Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences

**Faculty of landscape Planning,
Horticulture and Agriculture Science**

Potential to replace part of the current meat consumption in Sweden with locally produced faba beans

– Effects on land use and food system sustainability

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Potential to replace part of the current meat consumption in Sweden with locally produced faba beans – Effects on land use and food system sustainability

Möjligheter att ersätta delar av den svenska köttkonsumtionen med lokalt producerad åkerböna – Effekter på landutnyttjande och livsmedelsproduktionens hållbarhet

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Foreword

Coming from a developing Country, Cameroon and growing up in a rural area which depended mostly on subsistence farming with minimal chemical inputs, it was fixed in my mind how bad chemicals used in agriculture were to the human body and to the soil due to the beliefs of the poor farmers. But I was always worried why people will labor much and get little in return. Of recent years, the worry matured to what could be done to improve on the living standard of rural poor who mostly depended on agriculture. Then the program Agroecology was launched in 2010 at the Swedish University of Agricultural Sciences Alnarp, which I saw as a wonderful opportunity to help solve some of the worries of my mind.

During the course of the program, I came to learn how useful some of the indigenous practices were but also learnt what many rural farmers were not taking seriously such the replenishment of soil nutrients which was mostly allowed for nature to take care of. I also came to understand that no farming practice is considered the best and a farming system is a community within an environment and should be looked upon in the context in which it is involved.

The program did not only teach me how to improve on soil conditions or farmer´s economy but also the importance of taking care of the ecosystem on which agriculture and humanity depends.

It changed me as a person because with my natural science background, I was used to dealing with facts and drawing conclusions from those facts but with the holistic approach or systems thinking gained from the program I now handle situations differently and look at life in a different way. If the saying that "As a man thinks, so is he" is true, then I will proudly say the agroecology masters' program changed me as a person because it changed my way of thinking.

Pamela Konfor,

May, 2013.

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ABSTRACT

This paper presents an investigation of how replacing part of the current meat consumption in Sweden with locally produced faba beans would influence land use and the sustainability of the food system, combined with a study of consumers´ attitude towards faba beans as a food legume. A thorough literature review about meat, land use and food system sustainability was carried out. The amount of meat to be replaced by faba bean was deduced from the difference between 2009 consumption data and the health-based recommended daily intake of 126 g meat per capita in total and red meat intake of 60g per capita per day. This suggested decrease in meat consumption corresponded to a replacement of 25% of the protein derived from meat with protein derived from faba beans. The calculated reduction in meat consumption corresponded to all meat derived from suckler beef production and 30% of the pork meat consumed in 2009. A taste survey using structured questionnaires was also carried out to determine consumers´ attitude towards faba bean grains as food. Results showed that 437 883 hectares of land would be saved by the suggested replacement, with meat coming from all beef of suckler production constituting 43.8% of replaced meat and the rest (56.2%) coming from pork. It also showed an effect of reduced global warming and pollution as well as benefits for cropping system sustainability and health. In addition, growing and consuming more faba bean has potential economic benefits to both consumers and some farmers. The survey indicated that Swedish consumers accept faba bean as food. Although replacing 25% of meat consumed in Sweden with faba bean will be difficult in the short term, it may be quite feasible in the long run. Replacing some of the meat consumed with locally produced legumes would according to this study not only benefit health and the environment but also increase the sustainability of the entire food system with a large land saving effect.

Key words: Meat, faba beans, replacement**,** protein**,** land use, Sustainability, health, environment, consumers´ attitude.

Table of contents

List of tables

List of figures

1.0. INTRODUCTION

Increasing global population puts a high demand for food and increasing world's economy has led to an increase in living standard and also increase in global consumption of protein-rich diets, mainly of animal origin. Proteins are essential macromolecules, used for repair, regulation and protection as they build and repair body tissues. Proteins control body processes such as water balancing, nutrient transport and muscle contraction; help protect most other essential nutrients; keep skin, nails and hair healthy; they are an important source of energy and make up enzymes, hormones, and many immune molecules (Lloyd, 2011). Meat, fish, tofu, legumes, eggs, nuts, seeds, milk and milk products are rich sources of protein (Centers for Diseases Control and Prevention, 2012). Meat is a source of high quality protein with available iron, zinc, all B-vitamins except folic acid and all essential amino acids (Speedy, 2003). Globally, per capita meat consumption has more than doubled during the past half century even with the increase in world population and so, the demand for meat has greatly increased up to five folds during the same period (World Watch Institute, 2004).

1.1.1. Land use and environmental impacts associated with meat consumption

Global production of meat and dairy products contribute to approximately 18% of greenhouse gas effects (more than all transportation in the world combined) and 8% of all water consumption (Steinfeld *et al,* 2006), and the production is of course driven by consumption or demand. The production of meat requires large land areas exemplified by the case of Netherlands, that each kg of meat requires averagely 20.9 m^2 of land for feed and other inputs (Gerbens-Leenes and Nonhebel, 2002). At global level, livestock production accounts for 70% of total agricultural land use with 33% of total arable land dedicated to feed crop production (Steinfelds *et al.*, 2006). Yet, animal products contributed only 17% of total calories in 2003 to global food supply (FAOSTAT, 2008). Also an average of 6 kg of plant proteins are required for the production of 1kg of meat which makes it resource inefficient (Aiking *et al.*, 2006; Pimentel and Pimentel, 2003) as 85% of plant protein is wasted in the conversion to animal protein (Aiking, 2011).

1.1.2. Health problems associated with meat consumption

Consumption of meat does not pose a serious health threat in developing countries, where the level of meat consumption varies with income (FAO, 1990) and is taken as a measure of the nutritional quality of a diet. On the other hand, in the industrialized countries where cheap food of all kinds is often available in excess, there is concern about the potential harmful effects of the high intake of saturated fats from animal food sources (FAO, 1992). Overconsumption of meat is believed to contribute to the rising prevalence of overweight and obesity which is clearly noticeable (European Commission, 2010, McMichael *et al*., 2007). Excessive meat consumption has also been associated with problems such as cardiovascular disease, hypertension, type 2 diabetes, stroke, muscular-skeletal disorders, and a range of mental health condition, (European Commission, 2007; Haslam and James, 2005) and cancer of the colorectum (World Cancer Research Fund, 2007). Coronary heart disease in industrialized countries, which is one of the major causes of death, is due to overconsumption of saturated fatty acid which is mainly supplied by meat fats (FAO, 1992).

1.1.3. Current situation

Worlds average meat consumption is at 47 kg per person per year, while in Sweden the annual consumption increased from 74 to 79 kg per capita between 2002- 2007 (ChartsBin Statistics Collector, 2010). Despite the negative effects of meat consumption on the environment and health, its unique place in diets due to its conventionally high social status (Beardsworth and Keil, 1997) and nutritional contribution cannot be undermined. Also, for the vast majority, animals are an important element in a sustainable agriculture through manure production, efficient utilization of crop by-products and the facts that ruminant animals can bring into productivity land which is too poor or difficult to cultivate while pigs and poultry can scavenge on feed inaccessible to humans and convert it to human food (Food Ethics Council, 2001). Furthermore, manure from livestock can be used for biogas production (a clean and renewable energy) and the residue from the biogas digester later used as organic fertilizer (SGBF *et al*., 2008).

Since meat has traditionally held a central position in western food culture (Meiselman, 2000) and still does, coupled with the above mentioned benefits of meat production, we cannot think of

its complete elimination from diets. However, some of the meat currently consumed especially in industrialized countries where its consumption is so high could be replaced with locally produced plant based food of high protein content such as legumes to reduce the environmental effects of meat consumption and associated health problems. The Food and Environmental agencies in Sweden have pointed out meat as a food item with high environmental impact and suggested a reduction in the Swedish meat consumption for health and environmental reasons (Cederberg *et al*, 2009b). A good substitute for meat in Sweden will be a locally produced legume such as faba bean due to its high protein content and the facts that the weather and soil favor its production.

1.2.1. History of Faba beans

Photo: Pamela Yah Konfor

Fig 1. Faba bean grains

Faba bean (*Vicia faba minor*) is a small seeded relative of the Chinese broad bean (*V. faba major*), an annual leguminous plant and its origin dated back to 6250 BC in Jericho (Risula, 2008). In Europe, faba bean is primarily grown as feed for livestock with Great Britain being the largest European producer, producing both winter and spring types (Ibid). Faba bean grows best under cool moist conditions, and middle textured soils are ideal for its production since it requires a good moisture supply for optimum yield (Ophinger *et al*, 1989). The total grain production of faba bean has doubled during the last 50 years but the area of its cultivation has declined during the same period (Jensen *et al.*, 2010). It is grown globally as of 2006 on an area

of 2.6 million hectares with China being the dominating producer (FAOSTAT, 2008). In the Mediterranean region, it is a cheap source of good quality protein to complement the cereal dominated diets (Saxena, 1991). Small seeded faba beans (*V. faba minor*) are mostly favored for human consumption in North Africa and the Arabic world and also used as animal feed. However, in western diets the large seeded genotypes (*V. faba major* or broad beans) are consumed by humans mainly as green vegetables and the small seeded fed to livestock (Köpke and Nemacek, 2009) even though European small seeded varieties have protein content of approximately 30% which fits both the food and feed markets (Duc *et al*, 2011).

In Sweden as in other Northern European countries, faba bean is primarily spring-sown in cropping systems involving cereals, oilseed rape (*Brassica napus*) and sugar beets (Jensen *et al*, 2010). Long crop rotations are recommended with at least 4-5 years of non-legume crops (Slinkard *et al*, 1994) due to different fungal diseases attacking roots or above- ground tissues of faba bean as well as some cool season legumes (Jensen et al, 2010).

