

LOCAL FOOD IN ICELAND

IDENTIFYING BEHAVIOURAL BARRIERS TO CHANGE TOWARDS INCREASED PRODUCTION AND CONSUMPTION

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Abstract

Increased production and consumption of local food may partly counteract the negative environmental, social, and economic impacts of industrialised and globalised food production. The aim of this thesis was to identify the barriers the country of Iceland faces in increasing production and consumption of local food.

The research was guided by the framework of Integral theory, identifying behavioural barriers to change (Owens, 2005). Data collection was partly guided by the framework of Regional food systems (Clancy & Ruhf, 2010). The research questions were based on addressing structural, cultural, and personal barriers to change towards increased production and consumption of local food. The process involved estimating the food production capacity of Iceland, and illustrating consumers' attitudes towards local food. For this purpose, quantitative data sets were analysed, both from the Food and Agriculture Organization of the United Nations (UN FAO) and an Icelandic food and biotech research and development company (Matís). Qualitative data from public sources, such as the Ministry of Fisheries and Agriculture, were also explored in order to validate the quantitative data and deepen the results.

No structural barriers were identified, meaning that it is possible for the country of Iceland to increase production of local food substantially, even beyond the amount that is currently supplied through import. This could be done without compromising the needs of future generations. A cultural barrier to production was identified in the decrease in food variety that would occur if food production would only be from domestic sources. Survey results demonstrate that consumers' attitudes towards local food are positive, and they are aware of the sustainability issues connected to local food, but also that they make justifications for not choosing local food. This was identified as a personal barrier to change towards increased consumption of local food.

The results show that there is nothing obviously hindering increased production of local food in Iceland, but decreased food variety is an issue that should be given attention. Consumers are generally positive towards local food and are aware of the sustainability issues connected to local food. However they might justify their choices, which implies that marketing strategies and general knowledge connected to local food in Iceland might be improved. Although the results apply to the case of Iceland, the method of identifying behavioural barriers to change is applicable to other cases, such as countries, regions, or food sheds.

Keywords: weak sustainability, food supply, resource management, cultural norms, consumer behaviour.

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1 Introduction

1.1 Rationale

1.1.1 Problem area

As the global population grows, so does consumption. Although consumption by citizens in industrialised countries is less per unit of value of product, overall consumption is increasing beyond the gain technological improvements are providing (Kates & Parris, 2003). Food is no exception from the trend of increased consumption, and will continue to be so as diets become richer due to socioeconomic development, increasing the need for cropland (Kastner et al., 2012). It is estimated that the global population will be around 9 billion people by 2050, resulting in nearly double the present need for crops (FAO World summit on food security, 2009).

As a consumable product, food also makes a vast contribution to environmental issues (Tukker et al., 2010). The main contributor to environmental complications, deriving from food production, is agriculture (Foley et al., 2011). Intensification in agriculture increases land clearing, resulting in higher greenhouse gas emissions, and inefficient management practices increase nitrogen use (Tilman et al., 2011). Therefore food issues must not only be dealt with in connection to how to feed the population, but also how to do this with minimal pressure on the natural environment (Tischner et al., 2010).

The main challenges connected to food production can be described as maintaining high yields in industrialised food production while not compromising the environment (Foley et al., 2011) (Godfrey et al., 2010). Sustainable agriculture can be seen as a tool in this context, providing sufficient amount of food in an economically efficient, profitable, responsible, and environmentally sound manner (UNCSD Secretariat, 2011). There are some interesting areas to explore in the context of local food. As described by Pretty et al (2010), it is important to estimate the contribution of local food production to the sustainability of food systems. When discussing the implications connected to food supply systems, it must involve both production and consumption. This involves studying the actors in food systems and their respective activities (Pretty et al., 2010). In addition to consumption, the activities in food systems are producing, processing and packaging, distributing and retailing, all related to food supply. (Ericksen, 2008).

1.2 Background

1.2.1 Local and regional food systems

Depending on cultivation methods, locally harvested food can have lower environmental impacts than traditionally harvested food (Tukker et al., 2010). Locally grown and marketed food products can

increase diversification in cultivation, local biomass return, and foodstuff diversity (Feagan, Morris, & Krug, 2004). Generalisations about the environmental benefits of local food, such as less greenhouse gas emissions due to decreased transportation, should however be avoided as transport is not the dominant contributor of greenhouse gas emissions in the food system (Edwards-Jones, 2010).

The reconnection between producers and consumers is an important aspect of local food systems. Scaling-up is therefore a hurdle in the context of wide spreading local food production (Mount, 2012). An alternative to a local food system is a regional food system. As defined by Clancy and Ruhf (2010), a regional food system includes a local food system, but on a larger scale. The basic assumption behind a regional food system implies that economic returns are kept within the region, for the benefits of the communities. The connection between producers and consumers might not be direct, but the notion of buying regional products would still be meaningful to consumers as it benefits the community (Clancy & Ruhf, 2010).

1.2.2 The case of Iceland

In line with the definition by Clancy and Ruhf (2010), the food system in the country of Iceland can be seen as regional. A regional food system would however include small local food systems, which is not the case in Iceland. The population is small and the infrastructure is centralised when it comes to food production and distribution. Based on this I argue that the food system in Iceland can be seen as both local and regional. As the definition of local food implies shorter distances than is the case in Iceland, I stress that with the term “local” I am also referring to conditions that might be regional.

As for conditions in Iceland, the country is geographically isolated, situated between the North Atlantic and Nordic Ocean. Agriculture has limitations connected to the cold climate and over the recent years there has been increased public discussion regarding food production in Iceland, food security and sustainability in agriculture (The Ministry of Fisheries and Agriculture, 2010). In a conference held by The Farmers Association of Iceland, the importance of food security in the country was underlined. Dependency on imported animal feed is considered as very problematic, as was demonstrated in the economic crisis 2008, when foreign exchange restrictions nearly led to serious fodder shortage. The importance of increasing food production capacity as well as increased variety was stressed (The Farmers Association of Iceland, 2009).

1.3 Research aim

Research within the field of sustainability science incorporates interactions between nature and society. The aim of sustainability science research should be to understand these interactions, and identify how society can be guided down a more sustainable path (Kates et al., 2001). In line with this,

the aim of this thesis is to provide answers to questions connected to the natural environment. These questions specifically evolve around the capacity of Iceland to grow sufficient amount of food for the population and maintaining food variety, while limiting the environmental complications deriving from industrialised agriculture. As for the interactions between nature and society, the knowledge about the physical capacity of the food system in Iceland must also be seen in terms of the willingness of the population to transition to a more local food system.

My research therefore aims at understanding the different components of local food production and consumption in the country of Iceland. In this way, I seek to provide understanding about the capacity and limitations of agriculture in Iceland if food supply would come solely from local sources. I also aim to illustrate the reasons behind consumers' choices when it comes to local food. The purpose of this research is not to determine if the country of Iceland should rely entirely on locally grown food. The aim is rather to establish if there are grounds for growing more local food in Iceland and if so, what the main barriers to the change towards a more localised food system are.

1.3.1 Philosophical standpoint

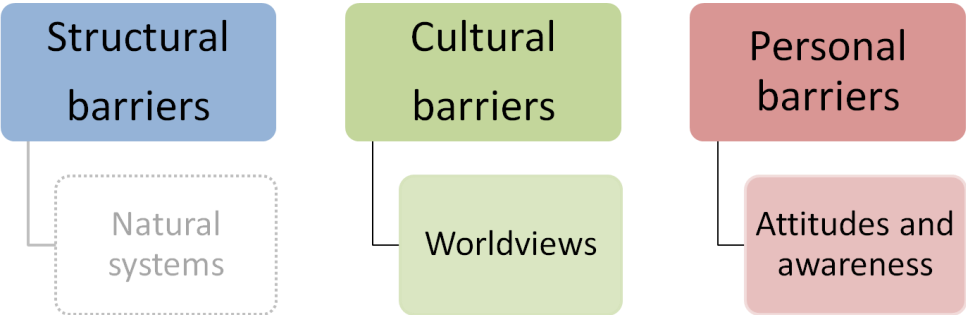
Critical realism implies that the conceptualisation of a reality is a way of knowing that reality, while a positivist position would assume that the conceptualisation directly reflects that reality (Bryman, 2008, pp. 14-15). My research addresses both the natural world and the social world, depending on the context to which I apply it. In line with this, my epistemological position is critical realism. I take the ontological position of constructivism, as it reflects how researchers do not present a definite version of the social world, but rather their own version of it (Bryman, 2008, p. 19).

I approach the term sustainability from the viewpoint of weak sustainability, as described by Solow (1993). This standing point implies that future generations should have the opportunity of similar standard of living as this generation. Resource use should thus be renewable if the needs of the future generations are to be uncompromised. However, it is natural that trade-offs between natural, social, and economic capital exist (Solow, 1993). In line with this, I assume that the natural environment will hardly be left unchanged for future generations, but the opportunities of resource utilisation should be left in tacked. This way, utilisation of natural capital takes place as a trade-off for increasing economic or social capital. However, the intensity should not compromise future possibilities of utilisation. Although very simplified, examples of this might be that energy sources should be renewable, fish stocks should not be depleted and agriculture should not be intensified.

2 Research Design

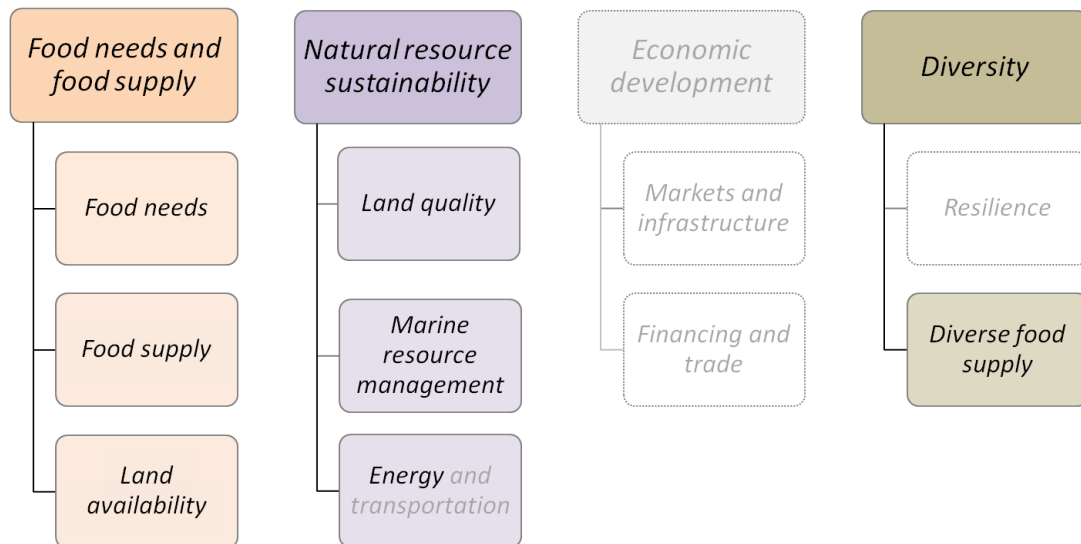
2.1 Framework use and research structure

For the purpose of identifying the problem areas connected to increased production and consumption of local food in Iceland, I have used Integral Theory. The framework was developed by Ken Wilber and is used in many disciplines when seeking solutions (Esbjörn-Hargens, 2010). Wilber intended the framework to bring together different approaches to environmental problem solving and ecology (Esbjörn-Hargens, Integral Ecology: The What, Who and How of Environmental Phenomena, 2005). I mostly followed the research structure of Owens (2005), who describes Integral Theory as a very fitting approach to categorise barriers to change towards sustainable consumption as it identifies different influences which affect our behaviour. I used the three barriers, structural, cultural, and personal, to guide the structure of my research questions. I also used the research topics connected to cultural barriers and personal barriers as described by Owens, worldviews and attitudes of consumers (Object



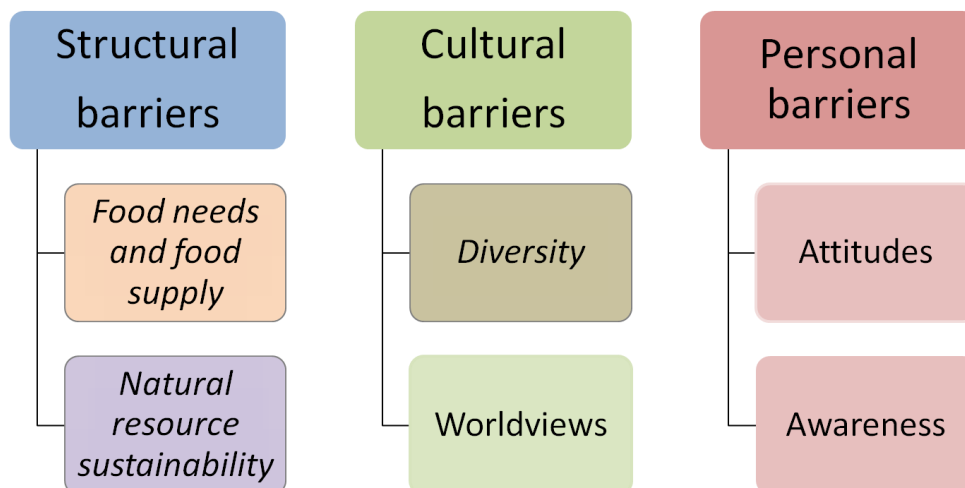
Object 1 - The Integral approach to identify barriers to change was applied in this thesis. Structural barriers in blue, cultural barriers in green and personal barriers in pink. Each barrier was used to guide different part of the thesis research and formulate research questions, represented in darker coloured boxes. Different research topics represented in lighter coloured boxes. Shaded item represents a topic that was addressed differently in this thesis research. Adapted from Owens (2005).

As my thesis research is aimed at issues connected to production and consumption of local food, I found it relevant to seek guidance for collecting data connected to local food on one hand, and food production on the other. For these purposes, I used guidelines of the Northeast Sustainable Agriculture Working Group for assessing regional food systems. The guidelines identify: food needs and food supply, the sustainability of natural resources, economic development, and diversity as crucial dimensions to regional food systems. Analysing the topic of economic development involves identifying the infrastructural challenges connected to building regional food supply chains. For the purpose of identifying barriers to change, I decided such an exercise was beyond the scope my research. I however built my point of departure on the assumption that there are definite economic regional benefits of increasing local food production and consumption (Object 2).



Object 2 - Guidelines for assessing regional food systems, as applied in this thesis. Food needs and food supply in peach, natural resource sustainability in purple (transportation shaded as it was excluded), and diversity in brown. The shaded topics connected to economic development were excluded from this thesis research, and resilience is addressed indirectly along with the topic diverse food supply. Adapted from Clancy & Ruhf (2010).

