibilities or obstacles with these products?
- Vad tror du att samhället kommer vilja ha? / What do you think the society wants?

Avslutning / Ending
- Finns det någon ni skulle vilja ta upp, utveckla eller kommentera? / Is there anything you would like to bring up, develop or comment?
- Tack för medverkan / Thanks for the participation
- Vill IP ta del av resultatet? / Would IP like to take part in the result?
- Be IP kontakta oss om denne skulle vilja tillägga något eller har några andra frågor kring studien? / Ask IP to contact us if he/she would like to add something or has any other questions regarding the study?