1.2.2. Nutrient content of faba beans

Table 1. Nutrient composition of faba bean seed (per cent). Source: Burridge (1999)

Protein	24-30
Total starch (dry basis)	35-39
Cystine acid	0.25-0.31
Lysine	1.48-1.61
Methionine	0.17-0.19

Table 2. Nutrient composition of milled and polished faba bean for human consumption per 100g edible portion of edible dried whole seed. Source: Summerfried (1988).

Protein	25g
Oil	1.2g
Crude fiber	5.1g
Starch	51%
Sugars	5%
Iron	4.2g
Thiamin	0.45mg
Riboflavin	0.19mg
Niacin	2.4mg
Energy	328kCal

Table 3. Protein content of Swedish faba beans varieties. 2007 - 2010 results. Source: Larsson and Hagman (2011)

Variety	Tannin-free/with tannin	Protein content (%)
Paloma	tannin-free	28.8
Columbo	tannin-free	28.3
Marcel	with tannin	29.6
Tatoo	tannin-free	28.6
Fuego	with tannin	28.2
Alexia	with tannin	31.2
Gracia	with tannin	29.9
Ben	with tannin	29.2
Julia	with tannin	31.7
Imposa	Tannin-free	29.8
Nile	with tannin	28.4
Granit	with tannin	29.5

Faba bean possesses physico-chemical properties similar to those of soy beans, with similar protein quality except for the contents of the amino acids tryptophan, methionine and cysteine which are lower in faba bean (Arogundade *et al*, 2006). Faba bean also has very low lipid content of 1.5% compared to 21% of soybean (Whittaker and Tannenbaum, 1977) and fewer anti-nutritional and flatulence factors than soy beans (Olsen, 1978) which is well known for its protein quality.

1.2.3. Faba beans and nitrogen fixation

Faba bean like all cultivated legumes does not require N- fertilizer in its production as its nitrogen is supplied from root nodules in which the bacteria *Rhizobium leguminosarum* converts atmospheric nitrogen (N_2) into a form usable by the plant (Wright, 2008). The nitrogen fixation reaction is catalyzed by the enzyme nitrogenase though faba bean initially depends on seed nitrogen until root nodules are formed (Jensen *et al.*, 2010). Faba bean can fix an estimate of 150-200 kg/ha most of which is removed in the grains of the crop (Fisher, 1996). Up to 40% of the fixed nitrogen may remain in the soil and be available for the subsequent crop (Mathews and Marcellos, 2003).

1.3.0. Objectives and research question

1.3.1. Objectives

Since the ongoing dietary changes cause rapidly increasing claims on the available agricultural land (Gerbens-Leenes and Nonhebel, 2002), there is an urgent need to seek convincing alternatives to excessive meat consumption. This study aims to:

-Investigate what effects will be on land use and the sustainability of the food system if part of the meat that is currently consumed in Sweden is replaced by a locally produced legume such as faba bean.

-Find out consumers´ attitude towards faba bean as a food legume since a replacement is impossible if the consumers are not involved or willing.

1.3.2. Research question

The main research question is: **What are the effects of replacing part of the current meat consumption in Sweden with locally produced faba beans on land use and the food system sustainability?**

To answer this question, it is split into sub research questions (1-5) and a sixth sub research question which tries to find out if this replacement is feasible from the consumers´ point of view.

Sub research questions

1. How much land is used for the current meat consumption in Sweden?
2. How much meat and what amount of each type should be replaced with the legume faba bean?
3. What quantity of faba bean is needed for this replacement?
4. What is the effect of this replacement on land use?
5. What is the effect of this replacement on food system sustainability?
6. Is the Swedish population ready for this change in dietary pattern?

2.0. MATERIAL AND METHODS

Since "Research methods are valid if they are successful in eliciting true responses relevant to the information desired" (Taylor, 2005 p.5), different methods were used to answer the different sub-research questions in this study. Mostly secondary analysis of data was undertaken based on available statistics (Davies, 2007) coupled with a taste survey of faba beans as human food.

2.1. Land needed for the current meat consumption

To answer research question 1, "How much land is used for the current consumption of meat in Sweden?" the total land requirement for meat consumed in Sweden was determined by the specific land requirements of every category of meat and the amount consumed from both locally produced and import. Results from a study on sustainable meat consumption in relation to land use from a Swedish perspective were used as the basis for calculations (Hallström *et al.*, 2013). That study used 2009 statistics of different sources of beef, pork and chicken consumed in Sweden combined with data on land requirements for feed production and feed intake for different animals (Cederberg *et al*., 2009a) to calculate land use per kg bone-free meat for the major categories of domestic and imported meat consumed in Sweden (beef from milk production, beef from suckler production, pork, chicken). Data on consumption rate for each meat category (g meat per capita per day) and their corresponding land requirements (m^2/kg) from Hallström *et al.* (2013) together with the 2009 Swedish population of 9.2 million persons (Statistics Sweden, 2009) were used to calculate the total land used for the production of each category of meat currently consumed in Sweden. The results of this calculation are presented in Table 5. Since the results obtained by Hallström et al. (2013) used for this calculation are presented in a manuscript submitted for publication in a scientific journal they cannot be reproduced in this thesis.

2.2. Amount of each meat type to be replaced

In order to answer research question 2, "How much meat and what amount of each type should be replaced with the legume faba bean?" the reference (REF) scenario and NUTR-1 scenario of Hallström *et al*. (2013) were used. REF scenario was the current meat consumption in Sweden using 2009 data and NUTR-1 scenario was based on prevailing dietary guidelines: a recommended upper limit of 126g uncooked pure, bone-free meat per capita and day stated by the Swedish dietary guideline Enghardt and Lindvall, (2003); and a recommended upper limit of 60g red meat per capita and day stated by the World Cancer Research Fund (2007). Results from Hallström *et al*, (2013) showed that a reduction of 25% of the current meat consumption in Sweden (169g per capita and day) was required to meet the recommended intake.

The scope of this study was therefore to replace 25% of the meat currently consumed in Sweden with locally produced faba bean. To determine how much of each type of meat was to be replaced, the following steps were taken:

-Meat to be replaced was first restricted to beef since beef production has the highest demand for land compared to pork and chicken (de Vries and de Boer, 2010) and so logical from a land use perspective that is the focus of this paper.

-Beef replaced came from suckler production (cows and offspring). Meat from milk production systems were maintained due to its dietary importance and because environmental effects could be shared between milk and meat, making the environmental impact smaller for meat from combined meat and milk production than from suckler beef production. The amount of beef from suckler production (domestic and imported) consumed in Sweden was calculated from data in Hallström et al. (2013).

-When the beef from suckler production was insufficient for the replacement, pork was replaced to try to get closer to the recommended upper limit of 60g red meat consumption per capita per day of the (World Cancer Research Fund, 2007).

-Since land use per kg pork consumed in Sweden is the same both for locally produced and import as in Hallström *et al*, (2013) replaced pork was not specified to be import or locally produced in order not to interfere with free trade. The amount of replaced pork was simply

calculated from the difference between total meat to be replaced and the amount of suckler beef to be replaced. Results from these calculations are presented in Table 6.

2.3. Quantity of faba beans needed for the replacement

To answer research question 3, "What quantity of faba beans is needed for the replacement?" the protein content of the replaced meat was used to get its equivalent protein in faba bean. Although there are different nutrient contributions from the consumption of meat such as energy, fats, protein, iron and zinc, this study used protein content, which is high in both meat and faba bean, as the basis for calculating how much faba bean was required to replace the 25% meat. Protein content was also a choice for replacement because protein is often used as an indicator of food security and when the protein supply is sufficient, the food supply is often also said to be sufficient since protein can also supply energy (Davis et al, 2009). The protein contents of beef, pork and faba bean given in Table 4 were used for the calculation since they all came from the same report.

Table 4**.** Protein content of selected food. Re-drawn from González et al (2011)

Selected food	**Protein content (g /kg)**
Beef	206
Pork	206
Faba bean	261

Since the protein contents of beef and pork are the same (Table 4), the amount of meat protein (g per capita and day) to be replaced is: (total meat replaced) *206/1000. Knowing the protein content of the replaced meat, the amount of faba beans needed to provide the same amount of protein was calculated using the protein content of faba beans as follows:(Total protein from replaced meat)*1000/261 and result given in g faba bean per capita per day.

2.4. Effect of the replacement on land use

To answer research question four "What is the effect of this replacement on land use?" this assumption was made before proceeding.

-The area currently used to produce faba bean as feed is not affected by this study (since, not all meat is to be replaced and if there is any faba bean feed excess in relation to what is currently being used, it will go to replace part of the soy that is imported) as there is potential for more faba bean production in Sweden (Gustafsson *et al.*, 2013).

The land used for the replaced meat was calculated from each replaced meat category's relative proportions and their corresponding land use from data in Hallström et al. (2013), as stated in section 2.1. The population of Sweden used for converting from per capita unit to total population was 9.2 million, the approximate population of Sweden in 2009 (Statistics Sweden, 2009) during which the data that form the basis for this study were obtained (Hallström *et al*., 2013). The land needed to cultivate the equivalent amount of faba bean to replace meat was calculated from Sweden´s faba bean average yield of 3.0 tons per hectare obtained from Gustafsson *et al.* (2013).

The land saved by such a replacement was obtained from the difference between the land used for replaced meat and the land needed for its equivalent faba bean production with respect to protein content.

2.5. Effects of the replacement on the food system sustainability

To answer sub-research question 5, factors related to sustainability affected by the replacement of meat with locally produced faba beans were investigated by a literature review, listed in section 3 and further discussed in section 4.