I modified the Integral approach according to the research topics I used from the food system guidelines. These research topics address issues connected to production, while the original topics from the Integral approach framework address issues connected to consumption. Two topics were integrated in the structural barriers: food needs and food supply, and natural resource sustainability. One topic was integrated into the cultural barriers: diversity (Object 3).

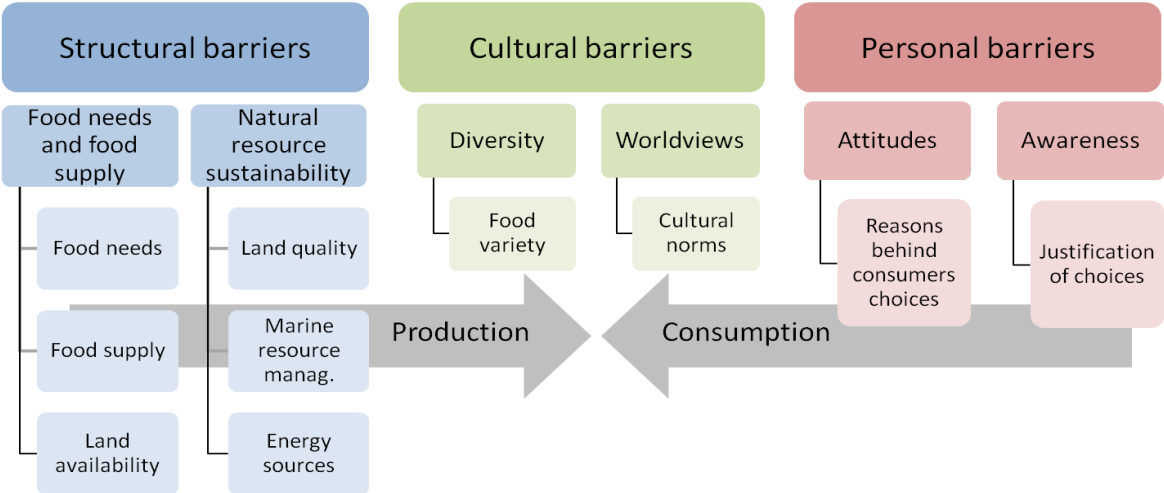


Object 3 – Two frameworks were combined for this thesis research. Data collection for three topics was guided by the regional food systems framework. The topics refer to food needs (peach), resources (purple), and diversity (brown). The remaining three topics derived from Integral approach: worldviews (green), attitudes (pink) and awareness (pink). Adapted from Owens (2005) and Clancy & Ruhf (2010)

Together these two frameworks address behavioural barriers to change in the specific context of increasing production and consumption of local food. For structural barriers, food needs and food supply addresses the ability of Iceland to be self-reliant in food production. Natural resource sustainability addresses if local food production would be sustainable. For cultural barriers, diversity addresses the variety of food that can be produced in the country. And then moving from topics which address production, over to topics which address consumption, the topic worldviews reflects how consumers perceive local food. For personal barriers, attitudes reflect upon what consumers base their choices. Finally, the topic awareness addresses on one hand, if consumers are aware of sustainability issues connected to local food, and on the other hand if they might make justifications for not choosing local food (Object 4).

2.2 Research questions

My overarching research question is intended to identify behavioural barriers to change towards increased production and consumption of local food. In order to do so, I use three research questions, each intended to address different aspects of this research through various tasks, data sources and methods (Table 1).



Object 4 – The thesis research is structured according to the Integral approach, which also provides basis for the development of research questions (boxes in darkest colour). Topics (boxes in a lighter colour) connect to either production or consumption (grey arrows). Elements of topics (boxes in lightest colour) reflect tasks performed for each topic of this research. Adapted from Owens (2005) and Clancy & Ruhf (2010)

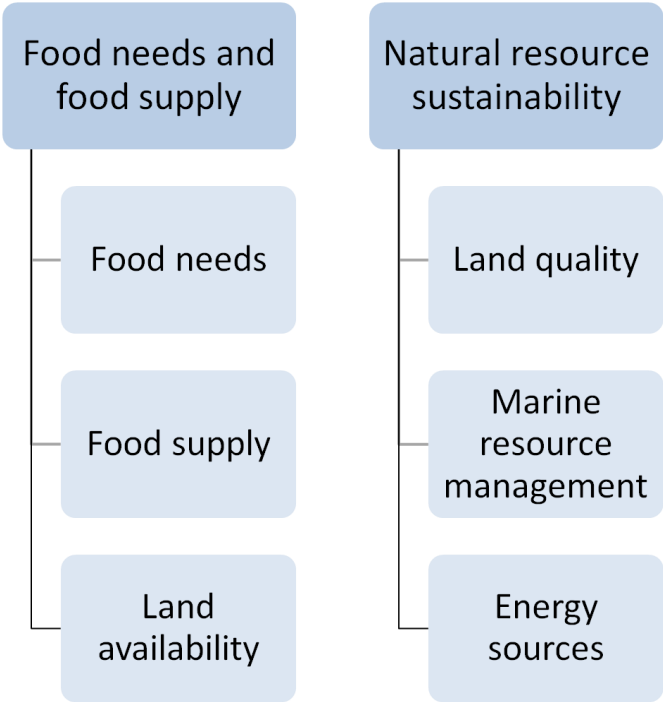
Table 1 - Research questions, topics to analyse, and specific tasks, followed by data sources for each task.

Overarching research question: What are the behavioural barriers to change towards more production and consumption of local food in Iceland?			
Research questions	Topics to analyse	Elements of topics	Data sources
1. What are the structural barriers to change towards more production of local food in Iceland?	1.1. Food needs and food supply	Estimate food needs for the population in Iceland	FAO – Food Balance Sheet (2012)
		Estimate possible local (domestic) food supply	FAO – Food Balance Sheet (2012) The Ministry of Fisheries and Agriculture (2010) The Agricultural University of Iceland (n.d.) Bernódusson & Eggertsson (2010) Icelandic Maritime Administration (2010)
		Estimate available land area	The Ministry of Fisheries and Agriculture (2010) Hermannsson & Guðmundsdóttir (2012)
	1.2. Sustainability of resources.	Evaluate agricultural inputs of land quality, fertiliser use and need for irrigation	FAO – Food Security (2013) OECD (2008) The Ministry of Fisheries and Agriculture (2010) Statistics Iceland (n.d.)
		Evaluate fisheries management	FAO – Fisheries and Aquaculture Department (2013) FAO – Fisheries Governance (2013)
		Evaluate energy sources used for greenhouses and aquaculture	FAO – Fisheries and Aquaculture Department (2013) NEA – Geothermal (n.d.) Axelsson et al. (2005)
2. What are the cultural barriers to change towards increased production and consumption of local food in Iceland?	2.1. Diversity	Estimate food variety loss	FAO – Food Balance Sheet (2012)
	2.2. Worldviews	Illustrate cultural norms when it comes to local food	Questionnaire data from survey about local food
3. What are the personal barriers to change towards increased consumption of local food in Iceland?	3.1. Attitudes	Illustrate the reasons behind consumers' choices	Questionnaire data from survey about local food
		Illustrate consumers' awareness of sustainability issues	Questionnaire data from survey about local food
	3.2. Awareness	Illustrate if consumers justify their choices	Questionnaire data from survey about local food

2.3 Research question 1: What are the structural barriers to change towards more production of local food in Iceland?

In order to analyse the topic “Food needs and food supply,” I followed the guidelines for estimating regional food systems as described by Ruhf & Clancy (2010) and additionally added the element “Land availability.” According to the guidelines, this element is meant to be addressed within the topic “Sustainability of resources.” The reason for this change was that when calculating possible food supply, it was logical to do so for the land available for agriculture, not the entire suitable land that exists in the country (Object 5).

When analysing the topic “Sustainability of resources,” I excluded the element “Transportation.” Due to special conditions in Iceland, I concluded that transportation was not relevant to my thesis research. The majority of the population lives in the capital area and infrastructure for distributing food is designed accordingly. Most food, whether local or and imported, is transported to the capital area, from where it is distributed to other areas of the country.



Object 5 - Structural barriers are addressed through the topics of “Food needs and food supply” and “Sustainability of resources.” The elements are food needs, food supply and land availability on one hand, and land quality, fisheries management and energy sources on the other. Adapted from Clancy & Ruhf (2010) and Owens (2005).

2.3.1 Food needs and food supply

This section addresses the capacity of a country to produce a sufficient amount of food for the population, using domestic resources. This is connected to self-reliance, meaning that the country is self-sufficient in food production (Clancy & Ruhf, 2010). Crop and pasture land must in place to feed the population, otherwise food supply is a limiting factor to increase local food production. Availability of the land must also be considered. Even if there is land area suitable for cultivation, it is not necessarily available for those purposes (Ruhf & Clancy, 2010). For my research I used the criteria that there should be land area available to grow crops, sufficient to meet what is currently being grown, and additionally what is being imported. If these criteria were not met, I considered it a structural barrier to change towards increased production of local food in Iceland.

2.3.1.1 Food needs

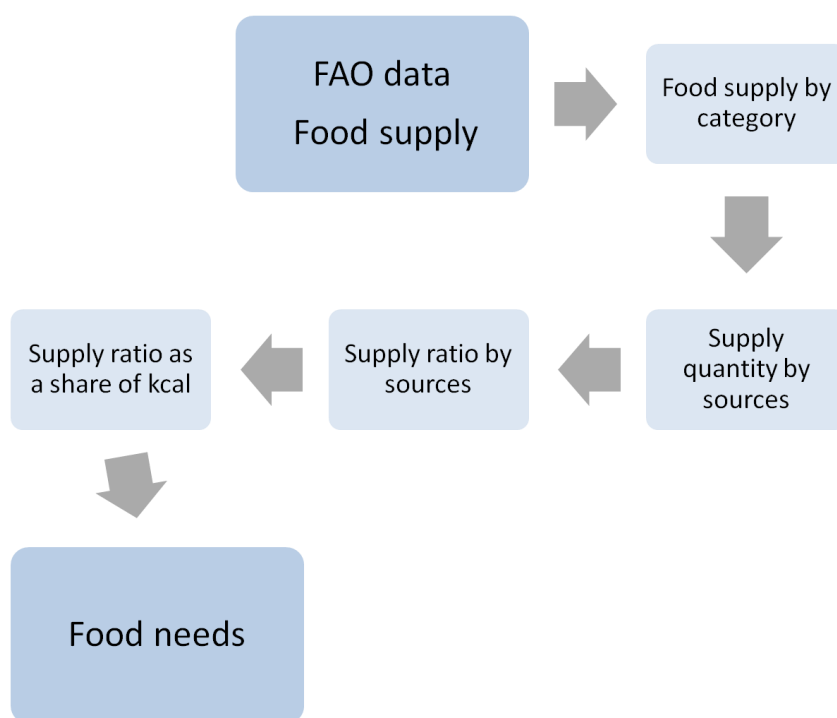
Before estimating the self-reliance of Iceland, I first needed to establish what the current food supply is and which types of food are most relevant for such estimation. For this part of the research, I used the most recent data (2009) from FAOSTAT about supply and utilisation for primary food commodities. The current food supply in Iceland represents what the population needs. Food supply consists of imported food on one hand and domestically produced food (local supply) on the other.

There are some limitations connected to the units used to display food supply in the FAO data set (1000 tonnes). As the population of Iceland is only around 320.000 (Statistics Iceland, n.d.), the quantity of local food production is in some cases too small for such units, for example for cereals. In order to ensure consistency, I nevertheless limited my data collection to the sources provided by the FAO. I considered this as appropriate as the purpose of this section is to estimate food needs, not actual local production. When estimating possible food production in the following section, I however used additional sources to make estimations based on less limited data.

I displayed the contribution of each category to the daily diet, by compiling the data into categories (Table 2) and ranking them according to kcal/capita/day for each category. I calculated the quantity supplied from local sources by subtracting import quantity from total supply quantity. I calculated the supply ratio by dividing food quantity for each source with total supply quantity for each category of food items. I calculated the supply ratio as a proportion of kcal/capita/day by multiplying kcal/capita/day for each category with the percentage of food supply, both for imported food and for local food (Object 6).

Table 2 - Food items compiled into 11 categories. Data source: FAO Food Balance Sheet (2012)

Fruit	Oil	Cereals	Fish	Beans and nuts	Vegetables
Apples	Animals, Raw	Barley	Aquatic Plants	Beans	Tomatoes
Bananas	Fish, Body Oil	Maize	Cephalopods	Soyabeans	Onions
Lemons	Fish, Liver Oil	Wheat	Demersal Fish	Cocoa Beans	Vegetables, Other
Grapefruit	Groundnut	Oats	Crustaceans	Pulses	Sweet Potatoes
Grapes	Sunflowerseed	Rye	Marine Fish	Sunflowerseed	Potatoes
Other	Maize Germ	Rice	Pelagic Fish	Rapeseed	Roots, Other
Coconuts	Oilcrops Oil	Other	Molluscs	Groundnuts	Cassava
Oranges	Rapeseed	Non-alcoh.bev.	Freshwater	Meat	Sugars
Pineapples	Sesameseed	Tea	Alcoh. bev.	Pigmeat	Spices, Other
Citrus	Soyabean	Coffee	Wine	Meat	Pepper
Dates	Olive	Dairy	Beer	Mutton & Goat	Sugar (Raw Eq)
Peas	Coconut	Butter	Alcoholic	Poultry Meat	Other
Olives	Oilcrops	Cream	Fermented	Bovine Meat	Honey



Object 6 – The food needs are represented by the current food supply. Imported food supply and local food supply was calculated as a share of kcal supply per capita, for each food category. Data source: FAO Food Balance Sheet (2012).