2.6.0. Testing the study outcome

To answer research question 6 "Is the Swedish population ready for this change of including faba beans in their menu?" a taste survey was carried out which is one of the two methodological approaches of a quantitative research (Davies, 2007). A sample of the population was studied

from which claims of the population were made (Creswell, 2009) after obtaining information through questionnaires which was analyzed, patterns extracted and comparisons made (Bell, 1999). The questionnaire was intended to find out if the population was aware of faba beans as food, if they liked the taste, if they could consider having it as a main dish prepared without meat and how often and if they preferred it as a side dish with a reduced meat portion and how often. See questionnaire in appendix I.

The sample population was lunchers at the SLU campus restaurant at Alnarp. Faba bean grains were prepared on four different days (9^{th} – 12^{th} April) using different recipes and served as a side menu close to salad table at the restaurants, and introduced to as many customers as possible who visited the restaurant on those days. Before the survey dates, information was circulated by email to all registered at SLU Alnarp inviting them to be part of the study and briefly explaining the purpose. Those who included faba bean in their meal were given a prepared questionnaire as they were served the taste portion and asked to fill in their answers as they savored their meal. To follow research ethics which says all participants have right (Bell 1999), they were all informed they were being studied and the reason. The quantity of faba bean served per person was the amount needed per capita per day to replace 25% of meat consumed in Sweden (33.3g dry weight and approximately 70g cooked weight with ingredients). In total, 154 questionnaires were given out on four different days; 40 on each of the first three days and 34 on the fourth day. Different recipes were prepared on the four days, three of which came from the chefs of the SLU Alnarp campus restaurant and the fourth from a graduate of Agroecology, Nawa Raj Djamala (faba beans curry, a Nepalese recipe). The different recipes are described in appendix II.

Below is a plan that provides a descriptive analysis of data for all variables and how results will be presented from which conclusions would be drawn.

2.6.1. Percentage respondents and non-respondents

Data analysis and presentation of results from the survey started with information on the members of the sample who did and did not return the questionnaire and this was presented as percentage respondents and non-respondents (Creswell, 2009) on a pie chart. Response bias which is the effect of non-responses on a survey estimate (Fowler, 2002) is discussed in section 4.4.1.

2.6.2. Faba beans known or not known as food for humans

The number of people who knew or did not know faba beans as human food was counted from the questionnaires, recorded on an excel sheet and presented on a column chart as percentages of the sample that knew (yes) or did not know (no) faba beans as human food on the different dates the survey was carried out.

2.6.3. Response to the taste of the different faba bean recipes

The data was treated in the same way as in 2.6.2 above and presented as percentage of the sample population that liked or disliked the different faba beans recipes.

2.6.4. Considering faba beans as a main dish without meat

The data was treated as in 2.6.2 and presented as percentage of the sample population that considered or did not consider faba bean as a main dish for the different recipes.

2.6.5. Frequency of eating faba beans as a main dish

The data was treated as in 2.6.2 above and presented as percentage of participants and the frequency at which they could have the different recipes as a main dish.

2.6.6. Considering faba beans as a side dish

The data was treated and presented in the same way as in 3.6.4.

2.6.7. Frequency of having faba beans as a side dish

The data was treated and presented in the same way as in 3.6.5.

2.6.8. Validity of the survey and conclusions drawn

Validity of the survey was checked by looking if the items measured the content they were intended to measure as mentioned in section 2.6.0 which is content validity (Creswell, 2009) and conclusions were drawn from the findings making claims for the total population.

3.0. RESULTS

3.1. Land used for current meat consumption in Sweden

Table 5. Land used (hectares) for producing different meat types consumed in Sweden as of 2009, calculated from data on per-capita meat consumption and land requirement for the production of each meat type (Hallström *et al*, 2013)

Beef	Pork	Chicken	**Total**
760 419	265 282	94 024	**1, 119 725**

Land used for meat consumption from Swedish meat production is **560 114 hectares**.

3.2. Amount of meat that needs to be replaced

Table 6. Meat to be replaced (g/capita and day) in order to meet the upper limits of 126g total meat per capita and day recommended by the Swedish dietary guideline (Enghardt and Lindvall, 2003).

Beef	Pork	Chicken	total
18.5	23.75	0	42.25

43, 8 % of total replaced meat is from beef, **52, 2%** from pork and **0%** from chicken.

3.3. Amount of faba beans needed to replace meat

Table 7. Meat to be replaced and faba bean needed to obtain the corresponding protein supply

Meat (g/capita and day).	**Faba beans (g dry beans/capita and day).**
42.25	**33.3**

Amount of faba beans with equal protein amount as in replaced meat is **33.3g dry faba bean/ capita and day**

3.4. Amount of land saved by the replacement

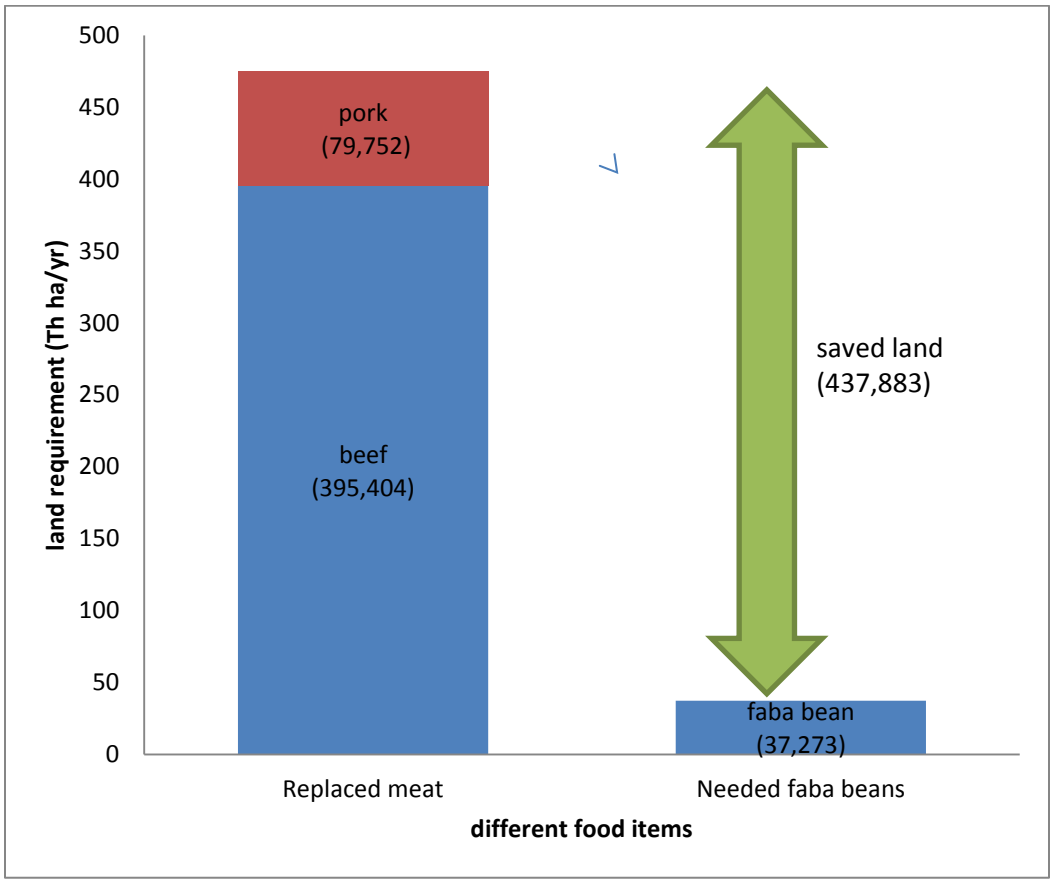

Fig.2 Land saving obtained by replacing 25% of Swedish meat consumption with locally produced faba beans.

3.5. Effects on the sustainability of the food system

- **Reduced climate change effect**: Replacing 25% of meat consumed in Sweden with faba bean will have a reduced global warming effect. A dietary change away from animal protein towards plant proteins is a viable solution to reduce climate change and has the ability to reduce emissions quickly and inexpensively (Eshel and Martin, 2006)
- **Reduced pollution:** Switching from a meat-based diet to a plant-based diet lowers pollution (Caitlin, 2012). Thus a 25% meat switch to faba beans will have a reduced pollution effect.

- **Benefits to the cropping system:** A replacement of 25% meat with faba bean will mean more production of faba beans, a grain legume that will diversify the cropping system and does not require nitrogen fertilization.
- **Reduced health problems and associated deaths**: According to the World Health Organization, 63% of deaths globally in 2008 were due to chronic non-communicable diseases and conditions (certain cancers, obesity, cardiovascular disease, diabetes type 2). The regional or national rate of these type of diseases are considerably lower in regions where plant-based diets are more common compared to regions where animal – based diets are prevalent (Nordqvist, 2012). A replacement of 25% meat with faba bean will therefore reduce these health problems and associated deaths.
- **Reduced demand for water**. The animals raised for meat, of all human food, places the highest demand for fresh water and a reduction in meat consumption is thus an easy way to reduce demand for water (World Watch Institute, 2004).
- **Economic benefit:** Many people save money by adding meatless meals to their weekly menus (Mayo Clinic Staff, 2011). Replacing 25% meat with faba beans will be one way of achieving healthy savings as meat is often more expensive than beans.
- **Improved health**: Plant-based diet contribute to longevity and good health as they are protective due to the high fiber and antioxidant contents and low saturated fats (Lambert, 2013). Replacing 25% meat with faba bean (a plant-based diet) will improve the health conditions of individuals and contribute to longevity.
- **Contribution to food security**: A meat based diet requires more energy, land and water resources than a plant-based diet (Pimentel and Pimentel, 2003). Replacing 25% meat with faba beans will contribute to global food security due to a reduced conversion of grains to animal feed, in addition to using some of the saved resources for more food production.