2.3.1.2 Food supply and land availability

For estimating the possibilities of self-reliance, I used the calculations I already performed while estimating food needs, but worked with the food categories that amount to over 5% of kcal supply per capita per day. Local sugar production seemed high to me as there are limited sources of sugar

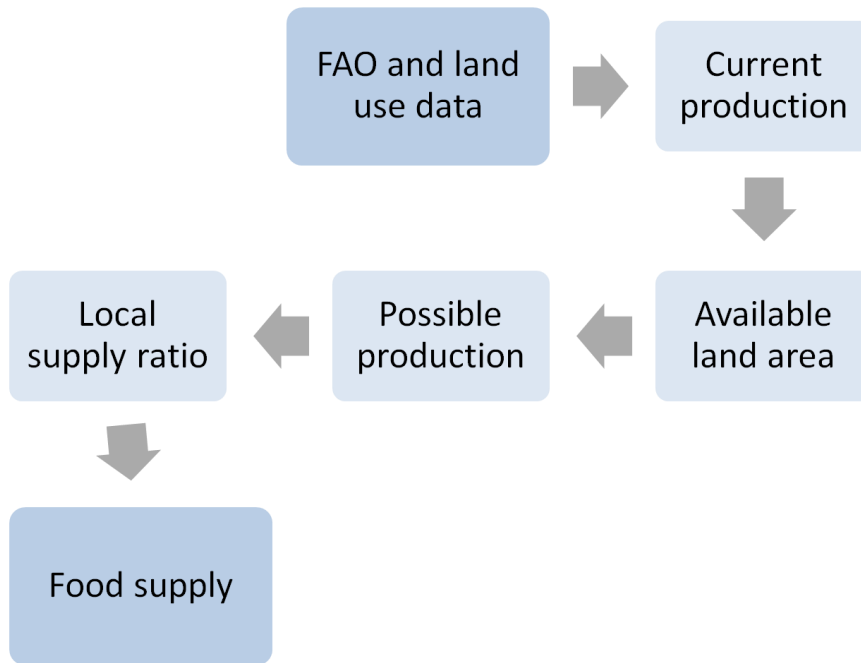
production in Iceland. When asked, the FAO statistics division explained these sources to be Glucose and Dextrose on one hand, and flavoured and sweetened beverages on the other (Gladys Moreno Garcia, communication by electronic mail, April 19th 2013). As there were no production data available for those items, I excluded sugars from further supply analysis. The remaining categories were: cereals, fish, vegetables, and oils. The categories meat and dairy were not subject to further analysis as they were addressed indirectly with other categories. Fodder for animals is included in numbers for cereals in the FAO data set and pasture for grass feed is included in the data I used from other sources. Other sources I used for this section consist of a 2010 report from a ministry-appointed committee about land use and conservation of arable land in Iceland, a 2012 conference proceeding about land needed for farming, agricultural economics data from the Agricultural University of Iceland, a 2010 report about cultivation of energy crops, and 2010 conference material about energy crops and fodder crops. All sources refer specifically to conditions in Iceland.

The criteria used for calculations connect to available land, average yield and conditions for specific crop types. Land area that is currently in cultivation¹ is estimated to be 119.000 ha and arable land² 600.000 ha (The Ministry of Fisheries and Agriculture, 2010). However, when availability and quality of the land area is considered, is estimated to be considerably lower or closer to 200.000 ha (Hermannsson & Guðmundsdóttir, 2012). For calculating possible food supply I assumed the number to be 300.000 ha. The criteria for wheat, barley and other cereals are 3.500 kg/ha average yield per ha (The Agricultural University of Iceland, n.d.). In the FAO data set there are many different types of oils, in my calculations I calculated for rapeseed oil and compared with all oil types combined, excluding fish oil. The criteria for rapeseed yield are 1 tonne of rapeseed oil pr ha (Bernódusson & Eggertsson, 2010). Additionally rapeseed and barley are appropriate switch-crops. This means that the same area of land can be used for those crops, rotating every other year. I adjusted my calculations accordingly (Icelandic Maritime Administration, 2010). Pasture represents cultivated fields where grass for livestock feed is grown.

In order to calculate how much is possible to grow I compiled information about cultivated land and arable land in Iceland, in both cases land for growing crops and pasture. I added data from the FAO data set about the current amount of food from local sources and imported food. I then calculated possible production for each food category according to the criteria appropriate for the conditions in Iceland and displayed as a ratio of possible local production to current total production. (Object 7).

¹ Cultivated land includes fields currently used for growing crops and pasture currently used for growing grass for livestock feed (The Ministry of Fisheries and Agriculture, 2010).

² Arable land includes cultivated land and other land meeting specific criteria connected to factors like maximum height above sea level and depth of the soil (The Ministry of Fisheries and Agriculture, 2010).



Object 7 - The possible local food supply was calculated as a ratio of current food supply. Available land area and production yields were taken into consideration. Data sources: The Ministry of Fisheries and Agriculture (2010), Hermannsson & Guðmundsdóttir (2012), The Agricultural University of Iceland (n.d.), Icelandic Maritime Administration (2010), Bernódusson & Eggertsson (2010), and FAO – Food Balance Sheet (2012).

For fish and fish oil I found it irrelevant to estimate ocean area and production possibilities. Fisheries depend on year to year quotas of allowed catch and are not subject to how much ocean area is available for the country. Using the FAO data set, I compiled data about current production for fish and fish oil, import, and export, and then calculated how much the current import is relative to production.

2.3.2 Sustainability of resources

This section addresses if food can be produced sustainably, meaning without compromising the natural environment. If production methods are not sustainable, future food production in Iceland might not be secure and I would consider such result as a barrier to change. In order to estimate this, I investigated the quality of the land and marine resource management, as well as energy sources.

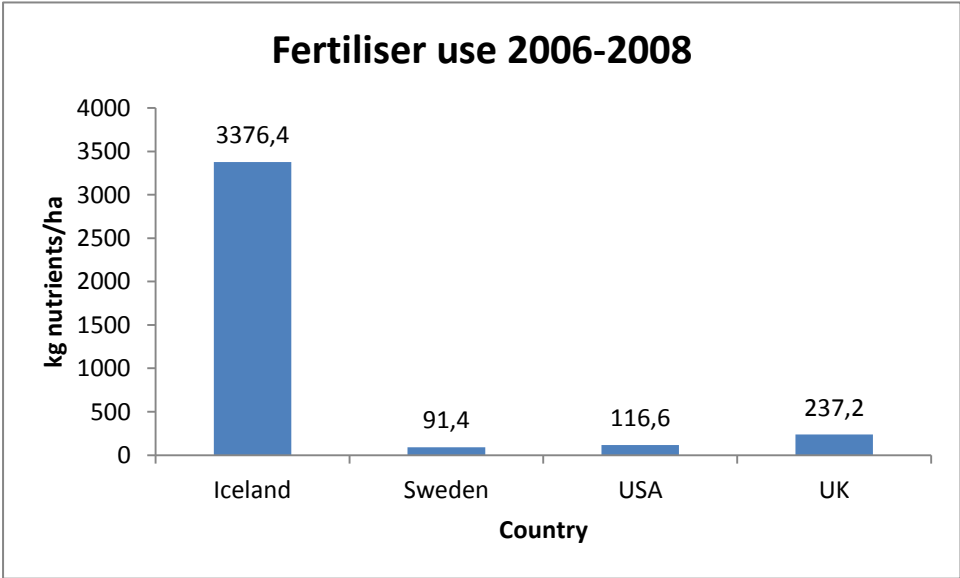
Quality of the land refers to if sustainable practices can be used in production, fertiliser use and irrigation being possible indicators (Ruhf & Clancy, 2010). I estimated the fisheries management system according to the guidelines of the FAO concerning the governance of capture fisheries, which assume that monitoring, control and surveillance (MSC) are key features of effective fisheries management processes (FAO - Fisheries Governance, 2013).

I did not address energy use in conventional agriculture and fisheries from wild stocks. Energy needs in agriculture and fisheries in Iceland are mostly connected to the use of crude oil fuels for agricultural machines and fishing vessels (The Ministry of Fisheries and Agriculture, 2010) (FAO - Fisheries and Aquaculture Department, 2013). I assumed this is also the case in other developed countries and did not see the need to aim my research at these topics. I therefore addressed energy from the viewpoint of special energy needs for fisheries and agriculture in Iceland, greenhouses and aquaculture.

2.3.2.1 Land quality

The amount of fertiliser used for cultivation and share of irrigation in arable land indicates the need for agricultural inputs, which may result in negative environmental impacts. I approached this part of my research by comparing fertiliser use and irrigation with another Nordic country (Sweden), the United States and the United Kingdom. This establishes grounds to estimate if fertiliser use and irrigation is considerably high in Iceland. If so, I assume that conditions in the country require high agricultural inputs, increasing the risk of negative environmental impact from agriculture.

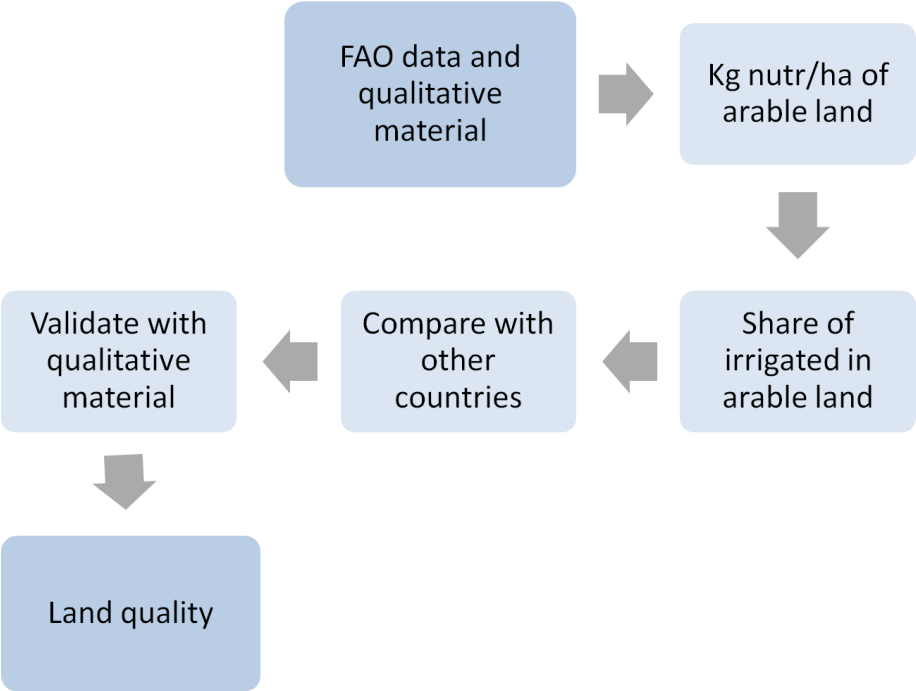
For the purpose of comparing fertiliser use I used numbers provided in the FAO food security reports for the relevant countries. The units are kg of nutrients pr ha of arable land and the reference years are 2006-2008. When using this method the difference between the countries was more than I expected, fertiliser use for Iceland being similar to the average corn yields in the country pr ha (Object 8).



Object 8 – According to the initial source, FAO – Food security (2013), fertiliser use for Iceland seemed more than tenfold the use for Sweden, USA and UK, which is inaccurate.

I found the FAO food security statistics inaccurate for Iceland. Fertiliser use is presented according to a given number of ha of arable land. For Iceland, the FAO bases calculations on arable land being nearly 20 times lower than other sources indicate, 7.000 ha (FAO - Food security, 2013) compared to 120.000 ha (The Ministry of Fisheries and Agriculture, 2010). I therefore re-calculated fertiliser use pr ha for Iceland according to fertiliser use as presented by the FAO, using 120.000 ha as the amount of arable land. For extra comparison, I also calculated fertiliser use pr ha for Iceland using numbers about fertiliser use provided from Statistics Iceland, also using 120.000 ha as the amount of arable land.

To compare the share of irrigated land between Iceland, Sweden, USA and UK, I used FAO food security statistics. As irrigation is represented as not existing for Iceland, I validated this number with a 2008 OECD report about the environmental performance of agriculture, and a 2010 report from a ministry-appointed committee about land use and conservation of arable land in Iceland (Object 9).



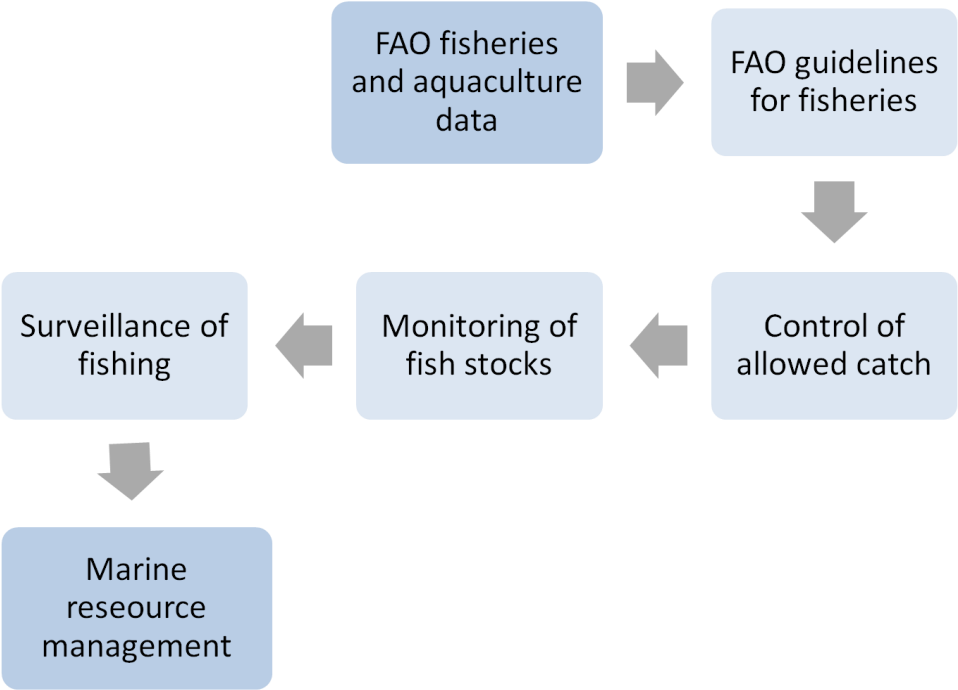
Object 9 - Land quality estimated by comparing fertiliser use and irrigation. The findings were validated qualitative. Data sources: FAO – Food security (2013), The Ministry of Fisheries and Agriculture (2010), and OECD (2008).

2.3.2.2 Marine resource management

The fisheries policy in Iceland is based on the UN Convention on the law of the Sea, the principle of sustainable development at the UN Rio convention in 1992 and the principle that those who have great interests in conservation and utilisation of marine ecosystems should be those who handle decisions thereof (FAO - Fisheries and Aquaculture Department, 2013). Based on this I assumed that there is foundation for sustainable harvesting of fish stocks in Iceland and aimed my research at establishing if the actual fisheries management system is sustainable.

The criteria I used for estimating the sustainability of the fisheries management system is in line with the guidelines of the FAO concerning the governance of capture fisheries. These guidelines assume that monitoring, control and surveillance (MSC) are key features of effective fisheries management processes (FAO - Fisheries Governance, 2013).

I analysed information from FAO’s report about fisheries and aquaculture in Iceland, according to the guidelines given by FAO regarding fisheries governance. The topics I explored were monitoring of fish stocks, control of allowed catch, and surveillance of fishing (Object 10).