3.6.0. Outcome of taste survey

3.6.1. Response to survey

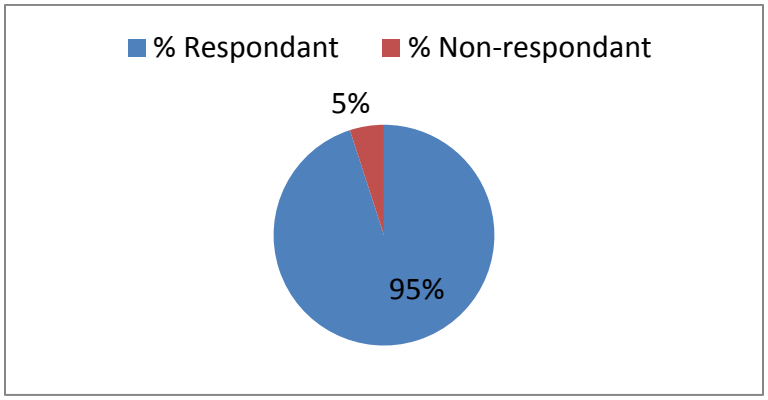

Fig. 3. Percentage response and non-response to the survey

3.6.2. Awareness of faba beans as food for humans

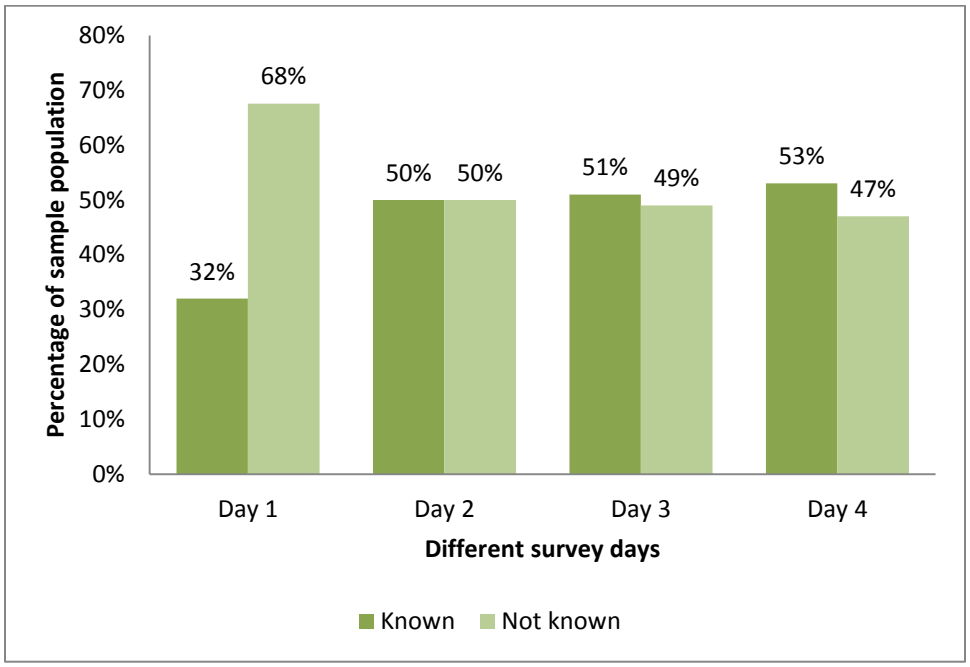

Fig. 4. Percentage of respondents who knew and did not know faba beans as human food.

There is an increasing trend in awareness of faba bean as human food with survey days.

3.6.3. Response to taste for the different recipes

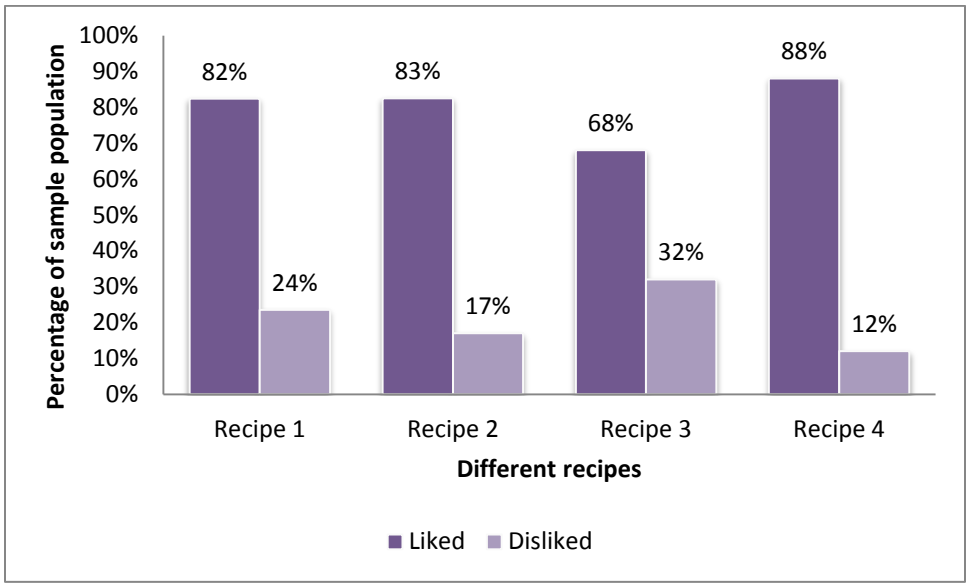

Fig. 5. Percentage of those who liked and did not like the different faba bean recipes

A high percentage of participants liked the taste of faba bean (75% on average).

3.6.4. Considering faba beans as a main dish without meat

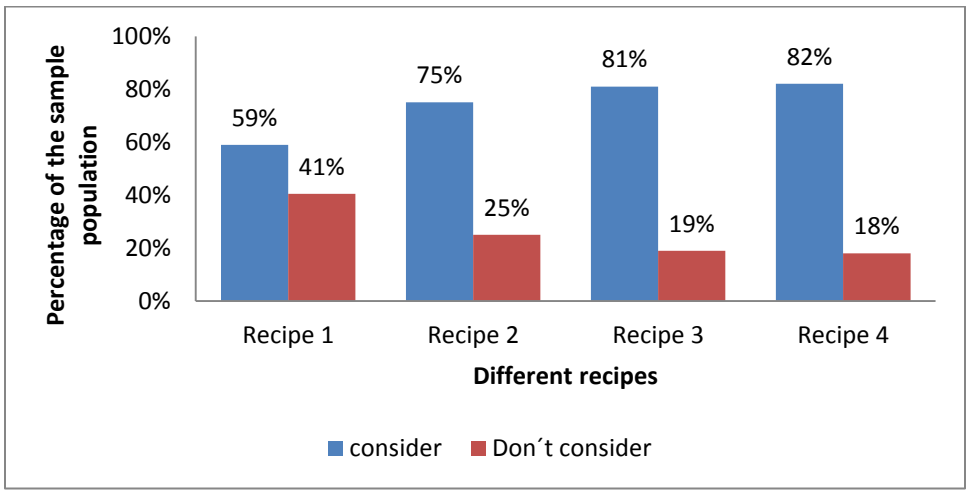

Fig 6. Percentage of respondents that considered and did not consider different faba bean recipes as a main dish.

There is an increasing trend with days in participants who considered faba bean as a main dish.

3.6.5. The frequency at which respondents would consider faba beans as a main dish

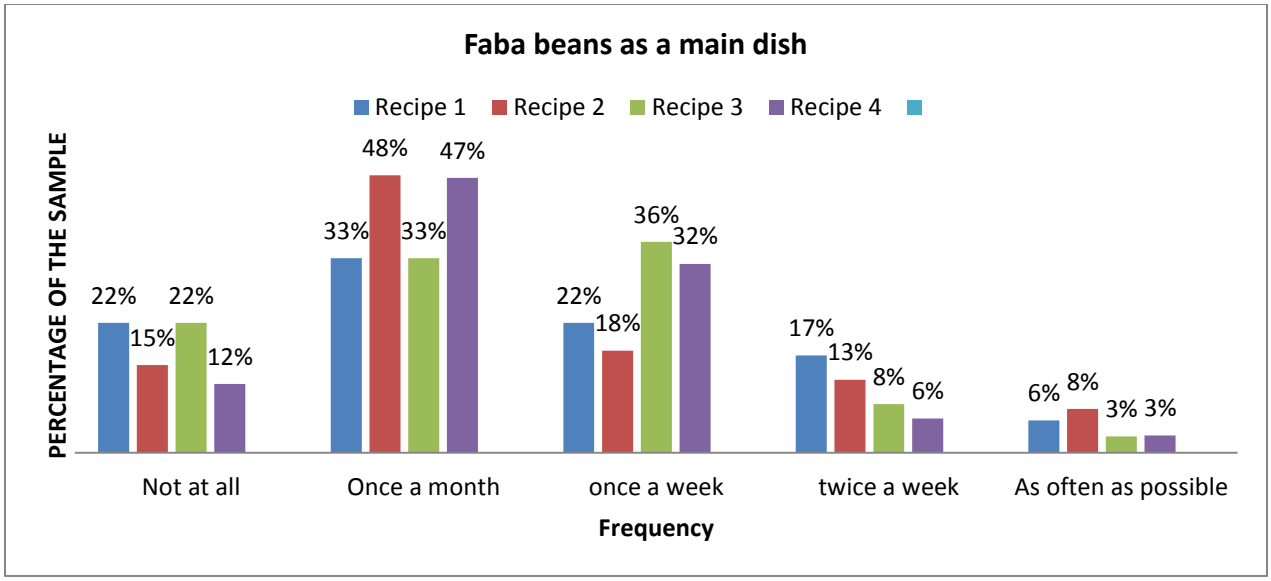

Fig 7. Frequencies at which respondents thought they could have the different recipes of faba beans as a main dish**.**

In average, a majority (40%) want faba beans once a month and a decline in the proportion of participants wanting faba beans up to twice a week with survey days. Those who want it as often as possible are slightly more for the first two days than the later days.

3.6.6. Faba beans as a side dish with reduced meat portion

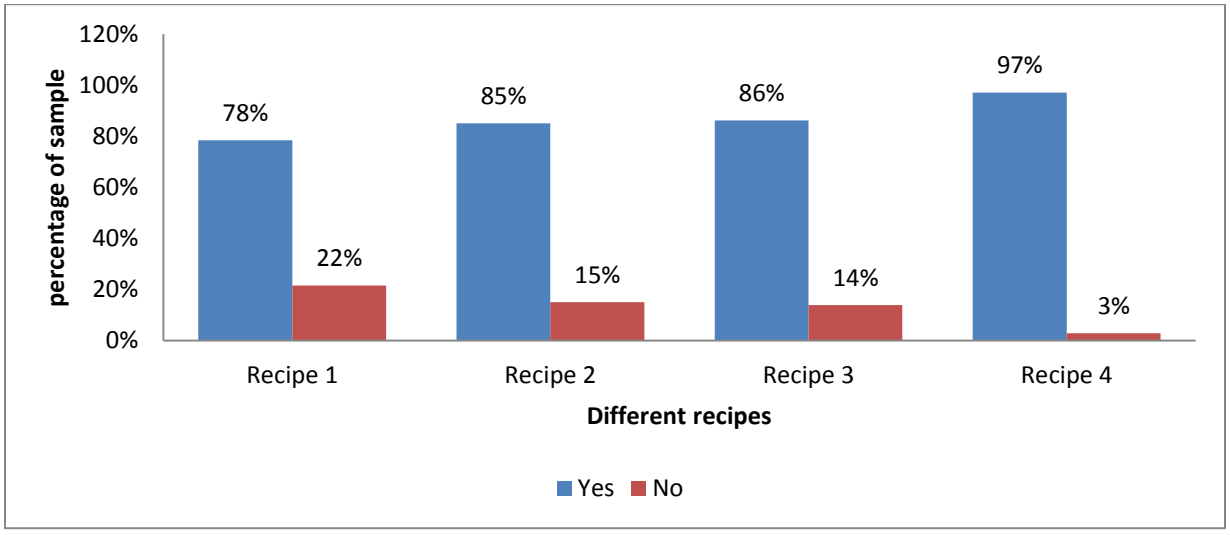

Fig 8. Percentage of respondents who considered having or not having the different recipes of faba beans as a side dish

There is an increasing trend in the proportion of participants with time of those who considered faba beans as a side dish with a reduced meat portion

3.6.7. Frequency of having faba beans as a side dish

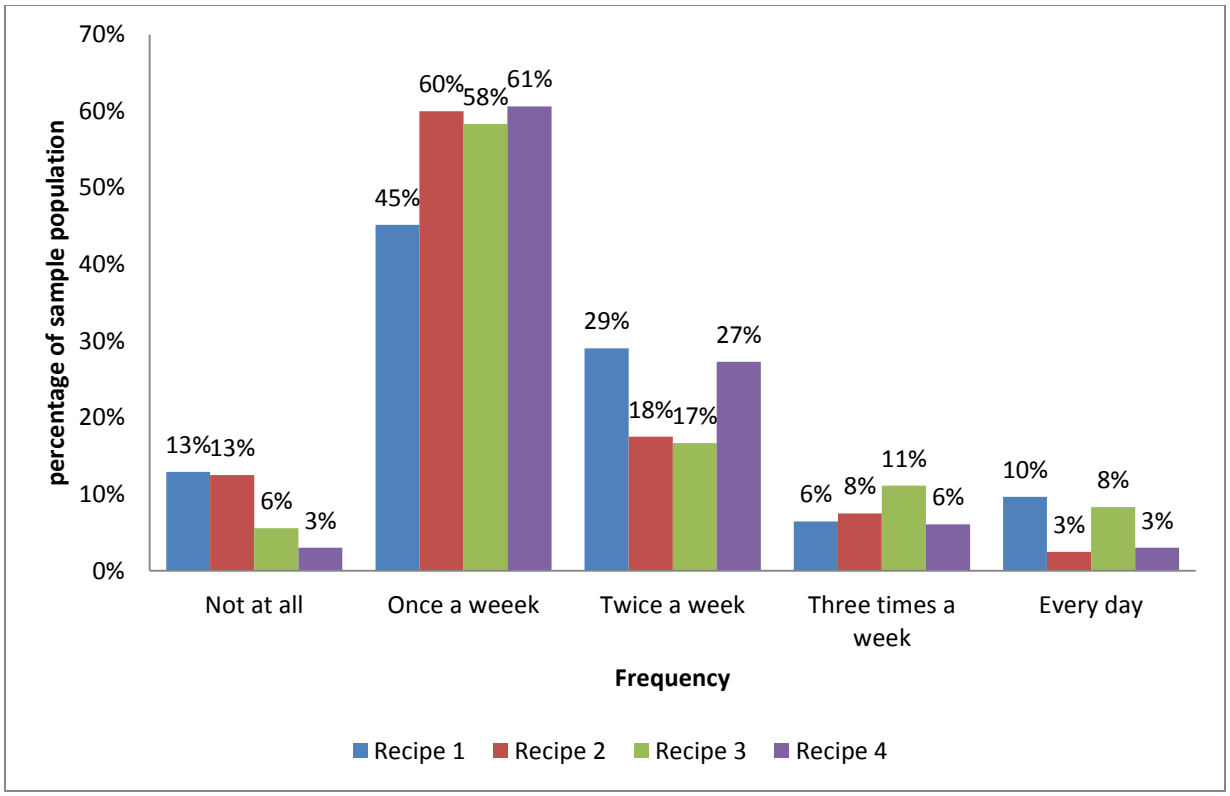

Fig 9. Percentages and frequencies respondents thought they could have the different recipes of faba beans as a side dish.

Only 6% of participants want faba beans as a side dish every day and the majority (56%) wants it once a week.

4.0. DISCUSSION

When evaluating effects of replacing part of the current meat consumption in Sweden with locally produced faba beans on the sustainability of the food system it will be good to start with the definition of the term sustainability or sustainable development. The Brundtland Commission of the United Nations (1987) defines sustainable development as a "development that meets the needs of the present without compromising the ability of the future generation to meet their own needs." Sustainability involves three main aspects as illustrated in figure 9 below.

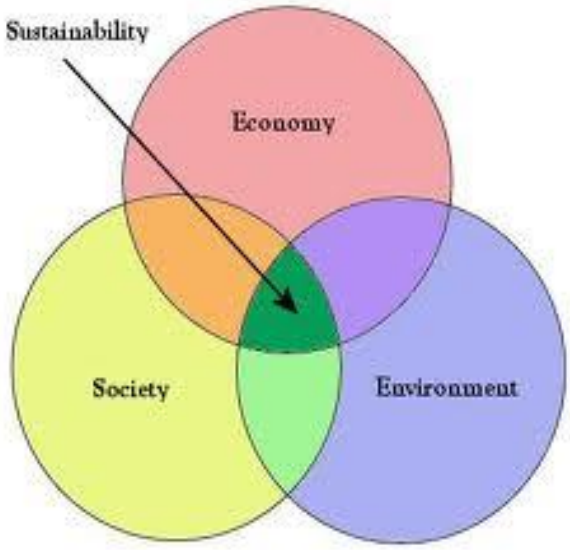

Fig. 10 .Sustainability Venn diagram

http://newyork.thecityatlas.org/lifestyle/urban-sustainability-not-just-green-technology/attachment/sustainability-venn-diagram/

In line with the above definition of sustainable development, the American Public Health Association (APHA) define a sustainable food system as "one that provides healthy food to meet current food needs while maintaining healthy ecosystems that can also provide food for generations to come with minimal negative impact to the environment." It also encourages local production and distribution infrastructures and makes nutritious food available, accessible, and affordable to all (APHA, 2007).

4.1.0. Environmental effects

4.1.1. Effects on land use

The area of land used for the current consumption of meat in Sweden is so huge (**1, 119 725 hectares)**; more than a third of the total Swedish agricultural land (World Bank 2010). Only about half of the land used for producing the meat currently consumed in Sweden is Swedish land (**560 114 hectares)**. Nevertheless, whether Swedish land or not, the current meat consumption in Sweden is putting enormous pressure on land use in the world which is already close to its boundary of sustainability (Rockstöm *et al*., 2009). In reality, more than this amount of land is used as data used to calculate the land requirement for the current Swedish meat consumption in this study did not include sheep and lamb, which is the fourth largest meat type consumed in Sweden. The number of slaughtered sheep and lamb in Sweden is increasing and was at 225, 000 animals in 2010, with per capita consumption at 1,4 kg per year and most of it is imported mainly from New Zealand and other EU countries (Lukkarinen and Jirskog, 2012).

Land use is considered unsustainable when remaining biodiversity values are low or there is loss of minerals and organic matter, erosion, salination and also when it involves direct or indirect deforestation (Blonk *et al.*, 2008). Swedish meat consumption does lead to unsustainable land use especially as it involves indirect deforestation of the South American rain forest for imported protein feed, with associated biodiversity loss.