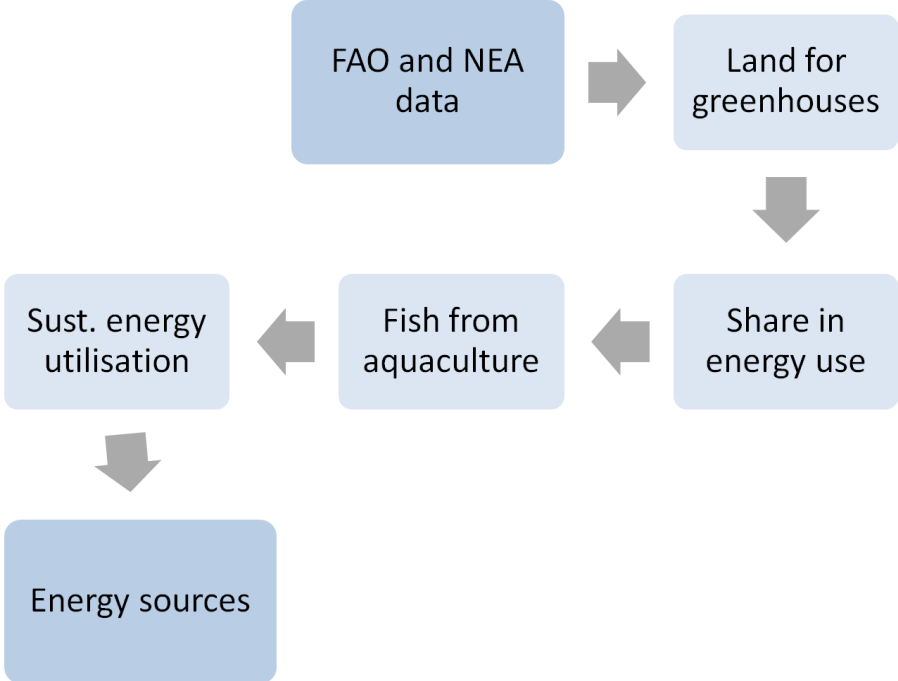
Object 10 – The sustainability of the fisheries management system in Iceland estimated according to FAO’s guidelines for fisheries governance. The process involved estimating if the fisheries management system in Iceland monitors fish stocks, controls allowed catch and surveillances fishing. Data sources: FAO Fisheries and Aquaculture Department (2013) and FAO-Fisheries Governance (2013).

2.3.2.3 Energy sources

In order to evaluate energy sources used for greenhouses and aquaculture, I estimated the share of greenhouse cultivation and aquaculture in agriculture and fisheries. I saw this as relevant due to the fact that even if roots, grass for livestock and cereals are grown outdoors in Iceland, greenhouses are generally used for horticulture (OECD, 2008). Fish farming is also practiced in Iceland and is an energy-intensive process as water for the fish is warmed up (NEA, n.d.).

To establish land area used for greenhouses, I used data provided by the National Energy Authority (NEA) in Iceland. I matched that with total land area used for growing vegetables in the country, using

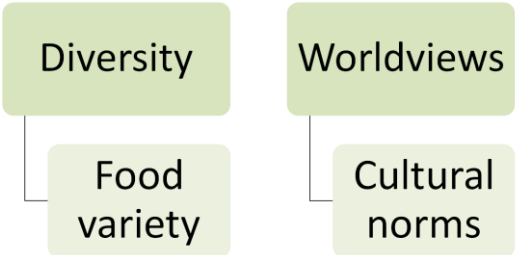
a 2010 report from a ministry-appointed committee about land use and conservation of arable land in Iceland. For estimating the share of Icelandic fish farming in total production I used FAO export data from the Fisheries and Aquaculture Department, providing information about fish from aquaculture and total amount of fish used for human consumption. To estimate the energy intensity of greenhouse cultivation and aquaculture I compared the share of production with share in total energy use for Iceland, assuming that if the share for both was similar then the activity was not energy intense. The data for energy use came from the NEA. In order to estimate the sustainability of the energy used for greenhouses and aquaculture, I used documents from the NEA regarding geothermal utilisation practices in Iceland. In order to establish that NEA practices in energy utilisation are sustainable, I additionally used conference proceedings from the International Geothermal Association (Object 11).



Object 11 – Energy sources avaluated by estimating the share of greenhouses and aquaculture in total production, comparing that with the share in energy use in the country, and evaluating if the energy used is utilised in a sustainable manner. Data sources: NEA (n.d.), FAO – Fisheries and Aquaculture Department (2013), The Ministry of Fisheries and Agriculture (2010) and Axelsson et al. (2005).

2.4 Research question 2: What are the cultural barriers to change towards increased consumption of local food in Iceland?

I addressed cultural barriers to change on one hand through food variety from local sources, in line with the guidelines for assessing regional food systems. On the other hand I followed the Integral approach and included the assessment of cultural norms (Object 12).



Object 12 - Cultural barriers consist of the topics diversity and worldviews. Adapted from Clancy & Ruhf (2010) and Owens (2005).

The guidelines for assessing regional food systems are structured so they address if the food system is resilient. This means investigating if crops grown are sufficiently diverse to meet the demand of the population as well as growing the amount needed (Clancy & Ruhf, 2010). I approached this from the viewpoint of estimating if food diversity would decrease if food supply derived from local sources

only. If it would decrease, then the loss of variety would be a cultural barrier to change towards increased consumption of local food.

Worldviews refer to group norms and perceptions of local food, either inhibiting or promoting change towards certain behaviour (Owens, 2005). I chose to explore if consumers in Iceland generally connect local food to positive feelings, as it would indicate the cultural norms connected to local food in the Icelandic society. If consumers do not seem to connect local food in Iceland to positive feelings, I would consider it a cultural barrier to change.

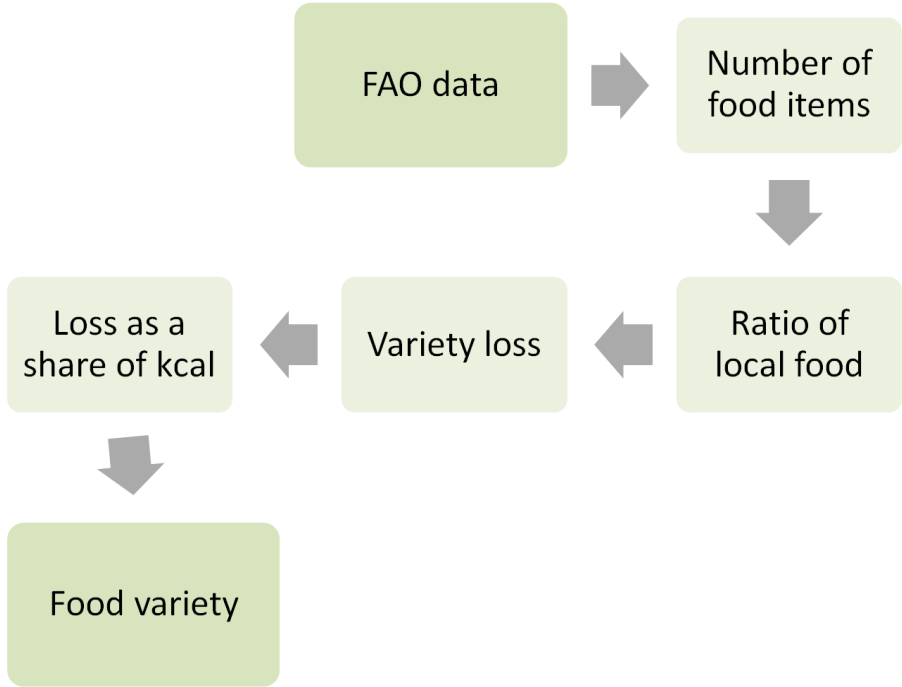
2.4.1 Diversity

2.4.1.1 Food variety

The aim of this part of the thesis was to illustrate the limitations of the current food system when it comes to producing variety of local food. In other words, I was not displaying a scenario that I believe is likely to happen. I see the likelihood of Iceland relying entirely on local food production, as very slim. In order to decide if food variety loss would contribute as a barrier to change, I set qualitative criteria. If important food items in the daily diet would suffer considerable variety loss, then diversity would be a cultural barrier.

To establish food variety loss I worked with the same 11 FAO food categories as I did for estimating food needs and food supply. I counted how many different items were in each category when looking at overall supply. I then counted the items in each category when looking at local supply. I calculated the local supply to overall supply ratio, identifying the loss of variety the country would face if solely

depending on local food sources. In order to illustrate the importance of the variety loss for the typical diet in Iceland, I calculated the variety loss for each food category as a share of kcal supply (Object 13).



Object 13 – Food variety addressed by displaying food items from local sources as a share of food items from all sources. Data source: FAO-Food Balance Sheet (2012).

2.4.2 Worldviews

2.4.2.1 Cultural norms

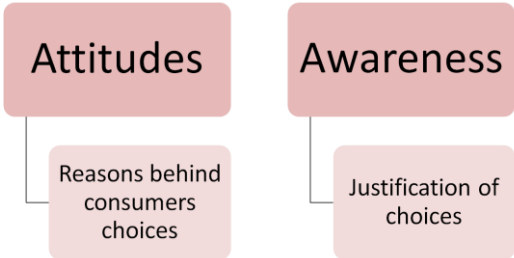
In order to explore the worldviews of consumers in Iceland, I aimed to illustrate how consumers in Iceland perceive local food, if the term is connected to positive feelings or not. For this part of my thesis research I analysed data, from a survey questionnaire I conducted in collaboration with another student in Iceland in 2012. The survey was about tourists’ attitudes towards local food and was conducted for, and overseen by a food industry R&D company in Iceland, Matís. The population of the Matís survey were foreign and domestic tourists, who were approached randomly over the time period of June to August 2012, in tourist locations around Iceland. There were 463 participants that completed the questionnaire, out of which 343 were foreign and 120 were Icelandic. The Icelandic sample is slightly gender biased as 56% of domestic travellers were women. Otherwise the sample represents tourists in Iceland when age distribution and residency are considered. For my thesis research, I assumed that the answers of the participants can give good insight into the attitudes of both tourists in Iceland and consumers in general.

To explore if consumers associate local food with positive statements, I analysed the answers from the survey question: “Do you agree on the following statements about local food?” The participants could rank ten different statements on a scale of five: “agree strongly, agree, neither nor, disagree, disagree strongly.” The statements referred to different attributes, for example connected to sustainability issues. The statement “healthy and safe” referred to trust of the participants towards local food. I compiled the answers according to the participants’ ranking and calculated the proportion of each ranking. I used the criteria that if a considerably high number of participants used the ranking “agree” or “agree strongly” then it indicates trust towards local food, a positive feeling.

In order to further estimate if consumers’ attitudes towards local food are positive, I analysed answers concerning satisfaction with purchased local food. Participants were asked “What kind of local food have you purchased on this trip?” and given the opportunity to mark different food items or answer “I have not purchased local food.” Those who had purchased local food on their trip could also answer the question “How satisfied are you with the product that you bought?” They were asked to rank their answer on a scale of five: “very satisfied, satisfied, neither nor, dissatisfied, very dissatisfied.” After compiling the answers I calculated the share of each ranking, using the criteria that a high share of the ranking “satisfied” or “very satisfied” would indicate a general positive attitude towards local food.

2.5 Research question 3: What are the personal barriers to change towards increased consumption of local food in Iceland?

In line with Integral approach, I address personal barriers through the topics attitudes and awareness (Object 14). Our personal feelings, emotions and sensations affect our behaviour. In this way, the choices we make may be influenced by our longing for convenience, often inhibiting us to act in a sustainable way. Awareness is an important aspect of behaviour as well as individual beliefs and attitudes. We might for example be well aware of the implications of our actions, but we still rationalise and justify choices that may be seen as unsustainable (Owens, 2005).



Object 14 - Personal barriers consist of the topics attitudes and awareness. In line with Owens (2005).

Consumers might value certain attributes more than others when making their choices. This might be attributes like convenient packaging, or availability of products ready for consumption. In my research, I assumed that if consumers prefer attributes of this sort, it indicates that there are personal barriers to change. Similarly, I assumed that consumers may be aware about the benefits of choosing local food, but still rationalise their choice. I see this as an indicator of a personal barrier to change. Consumers might see it as important that local food supports the farmer, also that local food is environmentally friendly, or that local food has less carbon footprint than other food. But they might still rationalise their choices on the grounds that local food does not always come directly from the farm and that it is not always a more sustainable choice. In other words, they might feel that they have no obligation to choose local food in Iceland, and base that belief on the grounds that local food in Iceland does not really live up the expectations they have towards local food.

2.5.1 Attitudes

2.5.1.1 Reasons behind consumers' choices

In order to establish what the reasons behind consumers' choices might be, I used the Matís data set. Participants were asked "How important do you think the following is, in regard to local food?" A list of ten attributes followed, each with the possibility to answer on a scale of five: "very important, important, neither nor, not important, not important at all." The attributes represent issues connected to quality of the product, connection to sustainability issues and convenience. For this part of the thesis research I chose to explore the answers for "Ready for consumption" and "Convenient packaging." I compiled the answers according to how participants ranked these attributes and compared with the answers for "Product of the highest quality." My criteria was that if a high number of participants regarded it as important or very important that the product is ready for consumption or convenient, then it would indicate a personal barrier to change. This is not meant to indicate that local food in Iceland is never convenient, but rather to illustrate what consumers base their choices upon. As participants in the survey were asked about this specifically in the context of local food, I assume that their answers represent whether a lack of convenience would prevent them from buying local food.

2.5.2 Awareness

2.5.2.1 Justification of choices

To analyse consumers' awareness of sustainability issues connected to local food, I used the same survey data as before. I compared on one hand the importance of different attributes connected to sustainability issues, and on the other hand if participants agreed with statements connected to sustainability issues. I assume that the first question represents what consumers see as important for local food in general. Consequently I assume that the second question represents what consumers believe to be true about the actual local food in Iceland. If a high number of participants regard

statements connected to sustainability issues as important or very important, I saw this as a sign that they are aware of the implications of choosing local food. If a lower number of participants agree or agree strongly on statements connected to sustainability issues, then I assume that they justify their choices when it comes to local food. I do not assume anything about the actual purchasing behaviour of these consumers, only that the justification exists and could therefore be a barrier to change towards increased consumption of local food.

The attributes connected to sustainability issues were: “supports the local farmer,” “environmentally friendly,” “less carbon footprint,” and “fewer food miles.” As price is an important factor when it comes to purchasing decisions, I chose the attribute “comparable price” to compare. The statements connected to sustainability issues were: “direct from the farm,” “sustainably produced,” “organically grown,” and “sold by the producer.” I compiled the answers of the participants for the respective attributes and statements and calculated the share of each ranking.

2.6 Methodological and ethical considerations

Causal relationships are not directly identified through my research, but I underline the importance of doing so. Theory use is in this way explanatory as it aims at causality (Khagram et al., 2010). As for research style, the method I use to identify behavioural barriers to change is statistical. Statistical research strategy is considered appropriate for studying causality through case studies, and when the researcher cannot manipulate the variables to establish causality (Khagram et al., 2010).

The main ethical implications of this research are involved with the Matís survey questionnaire. According to the code of conduct of the School of Social Science (University of Iceland), all research that involves human participation is subject to an ethical protocol regarding vulnerable participants. In this case the participants are not considered as vulnerable as they do not belong to an especially fragile group due to issues like handicap or social status, neither are they minors. The ethical protocol in the research on tourists’ attitudes towards local food therefore mainly refers to the informed consent and anonymity of participants (The University of Iceland, 2006).

While conducting the research all participants were informed about the intended use of the results. Also, anonymity of participants was ensured. This was done by not collecting names or other information indicating the identity of the participants. After the collection of completed survey questionnaires, the paper sheets were kept in a random order so it would not be possible to connect answers to individuals while processing the data later on.

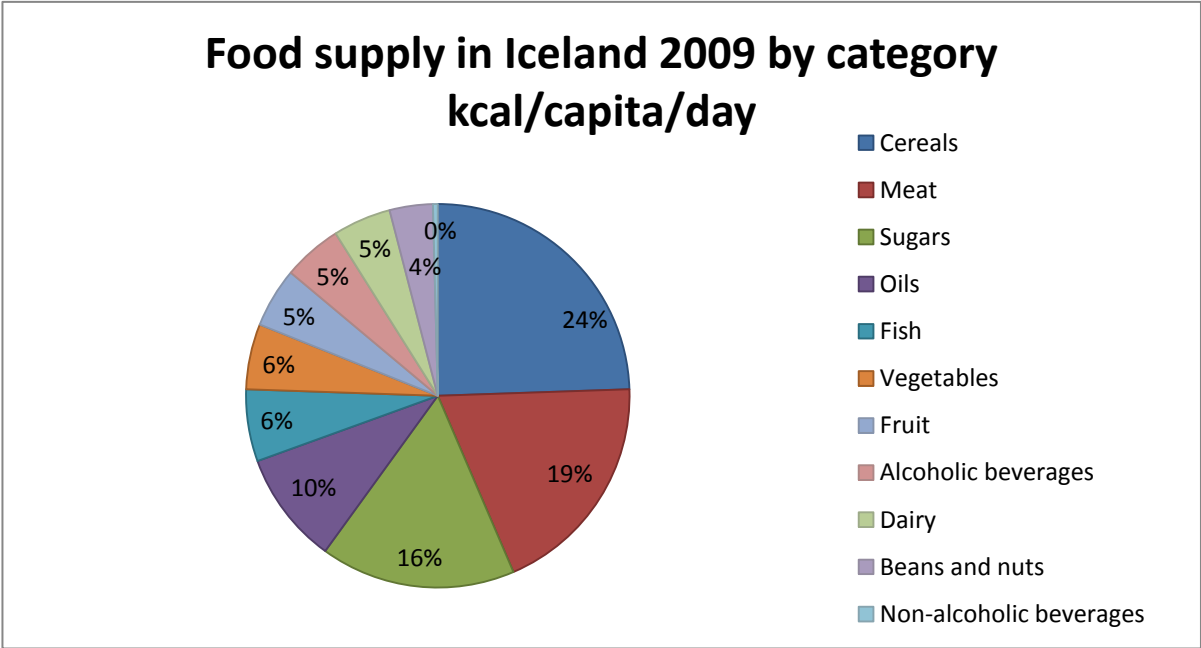
3 Results

3.1 Structural barriers

3.1.1 Food needs and food supply

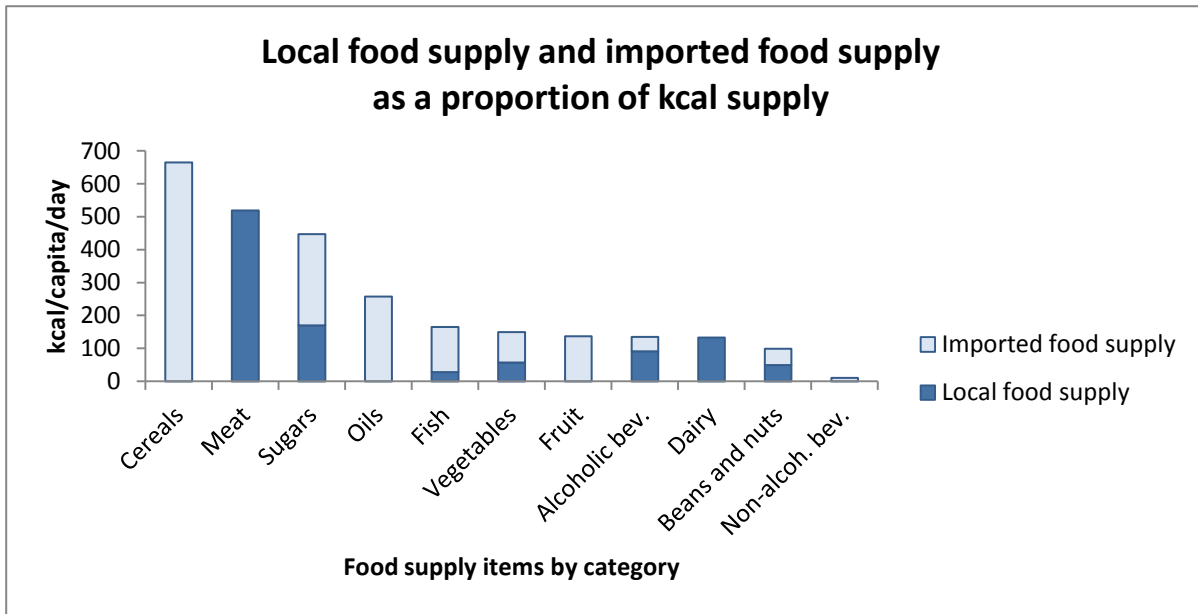
3.1.1.1 Food needs

Nearly half of the food supply in Iceland is from cereals and meat. Sugars and oils are also important as those categories amount to a quarter of the daily kcal supply. Fish, vegetables, fruit, alcoholic beverages and dairy similarly provide over a quarter combined. Beans and nuts, along with tea and coffee make up less than five percent of the daily kcal supply (Object 15).



Object 15 – Total food supply consists of imported food and local food produced in Iceland. Food supply in Iceland is displayed by food category, as a portion of kcal supply per capita per day. Compiled and ranked data from: FAO – Food Balance Sheet (2012).

When taking into consideration low level of local supply then cereals, sugars, oils, fish and vegetables are most relevant for estimating local production possibilities. Food supply in Iceland is 100% provided by import for cereals, oils, fruit and non-alcoholic beverages. The proportion of imported fish is 83%, sugars 62%, vegetables 61%, beans and nuts 50%, and alcoholic beverages 32%. The country is self-reliant with meat and dairy. The categories contributing the most to the daily kcal supply are cereals, meat, sugars, oils, fish and vegetables (Object 16).



Object 16 - Imported food (lighter colour) and locally produced food (darker colour) calculated as a proportion of kcal supply. For each food category, kcal supply was multiplied by import proportion and local food proportion. Data for calculations from: FAO – Food Balance Sheet (2012).

3.1.1.2 Food supply and land availability

Available, arable land in Iceland is estimated to be nearly threefold the area that is currently in cultivation. The land area is sufficient in order to grow the amount of cereals that are currently being imported for human consumption and fresh fodder for animals. Additionally, arable pasture land for livestock feed is nearly twice as much as land currently used for such purpose.

The land area fit to grow wheat is 20.000 ha, with the possibility to grow 70.000 tonnes. Wheat supply is currently 55.000 tonnes, entirely supplied by import. The possible production to current supply ratio illustrates that the available land area for growing wheat is sufficient to grow 27% more than is currently being supplied. The respective ratio for other cereals range from 47%-353% more than is currently provided, but this ratio depends on how the area fitting to grow these cereals is divided and could therefore be different. Vegetables supply could be 2% more than the current domestic production and import combined. Pasture for growing grass feed for animals could also be 70% more than already supplied, providing grass feed for animals far beyond the current production (Table 3).

Table 3 – Cultivated land in Iceland is 120.000 ha while available, arable land is estimated to be 300.000 ha. Current supply consists of local production and import. Possible local production calculated by multiplying yields pr ha with available land for each crop type. Possible production to current supply ratio calculated by weighing local supply against import. Data sources for calculation: The Ministry of Fisheries and Agriculture (2010), Hermannsson & Guðmundsdóttir (2012), The Agricultural University of Iceland (n.d.), Icelandic Maritime Administration (2010), Bernódusson & Eggertsson (2010), and FAO – Food Balance Sheet (2012).

Cereals, oils, vegetables	Current supply				Possible supply			
	Land area	Local supply	Import supply	Total supply	Land area	Yield	Local supply	Poss/Curr supply ratio
	1000ha	1000 t	1000 t	1000 t	1000 ha	t/ha	1000 t	
Wheat	13	-	55	55	20	3,5	70	127%
Barley		-	14	14	32,3	3,5 /2	57	404%
Other cereals		-	25	25	32,3	3,5	113	453%
Oils (rapeseed)		-	11	11	32,3	1 /2	16	147%
Vegetables	1	14	27	41	3	14	42	102%
Pasture (grass)	106		-	-	180	-	-	170%
Total	120	14	132	146	300		298	

For fish and fish oil, current production is nearly 20 times more than is supplied by import (1852%). The production is mainly used for export, 1.426.000 tonnes of fish are produced and 1.410.000 is exported, while 77.000 tonnes are imported. For fish oil, 62.000 tonnes are produced and exported, while 4.000 tonnes are imported. The production to import ratio is very high for both food categories, showing that domestic production could meet what is being supplied now through local sources and import (Table 4).

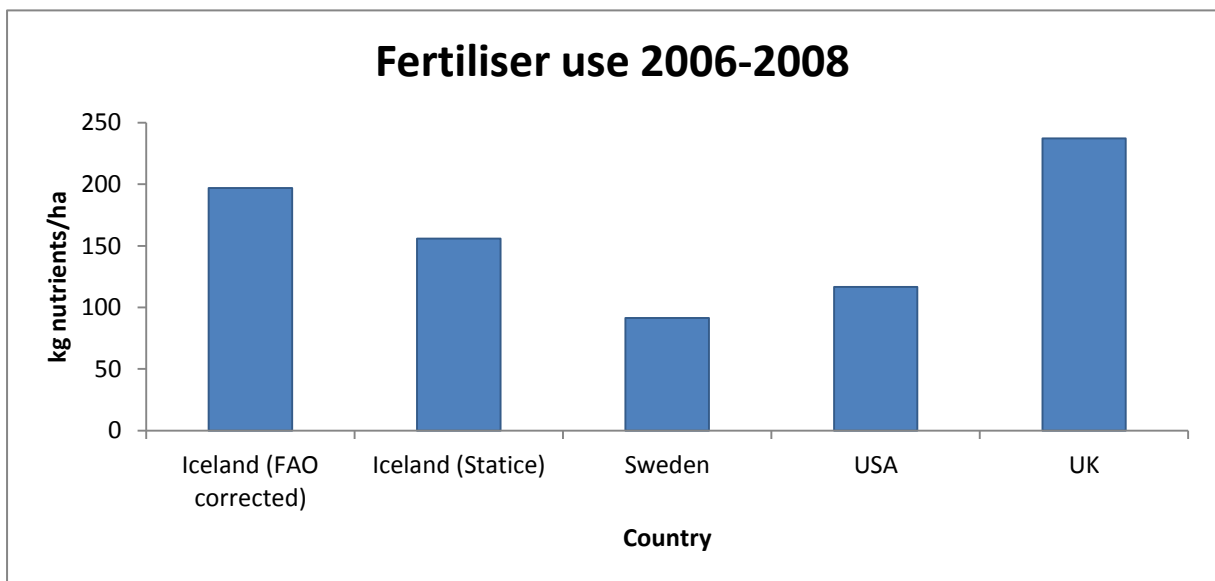
Table 4 - Fish and fish oil production exceeds import supply by far. Production to import to ratio indicates how much higher the current production is over imported fish and fish oil, over 18 times higher for fish and over 15 times higher for fish oil. Ratio calculated with compiled numbers from: FAO – Food Balance Sheet (2012).

Fish, fish oil	Current supply			Production/import Ratio
	Production 1000 t	Import supply 1000 t	Export 1000 t	
Fish	1.426	77	1.410	1852%
Fish oil	62	4	62	1550%
Total	1.488	81	1.472	

3.1.2 Sustainability of resources

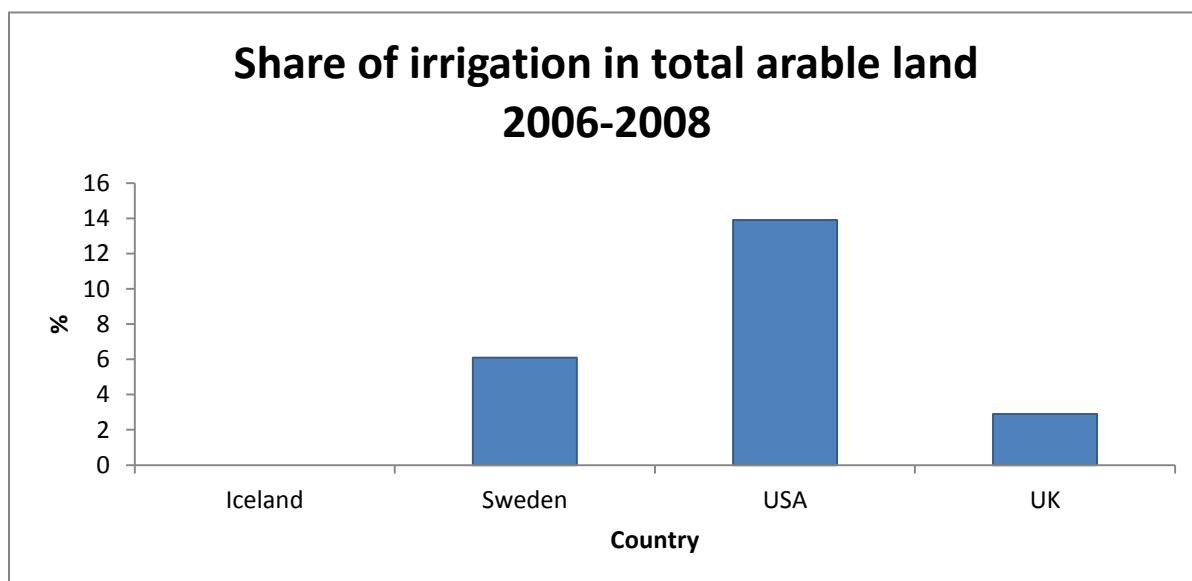
3.1.2.1 Land quality

Fertiliser use in Iceland is not considerably more than in the countries used for comparison, indicating that conditions in the country do not bring the need for agricultural inputs. Fertiliser use is 197 kg nutrients/ha for Iceland when calculated with corrected FAO data, but 156 kg nutrients/ha when calculated with data from Statistics Iceland. The comparable number for Sweden is 91 kg, for the United States 117 kg and the United Kingdom 237 kg. Thus Iceland is intermediate in fertiliser use, when compared to the other countries (Object 17).