A replacement of 25% of the meat consumed in Sweden with locally produced faba beans can save **437 883 hectares** of land, which is more than 1/3 the land used for the current consumption while maintaining the amount of protein consumed if all beef from suckler production is replaced and the rest comes from pork. In reality, more than this amount of land could be saved by this replacement because Swedish varieties of faba beans are higher in protein content with an average of 294 g protein/kg dry weight (table 3) compared to 261g/kg (table 4) used for the calculations and will therefore require less land to cultivate equivalent meat protein. Also, producing enough faba beans for the replacement is quite feasible since there is a large potential for increasing the area used for faba bean cultivation in Sweden. According to Gustafsson et al. (2013) there is a potential area of 150 000 hectares which can be allocated to faba bean and pea production in Sweden. This estimate is realistic since it takes into account that not all soils are appropriate for pea and faba bean crops, and that crop rotations need to be maintained with sufficient legume-free periods to avoid the build-up of soil-borne diseases. Assuming that the

potential land would be divided between the two crops at a 50/50 basis, faba beans can be produced on 75 000 hectares of Swedish land. As of 2010 faba bean was grown in Sweden on about 13,000 hectares (ibid) and since the cultivation of faba beans in Sweden has been increasing over the years and was at 15,860 hectares in 2011 (Sveriges Grisföretagare, 2011), we can estimate its production at 16,000 hectares as of now. These 16,000 hectares of faba beans cultivation is for animal feed and since this study is not interfering with that, it leaves a potential area of 59, 000 hectares for sustainable cultivation of faba bean for human consumption, quite above the calculated need of 37 273 ha for replacing 25% of the current meat consumption.

The choices of replaced meat (first suckler beef, second pork) and the basis for replacement (protein) in this study is not claimed to be the one best approach, as there are other interesting ways to base the calculations (i.e. replacing imported meat, using other nutritional content like iron or zinc as the basis for replacement). However, in order to keep the study within a realistic scope, one method had to be chosen and used consistently. Replacing suckler beef and partly the pork meat with faba bean based on protein content was considered a logical and straightforward method for this paper.

In addition to the effects on land use by replacing meat with faba bean, growing more faba bean has several benefits to the agricultural sector and other environmental aspects contributing to the sustainability of the food system.

4.1.2. Effects on the cropping system

Faba bean which is a grain legume with a high reliance on N_2 fixation for growth (Hauggaard-Nielsen et al., 2009, Lopez-Bellido et al., 2000) does not require nitrogen fertilization and when included in a crop rotation requires a reduced or no N- fertilization of the following crop as it can save up to 100-200 kg N ha^{-1} (Maidl *et al*., 1991). It has improved possibilities for using reduced tillage techniques and greater diversification of the crop rotation which helps to reduce weed and pathogen problems and also limit the application of pesticides (Nemecek et al, 2008). Temporal diversity is obtained by introducing faba bean in agroecosystems (Jensen et al, 2006) through planned biodiversity of crops and associated diversity of wild flora, fauna and soil microbes (Köpke and Nemecek, 2010. In addition to nitrogen fixation, faba beans can make phosphorus (P) more available in soils as it can acquire P from low P soils compared to cereals (Bolland et

al., 1999) and the mineralization of its P-rich crop residues improves the P availability for subsequent crops (Köpke and Nemecek, 2010). Faba bean like other legumes also improves the soil structure and carries over available soil water (Rochester et al., 2001) and is conducive to sequestrate carbon and build up soil organic carbon (SOC) over time due to the high nitrogen, phosphorus and sulfur contents of its residue (Jensen *et al.*, 2012). Intercropping of faba bean was previously common in Europe as in other parts of the world but according to Jensen *et al*, (2010), "fossilization" of agriculture with N-fertilizers, mechanization and pesticides has gradually eliminated intercrops of grain legumes and non-legumes in the industrialized countries" which Sweden is part of. However, faba bean intercropped with cereals could be an efficient weed management tool in cases where no herbicides are available or on organic farming systems where they are restricted (Hauggaard-Nielsen et al., 2008).

While increasing the cultivation of faba bean would have numerous benefits for arable cropping systems, some ecosystem services may also be lost due to the replacement of meat with faba bean, in particular, the production of ruminant feed from legume-grass leys and grasslands that provide several ecosystem services such as promotion of soil fertility, soil carbon sequestration and biodiversity. The suggested reduction in beef production would thus need to be compensated for by the development of alternative management and use of leys and grasslands in order to maintain these habitats and the valuable ecosystem services that they provide.

4.1.3. Effects on climate change

The reduced use of N- fertilizer in cropping systems with faba bean reduces the use of fossil fuel; a non-renewable resource which is almost at its peak and used for N- fertilizer production and transportation. It also reduces the production of nitrous oxide; a potent greenhouse gas which comes from N-fertilizer application. Though systems with faba beans also release nitrous oxide due to denitrification of nitrates in the root nodules (Smith and Smith, 1986), the amount is quite small compared to those of N-fertilized systems with mean values per growing season or year of 0.41kg N_2O-N ha^{-1} and 3.22kg N_2O-N ha^{-1} for faba beans and N-fertilized systems (including pasture) respectively (Jensen *et al*., 2012). Also CO_2 is emitted during nitrogen fixation in faba bean from respiration of the root nodules but it does not represent a net contribution of CO_2 concentrations in the atmosphere as it originated from photosynthesis (Ibid). The reduced use of

fossil fuel and reduced application of N-fertilizer from the cultivation of faba beans to replace meat both reduce the effect of climate change from food production. Furthermore, a reduction in meat consumption will lead to lower production and subsequently lower emissions of methane from rumination, slurry and farmyard manure; nitrous oxide from fertilizer, slurry and manure and CO_2 from the combustion of fossil fuel both directly and within the farm supply chain (Berners-Lee *et al*., 2012) which are all greenhouse gases and thus a further reduction in climate change. Reduction in meat consumption in Sweden also means a reduction in imported amount of protein feed since Europe depends mostly on imported feed protein concentrate of about 70% (Crepon, 2004) mainly soya from South America which is already putting much pressure on the remaining rain forest of that region of the world (Fearnside, 2008). Even though fossil fuel is also used in faba bean production for example in machineries, which will also contribute to CO_2 emissions, the amount required is incomparable to that of meat as it takes 2 calories of fossil fuel to produce 1 calorie of protein from soy beans, which I think faba beans will be close to, but up to 54 calories of fossil fuel to produce a calorie protein from beef (Robbins, 2011). These give in total an equivalent of 29 kg carbondioxide released for each kg beef produced, 8.2 kg for each kg pork and only 0.94kg CO_2 equivalent for each kg faba beans produced (Gonzalez *et al*., 2011).

4.1.4. **Effects on pollution**

Reduced meat consumption will also reduce pollution from livestock facilities and the associated harm to the human population in the vicinity as a Dutch report showed direct influence of emissions of pathogens in the human population living near industrial livestock units (Schmidinger, 2012). Also there will be reduced release of ammonia which would have contributed to acid rain and nitrogen deposition that damage crops and natural ecosystems (Gold, 2004). About 70-80% of dietary nitrogen fed to cattle and pigs end up in urine and may ooze out and contaminate water bodies because they can absorb only a limited proportion of nitrogen and phosphorus contained in their feed (Food Ethics Council, 2001). A reduction in the meat production due to reduced consumption will reduce the amounts of ammonia volatilization and harmful deposition and reduce the amounts of liquid slurry that may contaminate watercourses and waterways with excess nitrogen and phosphorus (Gold, 2004). Furthermore, it will reduce nitrate leaching from fertilizer application and also nitrogen run-off into surface water thus a reduced eutrophication effect.

Though much mineral soil N accumulate in autumns after faba bean which could leach during the winter from bare soils (Jensen et al., 2009) and pollute grown water, it could be controlled by planting autumn-established catch crops such as oil radish and white mustard and winter oil seed rape which recover almost all the soil mineral N (Maidl *et al*., 1991).

4.1.5. Water conserving effects

Livestock take a far heavier toll on water than food plants such as faba beans (Gold, 2004**)** as the animals themselves need water as well as the production of the feed. The replacement of 25% meat with faba bean therefore also leads to water conserving effects.

4.2. Economic effects

The cost of producing 1kg of faba beans is by far less than that of meat and though there is yield instability in faba beans (Jensen *et al.,* 2010), it is compensated for by the reduced cost on N-fertilizer as its production does not require nitrogen fertilization and can save up to 100-200 kg N ha^{-1} (Maidl *et al*., 1991) for the subsequent crop. Also the reduced use of inputs like pesticides reduces the farmers´ cost as faba bean in cropping systems diversifies the sequence thereby reducing the incidence of cereal pathogens and pests and changes the weed population (Jensen *et al*, 2012). From the consumer´s side, a kilogram faba beans, richer in protein content than meat as seen above in table 4 is cheaper than a kilogram meat and could be termed a "cheap source of rich protein". Since faba bean is free from saturated fats and cholesterol linked to many heart diseases, type 2 diabetes (European Commission, 2007) and cancer of the colorectum (World Cancer Research Fund, 2007) associated with meat consumption, some money that might have been needed to treat these diseases in the future could be saved for other uses which is economically beneficial to individuals, governments and society at large.

A farmer growing faba bean can save some money by introducing it to the cropping system and a consumer can equally save some money by a dietary change of replacing some of his daily meat intake with faba beans. However, one cannot conclude that the replacement is economically sustainable because it is difficult to predict what will happen to the saved land from the replacement and how it will affect the economy of farmers in different parts of the world who

have been using it for feed production or pasture. Also, reducing the meat consumption will also inevitably affect the economy of the meat industry negatively.

4.3. Social effects

4.3.1. Value in diets

The place of meat and legumes in a diet cannot be compared as meat has a very high value and occupies a central position in diets (Beardsworth and Keil, 1997). However, people are often more satisfied when doing the right thing (van den Bos *et al*, 2006). Knowing that replacing some meat with faba beans is good for health and the environment will definitely give some additional satisfaction when eating faba beans. Thus a purposeful replacement of meat with faba beans will affect the wellbeing of consumers positively as well as a purposeful inclusion of faba beans into cropping systems by farmers for the same reasons. Intentional activities or active efforts by individuals accounts for 40% of the variance in wellbeing in developed countries (Lyobomirsky, 2008). Replacing some meat with faba beans for health or environmental reasons or both will have positive effects on human wellbeing, and is hence socially sustainable.