Object 17 – Fertiliser use is higher than in Sweden and USA, while lower than the UK, indicating that sustainable cultivation methods are possible. Calculated with data from: FAO – Food security (2013), The Ministry of Fisheries and Agriculture (2010), and Statistics Iceland (n.d.).

Irrigation is less in Iceland than in the countries used for this comparison, further establishing the possibility of using sustainable cultivation methods in Iceland. The share of irrigation in total arable land is zero in Iceland, while it is 6% in Sweden, 14% in the United States and 3% in the United Kingdom (Object 18).



Object 18- Due to conditions in Iceland, no irrigation is needed for cultivation while the number is higher for the UK and Sweden, and considerably higher for the US. Adapted from: [FAO-Food security \(2013\)](#).

Qualitative data from The Ministry of Fisheries and Agriculture and the OECD validates that there is not substantial need for agricultural inputs in Iceland. The soil in Iceland is mainly Andosol, which does bring some need for fertiliser use (The Ministry of Fisheries and Agriculture, 2010). Even so, the soil is more or less fertile and the main limitations to farming in Iceland are rather connected to short growing season and topography (OECD, 2008). Irrigation is entirely rain-fed in Iceland as the soil stores water over longer periods of time and makes water available to the plants (The Ministry of Fisheries and Agriculture, 2010) (OECD, 2008).

3.1.2.2 Marine resource management

The fisheries management system in Iceland is sustainable according to the FAO criteria regarding fisheries governance. All fisheries in Iceland are managed by the Ministry of Fisheries and Agriculture, and the ministry also implements laws and regulations relevant for fisheries. Fishery inspectors monitor compliance of laws and regulations. Each fishing vessel is assigned individual transferable quota (ITQ) in accordance with the total allowed catch (TAC). The TAC depends on recommendations of scientists and is based on the status of each fish stock from year to year. Shore fishing is limited to smaller vessels and both mesh size for trawls and by-catch is monitored (Table 5).

Table 5 – The criteria for sustainable fisheries management are met for all parts of FAO guidelines about fisheries governance. The catch limitations system is a vital part as allowed catches are controlled in line with scientific recommendations based on stock monitoring. Vessels are subject to surveillance for: staying within quotas, by-catch, shore fishing, and fishing gear. Adapted from: FAO – Fisheries and Aquaculture Department (2013) and FAO – Fisheries Governance (2013).

FAO guidelines	Fisheries management in Iceland	Sustainability criteria met
Monitoring of fish stocks	Monitored by scientists who recommend allowed catch each year	Yes
Control of allowed catch	Individual transferable quota according to total allowed catch	Yes
Surveillance of fishing	Quota, shore fishing, by-catch and equipment monitored by fisheries inspectors	Yes

3.1.2.3 Energy sources

The share of energy used for greenhouses and aquaculture is low in terms of total energy consumption. Also, the energy source used for greenhouse cultivation and aquaculture in Iceland is renewable. For greenhouses, the share of land area is similar to the share of energy used for greenhouses in total geothermal energy use. Greenhouses cover 19 ha out of the 1.000 ha used for cultivating vegetables in Iceland. Similarly 700 TJ (TeraJoule) are used for those greenhouses, approximately 2 percent of the total geothermal energy use in the country. As for aquaculture, exported fish for human consumption is 4.800 tonnes from aquaculture, a small share of the total 783.000 tonnes exported in 2008. The share of aquaculture in total energy use for the relevant energy source is however four times higher. The energy used for greenhouse cultivation and aquaculture is geothermal, a renewable source. Methods for sustainable utilisation of the energy source are followed. This means that utility rate does not exceed the ability of the resource to renew. A long utility rate prolongs the utility period to 100-300 years, avoiding excessive production (Table 6).

Table 6 – In 2008, greenhouses made a small portion of the land area used for growing vegetables and also a small share of total geothermal energy use in Iceland. Fish raised from aquaculture is similarly a small share of total exported fish for human consumption, but the share of aquaculture in geothermal energy use is relatively high. However, the energy source for both greenhouses and aquaculture is renewable and utilised sustainably. Data for calculation adapted from: NEA (n.d.), FAO – Fisheries and Aquaculture Department (2013), and Axelsson et al. (2005).

Activity	Share of total production	Share in total energy use in Iceland	Sustainable utilisation of energy source
Greenhouse cultivation	2%	2%	Yes
Aquaculture	1%	4%	Yes

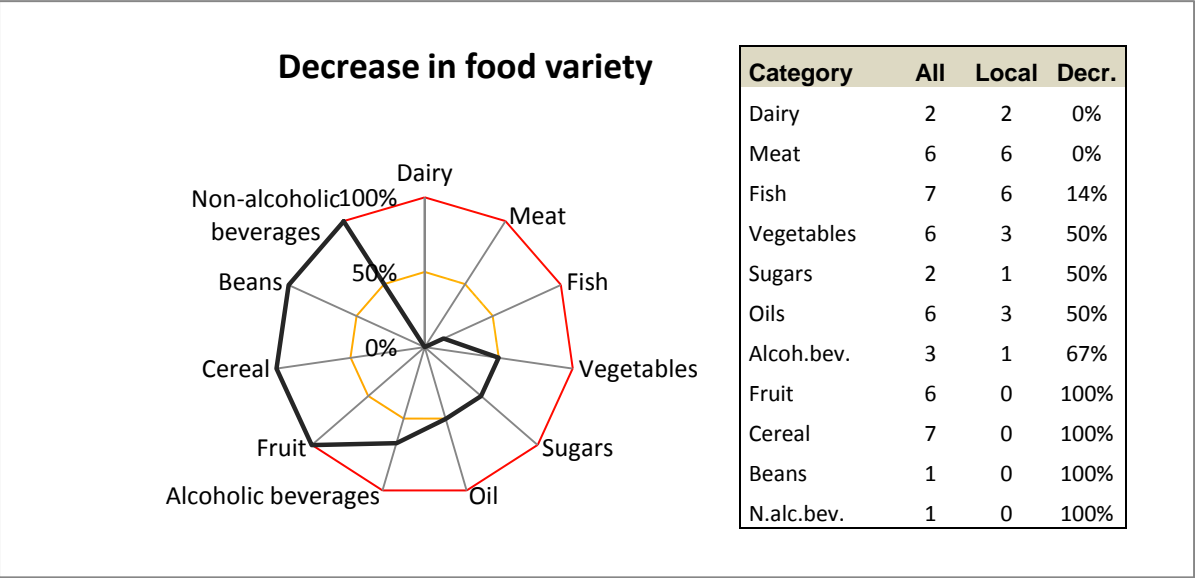
3.2 Cultural barriers

3.2.1 Diversity

3.2.1.1 Food variety

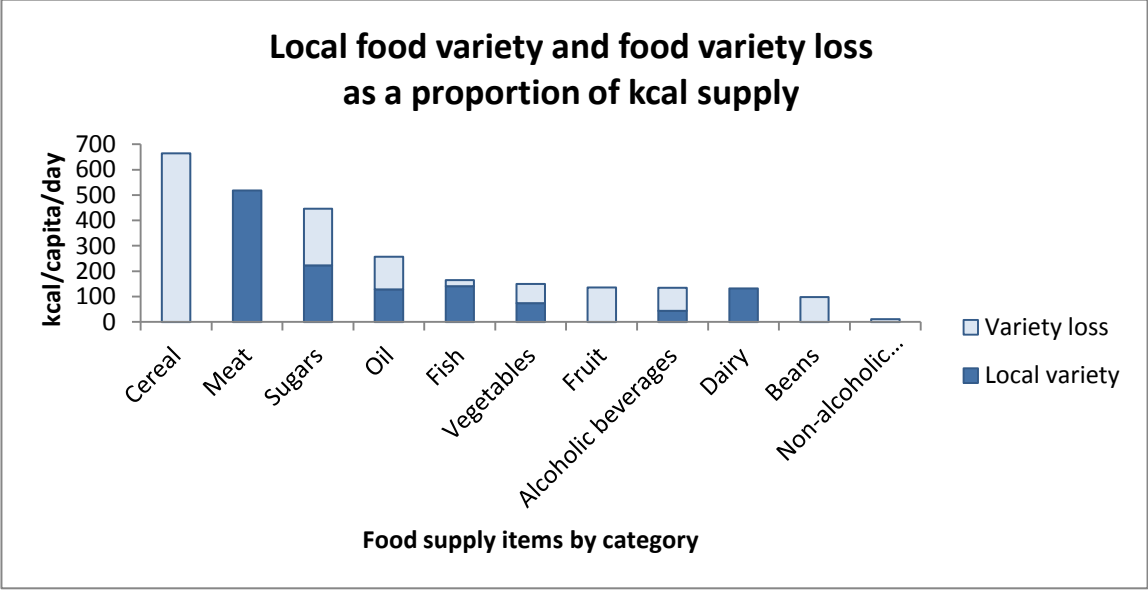
Food variety would decrease if all food supply were derived from local sources. These results are limited to data concerning food currently grown in Iceland, in sufficient amounts to fit the criteria for the FAO data (1000 tonnes). Hence it might be possible to grow more variety than is displayed in these results, and there might currently be more items grown than are displayed.

If all consumption were supplied from local sources, variety would decrease by 100% for the food categories fruit, cereals, beans, and non-alcoholic beverages, meaning that these food categories are currently not produced in the country, according to the given criteria. If these food categories were to be supplied from domestic sources only, in amounts meeting current supply from imported sources, it would result in minimal or non-existing variety. Variety would decrease slightly for fish (14%). The decrease would be 67% for alcoholic beverages and 50% for vegetables, sugars, and oils. Iceland would however be self-reliant for dairy and meat and food variety would not decrease for those categories (Object 19).



Object 19 – Variety loss would be least for dairy, meat and fish if food supply would be entirely from domestic sources. Vegetable, sugar, and oil variety would decrease by half, and the decrease would be two thirds for alcoholic beverages. Variety loss would be complete for fruit, cereals, beans and non-alcoholic beverages as those food categories are currently not produced domestically in amounts displayable in 1000 tonnes. Food items per category compiled and rate of decreased variety calculated using: FAO – Food Balance Sheet (2012).

The population would be most affected by variety loss for cereals, sugars and oils. In proportion of kcal supply and current food supply (the kcal supply per capita is 2.719 on a daily basis), cereals provide 665 kcal, sugars 447 kcal (variety loss 224 kcal, calculation based on FAO data for kcal consumption) and oils 258 kcal (variety loss 129). The proportion would be similar for vegetables, as 75 kcal would be subject to variety loss out of a total 150 kcal. Meat provides 519 kcal and variety would not be affected if the supply would only come from domestic sources, fish provides 165 kcal and variety loss would amount to 23 kcal (Object 20).



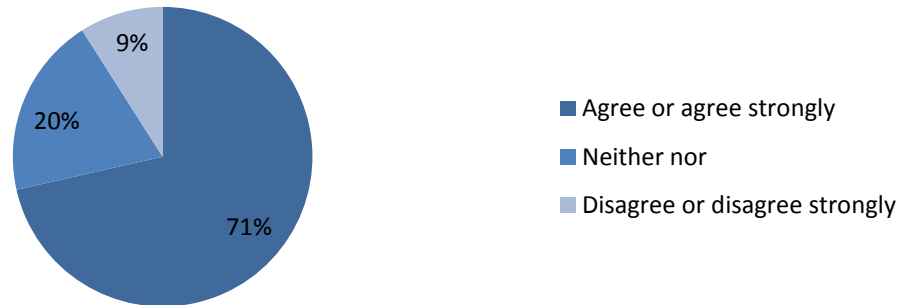
Object 20 – Variety loss for cereals, sugar and oils would affect the daily diet the most. Meat is a large share of the daily diet and would not be subject to variety loss. The effects would be less for other food categories. Share of kcal for each food category multiplied with the variety loss for the respective category. Data source: FAO – Food Balance Sheet (2012).

3.2.2 Worldviews

3.2.2.1 Cultural norms

Over seventy percent of participants in a survey about local food agree or agree strongly that local food is healthy and safe. One out of five responded neither nor. Less than ten percent disagree or disagree strongly that local food is healthy and safe. This indicates that consumers generally consider local food in Iceland to be healthy and safe, reflecting that consumers have trust in the local food in Iceland. According to the given criteria, these answers indicate that consumers associate positive feelings with local food (Object 21).

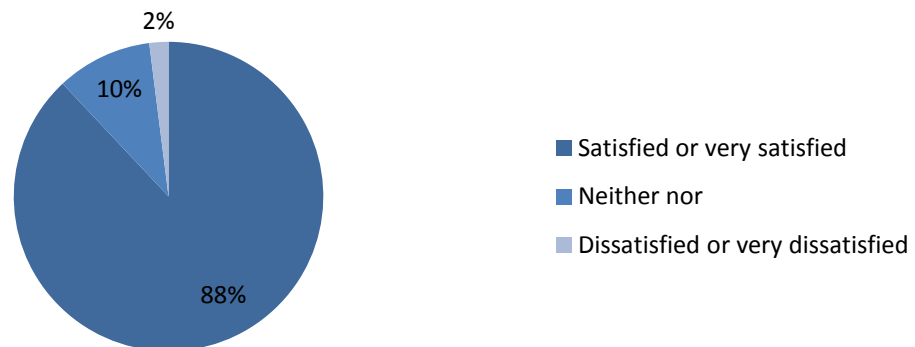
Agree with the statement that local food is healthy and safe



Object 21 – In a local food survey of N=463, the majority of participants agree or agree strongly that local food in Iceland is healthy and safe. Considerably fewer respond neither nor, or disagree with the statement. This reflects positive feelings towards local food in Iceland. Responses for this statement were 410, or 89%

Consumers who had purchased local food in their current trip were generally satisfied or very satisfied with the food. Those who responded neither nor were a small group and even fewer were dissatisfied or very dissatisfied. This indicates that consumers are generally satisfied with the local food in Iceland, reflecting positive attitudes towards local food (Object 22).

How satisfied are you with the local food you have bought?