4.3.2. Effects on health

Also this replacement is very beneficial for the health and wellbeing of people as faba bean can help reduce the risk of non- communicable diseases such as heart diseases and type 2 diabetes due to the fact that faba beans has no cholesterol, low saturated fats and high fiber content (Wolfe, 2012). Although a reduction in meat consumption will mean a reduction in iron and zinc which are very available in meat, faba bean as seen in table 2 (section 1.2.2) is high in iron though its iron is less easily absorbable compared to that of animal protein. Also, iron and zinc deficiencies are not serious threats as deaths caused by saturated fats from excess meat consumption and there are supplements of these minerals available. This dietary change will not only influence the present health of individuals but will go a long way to determine their health situation in the future and health is greatly related to the state of wellbeing as an unhealthy person cannot be completely happy as if otherwise.

Although faba bean is known to possess anti-nutritional factors, cuticle removal or heat treatment (e.g. boiling) reduces anti-nutritional factors of faba bean such as tannins, trypsin inhibitors and flatulence factors which are stachyose and raffinose (Zee et al, 1988). Furthermore, faba bean

breeding priorities includes the removal of tannins, and also vicine-convicine responsible for favism in humans (Torres and Avila, 2011). Favism as defined by the medical laboratory dictionary is an acute hemolytic anemia caused by the ingestion of faba beans occurring in people deficient in glucose-6-phosphate dehydrogenase. New faba bean varieties low in tannins and vicine-convicine have been released on the European cultivar catalogues (Duc et al, 2011), and are among the varieties grown in Sweden (table 3). It therefore seems promising that the problem of favism, which has imposed the main limitation of faba beans for human consumption (Köpke and Nemecek, 2010), can be overcome by targeted breeding.

4.3.3. Contribution to food security

The reduction in meat consumption will mean some of the grain that is currently being fed to animals will be used for human consumption. Also the extra land saved from the replacement could be used for the production of different food crops. These will help to solve the problem of global food insecurity if the problem of wastage is handled and it is distributed to reach areas in need, which I think would contribute to world peace as food insecurity is both a cause and consequence of violence (Brinkman and Hendrix, 2011).

4.4.0. Survey outcome

4.4.1. Response bias of the survey.

The response to the survey was quite high (95%) as it was carried out in a learning institution and participants knew and appreciated the value of research and so quite willing to participate. The response might have been different if the survey was carried out in a public restaurant in a big city that receives all categories of customers. Only 34 persons participated on the fourth and last day of the survey instead of 40 people who were expected because the SLU campus restaurant receives almost the same people every day and by the fourth day almost every one willing to participate had already done so once or repeatedly and did not see the need for further tasting. However, a few people actually tasted on all four days as well as answered the questionnaires as some of them were recognized especially those who made comments when they handed back the filled- in questionnaires. Another likely bias is that vegetarians were highly interested in the survey and participated largely during the first two days of the survey as they are non-meat eaters and probably wanted to promote the idea of reducing meat consumption.

4.4.2. Participants´ awareness of faba beans as human food.

The population of participants that knew faba beans as human food increased from 32% on day 1 to 53% on day 4. The low percentage awareness especially on day 1 shows how un-aware the Swedish population is about faba bean as a protein rich food for humans. Some specified on the questionnaire that they only knew of it as animal feed. The increase in awareness is because some of them had heard of it from their friends who participated on previous days of the survey or themselves had participated on previous days as they specified on the questionnaires. It also means that once faba bean is available in the Swedish market, consumer awareness of the product will increase and more people may become tempted to try it.

4.4.3. Issue of taste

In average, 75% of the participants liked faba beans after tasting, with the most liked recipe being recipe 4 and the least liked being recipe 3. But the issue of taste being good depends on individuals´ taste buds as a particular participant who tasted on all four days, made verbal comments each day, and so was greatly recognized, still commented on the fourth day that recipe 3 was the best which actually is the least liked by the survey. The average number of those who liked the taste of faba beans is quite good which shows that if available, people could use different recipes to prepare in order to suit their taste and by so doing will be cutting down on meat consumption as a lot are quite aware that beans is a rich source of protein and does not require additional protein in its preparation. The population that liked the taste of faba beans could actually increase with time as one participant commented on a certain recipe “tasteless, but I ate up the portion served, will come to like it with time”. Many people actually do not enjoy certain food or recipes when they try it for the first time but gradually enjoy it, the more they eat it.

4.4.4. Considering faba beans as a main dish

74% in average considered having faba beans as a main dish without meat with the number increasing from 59% on day 1 of the survey to 82% on day 4. The increasing trend observed does not tie well with the taste response as 82% liked recipe 1 but only 59% thought they could have it as a main dish while 68% liked recipe 3 but up to 81% considered having it as a main dish. Some actually specified they would like it as a main dish but with a better recipe meaning it

was not actually the taste or the recipe they liked but the idea of eating the beans. This could be because as the days went by during the survey period, a lot of discussions were taking place among participants concerning faba beans and a lot of questions were asked and the idea of having it as food got increasingly appealing to them the more they got informed about the beans, especially when they learnt they were locally produced. People can get interested in a food for different reasons, some for taste, some because they can produce it themselves or because of the benefits to them or to the environment. This is in line with Rodriguez (2011), that influences on food choices could be individual preferences or cultural, social, religious, economic, environmental and political influences. One participant responded "tasteless but ok, matter of habit" and further went to accept it as a main dish twice a week.

4.4.5. The frequency of having faba beans as a main dish

The greatest proportion of participants (40%) wanted to have faba beans once a month as a main dish which is by far less than the required amount of approximately 1kg dry weight per capita per month to replace 25% of meat currently consumed. 27% thought they could eat it once a week which is still less than the required amount per capita per week of 233g dry weight which when boiled approximately doubles its weight to 466g and is impossible to eat in a single meal. Having it twice a week will successfully replace slightly more than 25% of meat as it should be possible to eat on average 280g cooked weight per dish and twice a week gives 560g cooked weight (compared to 466g needed to replace 25% of meat). However, only 11% of the participants were ready to eat that much faba beans. In addition, the majority of those who wanted faba beans as a main dish up to twice a week or more were vegetarians (as they indicated on the questionnaire mainly on the 5^{th} question that asked if they wanted to have faba bean as a side dish with a reduced meat portion) which actually will not have much effect on meat consumption as they are non-meat eaters but they could occasionally influence the choices of their meat-eating companions. It was seen from the filled-in questionnaire (mainly as regards to the 5^{th} question) that a lot of vegetarians showed up for participation in the beginning of the survey which explains the decline with days of participants wanting faba beans twice a week and the first two recipes having more people wanting it as often as possible than the last two.

4.4.6. Faba beans as a side dish with reduced meat portion

The steady increase in the proportion of participants that thought they could have faba beans as a side dish could be explained by the fact that faba beans became more and more popular with time during the survey period as mentioned above (4.4.4) and most people thought they could give it a try. Furthermore, a lot of vegetarians participated at the beginning of survey and did not want it as a side dish since the question specified "as a side dish with a reduced meat portion" and some clearly stated they wanted it as the only protein source (since they did not eat meat) giving the lower percentage on the first two days. By day 4 of the survey, up to 97% thought they could have faba beans as a side dish which is promising because even if they are not yet used to it or do not yet like it that much, they are ready to give it a try while reducing their meat portion and hopefully with time they will start enjoying it so much so that they can have it as a main dish. Though it should be admitted that the recipe might have had an influence, as recipe 4 was the most liked (88%), had the highest consideration for as a main dish (82%) and even a participant who did not like the taste (that the beans were bitter), specified "but nice recipe".

4.4.7. Frequency of eating faba beans as a side dish

As a side dish, 33.3g dry weight per capita of faba beans needs to be eaten everyday which corresponds to approximately 70g cooked weight with ingredient and equivalent to the portion that was served during the survey. But only 6% were ready to eat that much of the beans and the majority, 56% wanted to have it once a week which is by far less than the required amount to replace 25% meat. Those who wanted it up to three times a week will be replacing about half of the meat that needs replacement yet only about 7% thought they could do that. The higher percentage of participants who did not want faba beans as a side dish with a reduced meat portion on the first two days than the later days could be linked to the high participation of vegetarians on those days as mentioned above (section 4.4.6).

4.4.8. Conclusions drawn from the survey

The survey shows that the Swedish population is ready to have faba beans as human food. In the beginning it will not be possible to replace 25% of meat currently consumed with faba beans alone, but with time it could be quite possible as more and more people will get to know of it, like it and eat more of it. And since the survey measures the content it was intended to measure (2.6.0), I will say it is content valid.

4.5. Implementation of study outcome

Even though the survey shows that the Swedish population accepts faba beans as food which they could replace part of the meat they consume with, a successful implementation will depend on a stability /energy minimum-hypothesis. This could be derived from Balluch (2009) and adapted to nutritional aspects with the basic assumption that most individuals in a society try to live in a way that costs least extra effort or a minimum of energy which when applied to eating habits will mean that people will eat what is cheap, available, tasty and socially accepted (Schmidinger, 2012) which lie in the trough of the curve in red (fig 11). Since the taste of faba beans has already been approved by the survey (75%), and it is socially accepted, it could attract more people to eating it if it is available in the market (i.e. Swedish food shops and supermarkets) and if this happens, prices will definitely drop thereby attracting even more people (Ibid).

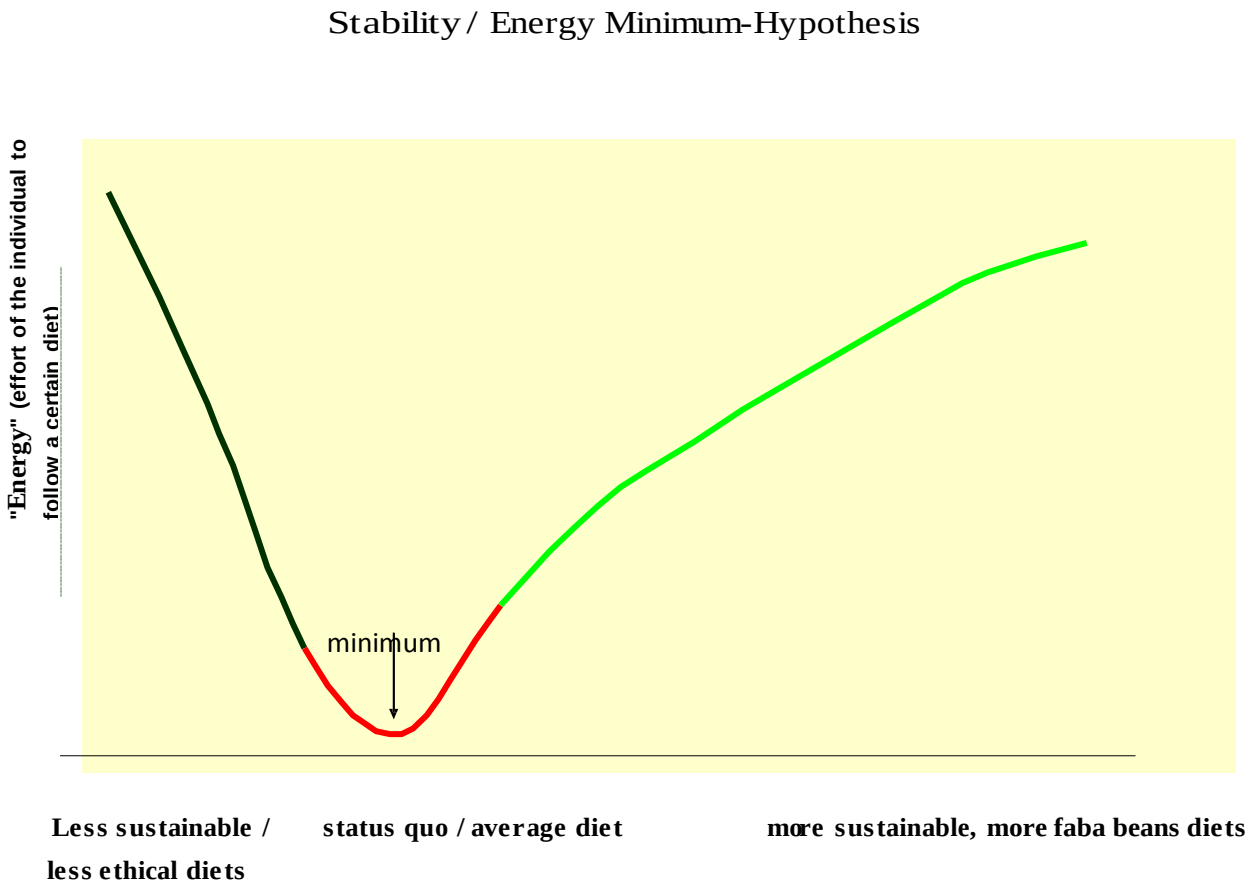

Fig. 11: Energy effort of an individual following certain diets. Source: Schmidinger (2012) modified.

The curve is shaped by the political and economic systems as well as the food markets. Living outside the (energy minimum, red) costs energy, and individuals "roll back", if they do not invest their energy perpetually and there is therefore need for great motivation to keep individuals outside the trough and even with that, their position there is not stable in the long term (Schmidinger (2012).

Implementation of the outcome of this study can only be achieved if faba bean is available in the Swedish market and since we are talking of locally produced faba beans here; Swedish farmers need to be informed of a ready market for faba bean grains as a food commodity and the advantages of this inclusion to their cropping systems. In this context, it is good that 85% of Swedish advisers are already recommending faba bean inclusion into cropping systems though currently produced just as animal feed (Dhamala, 2012). Since externalities to the farm such as climate change, markets, regulations and the availability of new technologies can affect a farmer´s decision on which cropping system to adopt (Jensen et al., 2010), with a promising market from the survey and existing machinery for harvesting of faba bean minor as it can be harvested with the same machinery used for drilling and harvesting cereals (Bond *et al*., 1980), farmers can easily adopt faba beans inclusion into their cropping systems. The general Swedish population should also be informed about this new food product (new because it is not yet popular as a food crop in Sweden as the survey showed that only 32% on day-1 knew it as human food) and all its associated benefits and even giving them different recipes for its preparation, four of which are described at appendix II. In addition, a study by Zee *et al*., (1988) shows that tofu could be made from faba beans minor which compares favorably with soy beans tofu. Advertising faba bean minor in comparison to soy beans could be quite popular as soy is quite known for its nutritional quality and studies by Arogundade *et al*, (2006) and Zee *et al*., (1988) show that faba bean L. minor possesses physico-chemical and functional properties that are quite similar to soy beans.

5. 0. CONCLUSION

A dietary change is very much required to reduce the growing epidemic of chronic diseases such as diabetes mellitus, obesity, stoke, cardiovascular diseases, hypertension and some cancer which are responsible for the cause of enormous deaths and disability (WHO/FAO, 2002). Replacing excess meat consumed is a good starting point as the diseases are mostly associated with saturated fats from livestock consumption. In Sweden, a 25% reduction of current consumption is needed to stay within national recommendations (Hallström *et al*., 2013). Replacing this 25% with locally produced faba beans of equivalent protein content will not only benefit health but also have an enormous benefit to land use and the sustainability of the entire food system. Approximately 421 thousand hectares of land could be saved from such a transition accompanied by a reduced effect of global warming and pollution, with benefits to the cropping system. Replacing the excess meat consumed with faba beans will be actually cutting off some extra hectares of land required, some extra energy burned, some extra chemicals and water used to produce feed for the animals as faba beans demands less of all these, in addition to cutting down the number of deaths from diseases associated with saturated fats from meat consumption. A taste survey shows that this replacement of 25% meat currently consumed in Sweden with faba beans could be possible even though it might be difficult in the short-run. If this well-needed transition is possible in Sweden, then why not in other countries with a similar meat consumption situation using any locally produced legume. A dietary change from mainly animal based products to more plant based products is needed for land minimization of the agricultural sector and to improve on the sustainability of the food system. This dietary change is not only necessary in Sweden or industrialized countries but the world at large which could also help to make possible the feeding of the predicted global population of 9 billion inhabitants by 2050.

6.0. REFERENCES

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Appendix 1

Questionnaire

1. What you have been given to try is small seeded faba beans. Do you know of it as a food crop? Yes or No…….....

2. Do you like its taste? Yes or No.....

3. Would you consider it as a main dish prepared without meat (may be served alongside some rice or potatoes? Yes or No.....

4. How often can you have it as a main dish? Choose from options a – e.

   a. Not at all
   b. Once a month
   c. Once a week
   d. Twice a week
   e. As often as possible

5. Would you like it as a side dish with a reduced meat portion? ……

6. How often will you like it as a side dish? Choose from options a – e.

   a. Not at all
   b. Once a week
   c. Twice a week
   d. Thrice a week
   e. Every day

Appendix II

Recipe 1 (2013-04-09)

Ingredients: Faba beans**,** butter, dill, salt

-Soak faba beans over night

-Boil half way and drain out the water

-Add fresh water and salt; continue boiling till beans is soft

-Drain out the water

-Add butter, dill and salt to taste and stir till it is properly mixed up.

Recipe 2 (2013-04-10)

Ingredients: Faba beans, garlic, chili, tomato puree, vegetable oil and salt

-It follows the same procedure for boiling as in recipe 1.

-Garlic, chili, tomato puree little vegetable oil and salt are added and stirred until it mixes up properly.

Recipe 3 (2013-04-11)

Ingredients: Faba beans, "saffan"**,** white wine, vegetable stock, salt

-Boiling procedure is the same as in recipe 1

-Drain out water

-Add white wine, vegetable stock, saffan and salt to taste.

-Boil for a while and stir for proper mixing

Recipe 4. Faba beans curry (2013-04-12)

Ingredients

Faba Beans: 1. 2 kg

Tomatoes: 4 big, freshly crushed

Tomatoes: 1 can tomato crushed, 500gm

Onion: 4 big, freshly crushed

Garlic: 10 cloves, crushed

Ginger: 1medium piece, crushed

Coriander Powder: 4tbsp

Cumin Powder: 4tbsp

Cumin Seeds: 1tbsp

Turmeric Powder: 2tbsp

Oil: 1cup

1 bunch of freshly chopped coriander leaves

Salt as per taste

Steps:

1. Soak the faba beans overnight.
2. Boil the faba beans in salted water till it gets cooked.
3. In a deep pan, heat the oil, add cumin seeds.
4. After cumin seeds get fried, add onion paste. After it turns little brown, add ginger garlic paste.
5. After the whole paste turns little golden, add the fresh tomato paste and canned tomato paste. Add coriander powder, cumin powder, turmeric powder and salt.
6. Cook it till the mixture throws oil out of it.
7. Add boiled faba beans along with the water in which it had been boiled.
8. Cook it till whole beans get completely mixed in the mixture.
9. After it is done, garnish it with freshly chopped coriander leaves.

(By Nawa Ray Dhamala)