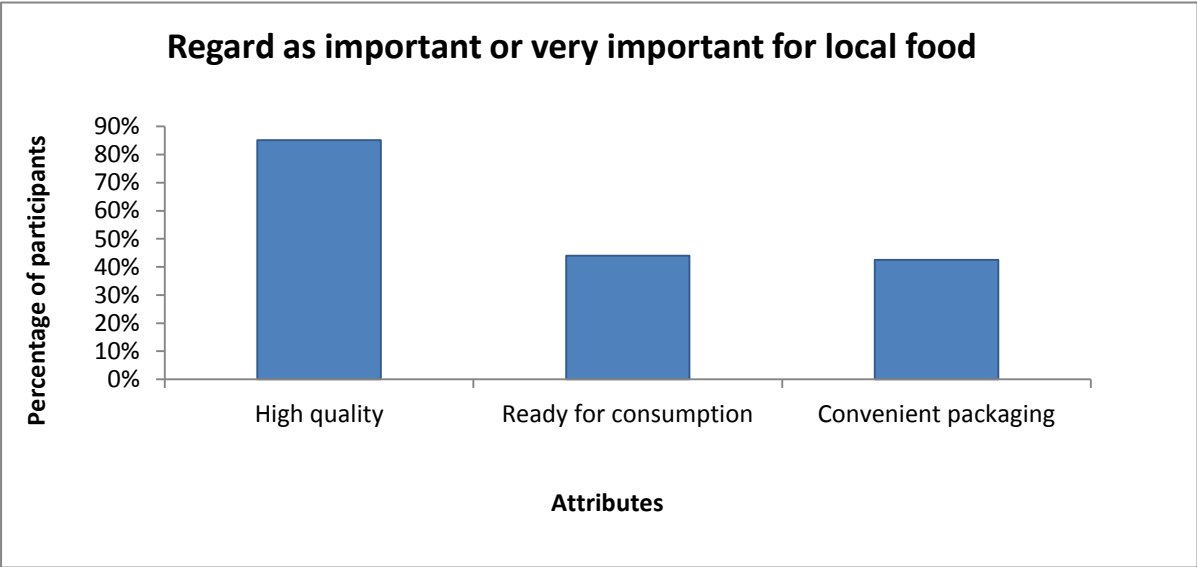
Object 22 – Results from a local food survey of N=463 reveal that those who had bought local food were generally positive about the product (87% response rate). In this way, the majority of participants were satisfied or very satisfied, while very few answered neither nor, or were dissatisfied with the product they had bought. This reflects a general positive attitude towards local food in Iceland.

3.3 Personal barriers

3.3.1 Attitudes

3.3.1.1 Reasons behind consumers' choices

The majority of those who answered about the importance of different attributes when it comes to local food consider high quality as important or very important. This is nearly twice as many as consider it important or very important that the product is ready for consumption or has convenient packaging. These results indicate that consumers do not make their choices about local food based on convenience (Object 23).

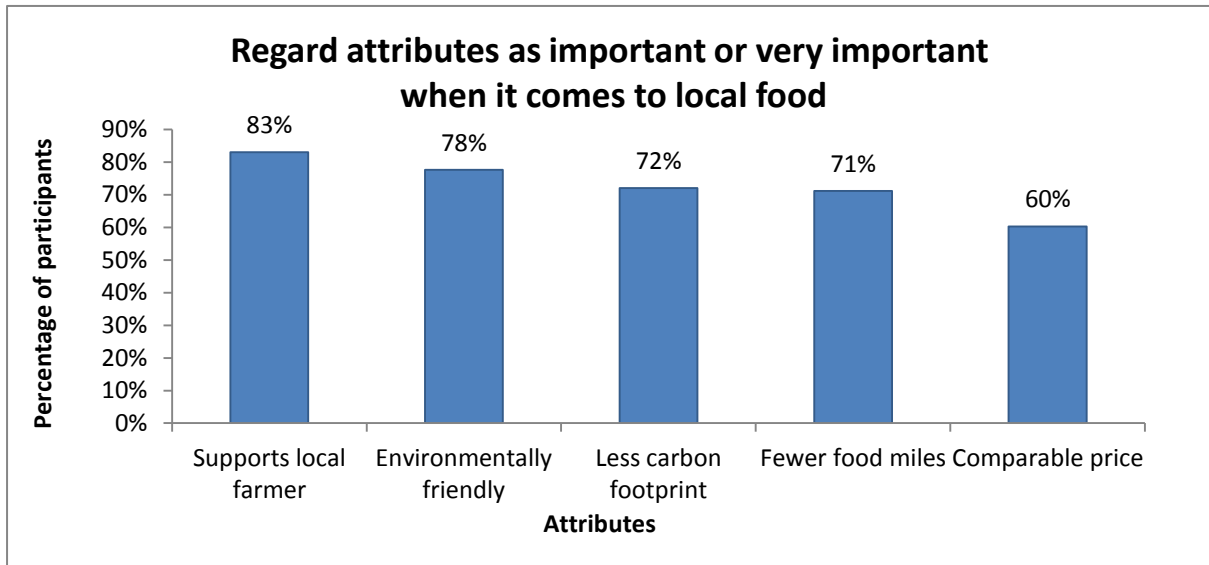


Object 23 - Participants in a local food survey of N=463 do not regard convenience as more important than quality when it comes to local food attributes. High quality is regarded as an important or very important attribute to local food by most participants (85%).

3.3.2 Awareness

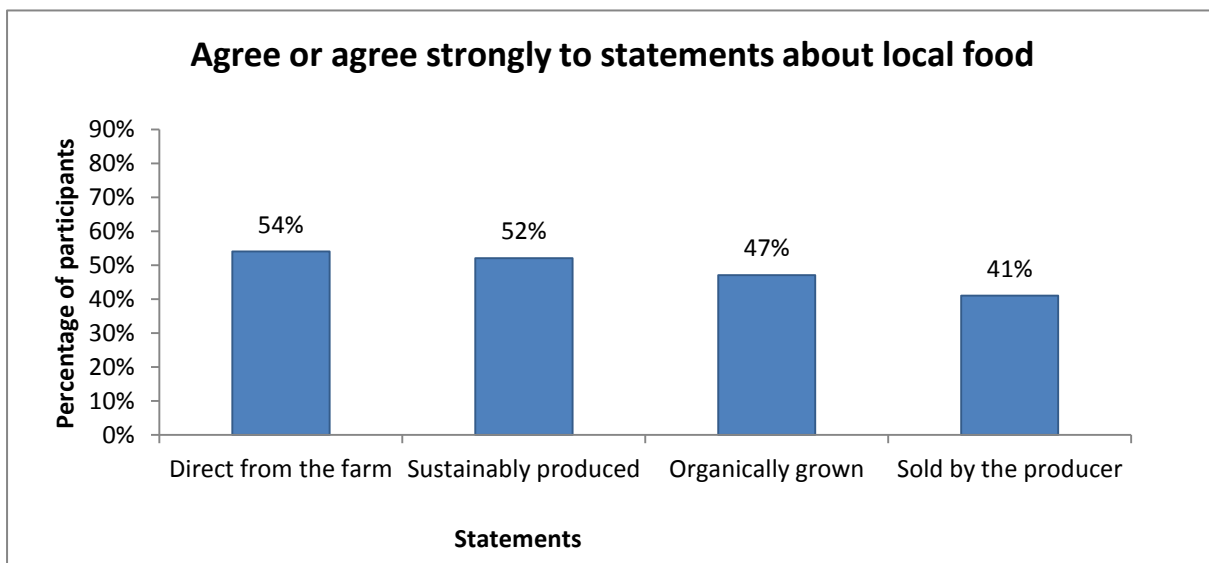
3.3.2.1 Justification of choices

The results show that participants regard sustainability issues, such as environmental impacts, as important when it comes to local food, indicating that consumers are generally aware of the implications connected to choosing local food. Over eighty percent consider support to the local farmer as important or very important. Similarly three out of four consider it as important that local food is environmentally friendly, that it has less carbon footprint and fewer food miles. Comparable price is considered important by two thirds of participants, which is considerably high but still lower than any of the statements connected to sustainability issues (Object 24).



Object 25 – Consumers consider sustainability issues to be important, reflecting their awareness of sustainability issues connected to local food. In a N=463 survey about local food, support to the local farmer is considered as important or very important by majority of participants. Other attributes connected to sustainability issues are also considered more important than comparable price. Response rate for these questions was 89-91%.

Attributes connected to sustainability issues are considered as important to a high number of participants, while those agreeing that local food is sustainable are considerably fewer. One out of two agreed or agreed strongly that local food comes directly from the farm and that local food is sustainable produced. Less than a half agree that local food is organically grown and that local food is sold by the producer. These answers indicate that consumers do not necessarily regard the local food in Iceland as a sustainable choice. This represents a justification, not finding it necessary to always choose local food, even if consumers are generally aware of sustainability issues connected to local food (Object 25).



Object 24 - In a N=463 survey about local food, around half of participants agree or agree strongly that local food comes directly from the farm, that it is sustainably produced, organically grown and that it is sold by the producer. Response rate varied from 83-87%. Participants agree to the statements about local food in Iceland, but not to the same extent as they regard those same issues to be important when it comes to local food in general. This indicates that consumers justify their choices.

4 Discussion

4.1 Behavioural barriers to change

In my thesis, I looked at the possibilities of increased production and consumption of local food, through identifying structural, cultural, and personal barriers to change. When assessing what is a behavioural barrier and what is not, it is important to avoid generalisation. This means that even if a barrier to change is identified, it does not automatically stop change from occurring. For example, even if the results indicate that consumers justify not buying local food, it does not mean that those consumers would actually refrain from buying local food. Identification of a barrier rather indicates a research area that should be given attention.

In the process of identifying barriers to change, I have referred to production of local food by addressing the capability of Iceland to grow food, explored the sustainability of resources necessary for the production of local food, and estimated food variety. Furthermore, I have looked into the consumption side through exploring what consumers base their choices on, what their attitudes are, and if they make rationalisations for their choices.

As for the results of my thesis research, in which I addressed six topics under three categories of barriers, I identified one cultural and one personal barrier to change. The topics connected to structural barriers, self-reliance in food production and sustainability of resources, did not present barriers to change towards more production of local food. For cultural barriers, diversity in local food production was identified as a barrier to change, but the worldviews of consumers were not. For personal barriers, consumers' justification of choices, presented through the topic awareness, was identified as a barrier towards change. Attitudes of consumers towards local food however did not.

Since I have identified one barrier connected to production and one connected to consumption, I structured my discussion accordingly. Although each research question is revisited, I explore the topics on one hand through discussing the ability of Iceland to produce sufficient amount of food and on the other by discussing if consumers want to buy more local food (Table 7).

Table 7 - The results reveal that there are no structural barriers to change towards more production of local food. There are however cultural and personal barriers to change towards more consumption of local food, diversity referring to increased production of local food and awareness referring to increased consumption of local food.

Barriers	Topic	Result	Addresses
Structural	Food needs and food supply	Not a barrier	Production
	Sustainability of resources	Not a barrier	
Cultural	Diversity	Barrier to change	Consumption
	Worldviews	Not a barrier	
Personal	Attitudes	Not a barrier	Consumption
	Awareness	Barrier to change	

4.2 Production: Can Iceland produce more local food?

4.2.1 Food needs and food supply

When identifying structural barriers to change, I found that land availability and possible food supply from local sources is sufficient for the food needs of the population. Therefore the conditions for self-reliance are met, indicating that this is not a barrier to change towards increased production of local food.

To put these findings into context, it may be said that the country of Iceland could produce sufficient amount of food to supply the population, according to the current supply from all sources. Keeping in mind the limitations of the natural environment in Iceland, this result might sound surprising. Nevertheless, this is in line with the general discussion in Iceland regarding food production. This non-academic discussion widely expresses the point of view that more food could maybe be grown in the country, and consequently less would be imported. The Icelandic congress is now proposing to point a committee responsible for developing policy regarding increased food production. The increase is not only aimed at increasing food security in the country, but also to create opportunities in exporting agricultural products (Icelandic Congress, 2013)

4.2.2 Sustainability of resources

The continuing identification of structural barriers suggested that conditions in Iceland allow for the use of sustainable cultivation methods. Furthermore, fisheries are managed in a sustainable way and energy sources used for greenhouses and aquaculture are renewable. The criteria I used for estimating if resources were sustainable were met and this is therefore not a barrier to change.

The country of Iceland could therefore practice sustainable resource use, while producing the amount of food needed to meet current supply. Without generalising about the sustainability of resources in other countries, Iceland is capable of producing more than is currently done and without more environmental impact than would come from imported food. An example of this might be bell peppers, on one hand grown in greenhouses in Iceland run by renewable energy, on the other those grown in greenhouses in Holland and then shipped to Iceland.

Due to impacts on the environment, food system research should include the effects of food production on natural capital (Ericksen, 2008). My results underline that the environmental impacts of local food depend on factors like cultivation methods (Tukker et al., 2010). Furthermore this can serve as an encouragement for increasing local food production in Iceland, where sustainable agriculture practices minimise the impacts of local food production.

4.2.3 Diversity

The process of identifying cultural barriers to change involved comparing the current variety, depending on if the supply was from local or imported sources. According to the results of this research, food variety would be decreased in Iceland if food supply were limited to local sources only. This means that food variety is a cultural barrier to change towards increased consumption of local food. An overview of my research topics connected to consumption reveals that it is possible to grow a sufficient amount of local food to match current supply, using sustainable methods. However, food variety would be considerably less than it is now.

These findings do not come as a surprise, as natural conditions in the country limit the crop types that could be grown. Looking beyond growing crops, the very small population in the country might limit the possibilities of producing certain foods at a reasonable price. With globalisation in the food industry, food variety has increased in most parts of the world. Even if there would be economic, environmental or social benefits associated with increasing local food production and consumption, it remains uncertain if consumers are willing to accept less variety as a result. However, the undertone of the current discourse is about exploring opportunities connected to increased production (Icelandic

Congress, 2013). In line with this, it is relevant to address lack of food variety as a challenge rather than a problem, and explore possibilities connected to increasing variety.

4.3 Consumption: Do consumers want more local food?

4.3.1 Worldviews

Addressing cultural barriers further, I established that participants in a local food survey associate local food with positive feelings and are satisfied with local food products they have bought. This connects to consumption and indicates that consumers in Iceland are generally positive towards local food. According to my criteria, it is a cultural barrier to change if consumers associate local food with negative feelings. Thus, the worldviews of consumers do not raise barriers towards increased consumption of local food in Iceland.

4.3.2 Attitudes

Identifying personal barriers to change, I evaluated the attitudes of consumers towards local food and found that this is not a barrier to change. I illustrated the reasons behind consumers' choices in order to estimate if convenience could be a determining factor when making decisions about buying local food. While doing so, I looked into the reasons behind consumers' choices in order to estimate if convenience could be a determining factor. According to my results, convenience is not a determining factor when consumers make decisions about buying local food; however high quality might be.

Although the attitudes of consumers are not identified as a barrier to change, these results can nevertheless be useful for producers of local food. Consumers value quality products over convenient food ready for consumption. This information can be used in product development as well as for marketing local food products.

4.3.3 Awareness

My results show that consumers are aware of the sustainability issues connected to local food. They also connect local food in Iceland to these sustainability issues, but not to the same extent as they connect these issues to local food in general. This indicates that consumers might tend to justify their choices, resulting in less consumption of local food. Hence, awareness is a personal barrier towards increased consumption of local food in Iceland.

My findings suggest that even if consumers associate positive feelings with local food, and do not favour convenience over other product attributes, they might make justifications when it comes to actually purchasing local food. Research on consumer profiling for local and organic food found that

consumers that are positive towards local food and organic food, value attributes like support to the local farmer, health benefits and environmental benefits (Bean & Sharp, 2011). When comparing my thesis results with research about other alternative food systems, the results are coherent in many ways. As described by Pearson et al (2011), the general positive attitude towards organic food has been well established. Consumers for example connect organic food with quality, and consider environmental issues as important in this context. However, these attitudes are not necessarily reflected in high level of purchase (Pearson et al., 2011).

Through my thesis research I have identified a tendency among consumers to be positive towards local food and aware of sustainability issues. I have also identified a possible justification. Consumers feel that sustainability issues are important but remain doubtful that local food in Iceland actually is sustainable. Further research might reveal if this scepticism results in those consumers actually buying less. The fact remains that there is a gap between consumers' attitudes and actual purchase when it comes to alternative food systems. I see the method of identifying cultural and personal barriers to change as very useful for future research connected to this gap.

4.4 Reflections

4.4.1 Limitations of the research and suggestions for improvement

For the topics connected to production: food needs and food supply, resource sustainability, and diversity I found the main limitations to be connected to data sources. I found it important to work with data that were accessible and more or less ready for analysis. I needed data for import, export and production within the country. The FAO data fit my criteria, and provides an excellent source of comparable data for food supply in Iceland. However, there are limitations to the food supply data set.

First, sugar supply from local sources seemingly included sugars from products like soft drinks made from imported concentrate, which I therefore excluded from further analysis. Second, the amount of supplied food is displayed in 1000 tonnes. While this might be convenient for the large numbers that most countries consume, it is not for a country with the population around 320.000 people. I found that all cereals grown in Iceland were displayed as zero (0), because the production levels were too low to register in FAO data. Thus, even if local cereals are non-existing in the data set, there are several cereal types grown in the country. This became problematic when I was estimating how much food diversity would decrease if sources would be entirely local.

This brings me to the methods I used for this part of the research. It would have been more accurate to use data about crops that are actually grown in Iceland, rather than what is grown according to the FAO data set. For the sake of consistency I chose to use the data set I based my other findings on. As a result, food variety loss is displayed more than is probably called for in my results. While this should

be kept in mind, I still estimated this difference not to be beyond the point that it would have changed the results. In other words, diversity would probably be identified as a barrier to change, even if different data sources would be used.

For the consumption topics: worldviews, attitudes, and awareness, I used quantitative data to explain consumer behaviour. This is explanatory as I did not describe the behaviour of consumers, but sought to find the reasons behind the behaviour (Bryman, 2008, p. 156). As such, my research can only provide speculations about causality and I see this as a limitation. In a study of waste reduction, based on the Integral approach, qualitative data were collected in order to explore the specific aspects of the behavioural barriers (Owens, 2005). Similarly it could contribute to my findings if qualitative data connected to the behavioural barriers, such as the personal barriers, would be collected, for example through interviews, and analysed in order to provide deeper insights into causality.

4.4.2 Further research and implications

As I identify two barriers to change in my research, the next obvious steps would be to work with how these barriers could be overcome. Diversity is a cultural barrier and connects to the activity of production in the food supply chain. Further research might be identifying what kind of crops can actually be grown in the country, and how diverse the local food production might become. In this context, it is also interesting to include aspects that connect to the resilience of the food system. As described by Ruhf & Clancy (2010), diversity in types of farms, soils, and crops increases resilience in regional food systems.

For future research regarding growing more local food in Iceland, there are some interesting methods available. For example, a 2011 research paper describes how it is possible to prioritise which food groups to grow locally, using spatial modelling of potential food-sheds (Peters et al, 2011). With work already underway towards spatially mapping land use in Iceland (The Agricultural University of Iceland - database, n.d.), there is potential to match these data with the amount of land area needed to grow the main crops, according to the best fitting soil type and weather conditions in each area of the country.

Second, awareness is a personal barrier and is connected to the consumption of food. Research aimed at overcoming this barrier would connect to consumer behaviour and the reasons for not choosing local food. I see it as relevant to explore causality in this context. The first step might be to do a qualitative study where attitudes, awareness, and consumer behaviour towards local food could be explored in more detail through interview data. This is in line with the approach of Owens (2005) when addressing barriers to sustainable consumption and waste reduction.

I also see it as relevant to study the practical implications of food system outcomes, which have been described by Ericksen (2008) as contributing to social welfare, food security, and environmental security. In my thesis research I assume that implications connected to social welfare come with the territory of enhancing the local food system. The actual outcomes could nevertheless be studied further and this would involve components contributing to social welfare like increased income and employment (Ericksen, 2008). Similarly, the components of food security can be seen as food utilisation, food availability, and food access, including points like nutritional value, production and affordability of food (Ericksen, 2008). The affordability of food connects directly to a point beyond of the scope of this thesis research, but a very interesting one for future research: the affordability of local food and connection to the economic implications of enhancing local food systems.

I see my research, and connected future research as beneficial to policy makers on all levels. The results should thus be interesting to the general public as well as policy makers and academia. The outcomes of food systems are common discussion points in decision making and are as such very relevant in food systems research intended to benefit policy makers. The process of policy making involves making trade-offs between different components. This applies to decisions made on household level just as well as national level (Ericksen, 2008). In the context of my thesis research I see it relevant for academia to apply the research structure to other local food cases. The diversity barrier is relevant for public policy makers as well as researches because it points out an important research area. Likewise it is relevant for product development and for marketing strategies to be aware of the awareness barrier.

5 Conclusion

Through this thesis research, I have made a practical contribution to the knowledge about the food system in Iceland. I identified two major barriers to change towards increased production and consumption of local food. Decreased variety is a cultural barrier connected to the supply chain, or production of local food. The scepticism of consumers regarding the sustainability of local food in Iceland is a personal barrier, as such inhibiting increased consumption of local food.

Although not directly linked, these barriers are both connected to consumers. Food variety is not only connected to the physical environment and what to grow, but also and what consumers prefer. The implications of overcoming decreased food variety could be beneficial to the natural environment through resilience, and to the social environment through supplying sufficient variety of food for consumers. The scepticism of consumers could be overcome through means like knowledge production and marketing strategies. The implications of such measures would be aimed at increasing demand for local food. This is also the touching point for the two barriers to change, for if the intention is to increase demand for local food, the supply must be in place.

In terms of theoretical contribution, I have merged two frameworks in order to address issues connected to both production and consumption of local food. I point out that food system research connected to alternative food systems has been criticised for leaving out the consumer perspective. Research needs in this way to demonstrate why consumers might make decisions about not buying local food. Research connected to local food systems for example, tend to evolve around why consumers want to support them and what they benefit from doing so (Tregear, 2011). By following the Integral approach as described by Owens (2005) I address issues like what could be hindering consumers from choosing local food. By adding the guidelines of Clancy & Ruhf (2010) for estimating regional food systems, I have provided a research structure that can be applied elsewhere for the purpose of identifying behavioural barriers to increased production and consumption of local food.

6. Bibliography

- Axelsson et al. (2005). Sustainable Management of Geothermal Resources and Utilization for 100 – 300 Years. *World Geothermal Congress* . Antalya, Turkey: The International Geothermal Association.
- Bean, M., & Sharp, J. (2011). Profiling alternative food system supporters: The personal and social basis of local and organic food support. *Renewable Agriculture and Food Systems* 26(3) , 243-254.
- Bernóðusson, J., & Eggertsson, Ó. (2010). *Environmentally friendly energy sources - Umhverfisvænir orkugjafir*. Retrieved March 25, 2013, from [www.matis.is: http://www.matis.is/media/fodurradstefna-2011/7_Matis-2011.04.08-orka_hrat.pdf](http://www.matis.is:www.matis.is/media/fodurradstefna-2011/7_Matis-2011.04.08-orka_hrat.pdf)
- Bryman, A. (2008). *Social Research Methods 3rd ed*. New York: Oxford University Press Inc.
- Clancy, K., & Ruhf, K. (2010, 1st Quarter). Is Local Enough? Some Arguments For Regional Food Systems. *Choices: 25(1)* .
- Edwards-Jones, G. (2010). Does eating local food reduce the environmental impact of food production and enhance consumer health? *Proceedings of the Nutrition Society* 69 , 582–591.
- Ericksen, P. (2008). Conceptualizing food systems for global environmental change research. *global Environmental Change* 18 , 234-245.
- Esbjörn-Hargens, S. (2010). An Overview of Integral Theory - An All-Inclusive Framework for the 21st Century. In S. Esbjörn-Hargens, *Integral Theory in Action* (pp. 33-64). Albany: State University of New York Press.
- Esbjörn-Hargens, S. (2005). Integral Ecology: The What, Who and How of Environmental Phenomena. *World Futures: The Journal of Global Education* 61:1-2 , 5-49.
- FAO - Fisheries and Aquaculture Department. (2013). *Fishery and Aquaculture Country Profiles - Iceland*. Retrieved April 5, 2013 , from [www.fao.org: http://www.fao.org/fishery/countrysector/FI-CP_IS/en](http://www.fao.org/fishery/countrysector/FI-CP_IS/en)
- FAO - Fisheries Governance. (2013). *Governance of capture fisheries*. Retrieved April 18, 2013, from [www.fao.org: http://www.fao.org/fishery/topic/2005/en](http://www.fao.org/fishery/topic/2005/en)
- FAO - Food Balance Sheet. (2012). *FAOSTAT - Iceland 2009*. Retrieved March 1, 2013, from [www.fao.org: http://faostat3.fao.org/home/index.html](http://faostat3.fao.org/home/index.html)
- FAO - Food security. (2013). *Country Profiles - Food Security Statistics*. Retrieved March 23, 2013, from [www.fao.org: http://www.fao.org/countryprofiles/default/en/](http://www.fao.org/countryprofiles/default/en/)

- FAO World summit on food security. (2009, October 12-13). *How to Feed the World in 2050 - The prospects for agriculture*. Retrieved May 12, 2013, from www.fao.org: <http://www.fao.org/wsfs/forum2050/wsfs-forum/en/>
- Feagan, R., Morris, D., & Krug, K. (2004). Niagra Region Farmers' Markets: local food systems and sustainability considerations. *Local Environment, Vol.9, No.3* , 235-254.
- Foley et al. (2011). Solutions for a cultivated planet. *Nature, Vol. 478* , 337-342.
- Gladys Moreno Garcia, communication by electronic mail. (April 19th 2013). Food Balance Sheet - Iceland. *Statistics Division - FAO* .
- Godfrey et al. (2010). Food Security: The Challenge of Feeding 9 billion People . *Science 327* , 812-818.
- Hermannsson, J., & Guðmundsdóttir, B. (2012). Land needed for farming - Landþörf til búskapar. *Land-use planning and land use in Iceland - Skipulag landnotkunar og landnýtingar á Íslandi* (pp. 18-19). Reykjavík: The Icelandic Planners Association and The Agricultural University of Iceland.
- Icelandic Congress. (2013, March 4). *parliamentary resolution concerning increased food production in Iceland - Tillaga til þingsályktunar um aukna matvælaframleiðslu á Íslandi*. Retrieved May 17, 2013, from www.althingi.is: <http://www.althingi.is/altext/141/s/pdf/1101.pdf>
- Icelandic Maritime Administration. (2010). *Environmentally friendly energy sources - Umhverfissvænir orkugjafar*. Retrieved March 25, 2013, from www.sigling.is: <http://www.sigling.is/lisalib/getfile.aspx?itemid=5350>
- Kastner et al. (2012). Global changes in diets and the consequences for land requirements for food. *PNAS 109(18)* , 6868-6872.
- Kates et al. (2001). Sustainability Science. *Science, New Series, Vol. 292, No. 5517* , 641-642.
- Kates, R., & Parris, T. (2003). Long-term trends and a sustainability transition. *Proceedings of the National Academy of Sciences, Vol. 100, No. 14* , 8062-8067.
- Khagram et al. (2010). Thinking about knowing: conceptual foundations for interdisciplinary environmental research. *Environmental Conservation* , 388-397.
- Mount, P. (2012). Growing Local Food: Scale and Local Food Systems Governance. *Agriculture and Human Values 29(1)107-21* , 107-121.
- NEA. (n.d.). *National Energy Authority, Geothermal*. Retrieved April 18, 2013, from www.nea.is: <http://www.nea.is/geothermal/>

- OECD. (2008). *Environmental Performance of Agriculture in OECD Countries since 1990*. Paris, France: OECD.
- Owens, C. (2005). An Integral Approach to Sustainable Consumption and Waste reduction. *World Futures: The Journal of Global Education*, 61:1-2 , 96-109.
- Pearson et al. (2011). Organic food: What we know (and do not know) about consumers. *Renewable Agriculture and Food Systems* 26(2) , 171-177.
- Peters et al. (2011). Mapping potential foodsheds in New York State by food group: An approach for prioritizing which foods to grow locally. *Renewable agriculture and Food Systems* 27(2) , 125-137.
- Pretty et al. (2010). The top 100 questions of importance to the future of global agriculture. *International Journal of Agricultural Sustainability* 8:4 , 219-236.
- Ruhf, K., & Clancy, C. (2010, September). *Northeast Sustainable Agriculture Working Group - Publications*. Retrieved April 8, 2013, from www.nefood.org: <http://api.ning.com/files/nRTEesYytUshUdiU-IEPLW6lFFE3Zgcz44LFacsKlo5K6P0X43KSuSZOkwFHiTQF6a0t5O9mAXuWNb0HbP7GZjgKVUkE7gVY/NESAWGRegionalFoodSystemFINALSept2010.pdf>
- Solow, R. (1993). An almost practical step toward sustainability. *Resources Policy* , 162-172.
- Statistics Iceland. (n.d.). *Agriculture - Consumption of artificial fertilizers 1977-2011*. Retrieved April 10, 2013, from www.statice.is: <http://www.statice.is/Statistics/Fisheries-and-agriculture/Agriculture>
- Statistics Iceland. (n.d.). *Population - Overview*. Retrieved May 6, 2013, from www.statice.is: <http://www.statice.is/Statistics/Population>
- The Agricultural University of Iceland - database. (n.d.). *Building a land use database - Uppbygging gagnagrunns um landnýtingu* . Retrieved May 17, 2013, from <http://www.landbunadur.is>: [http://www.landbunadur.is/landbunadur/wgsamvef.nsf/0/e31da5b1709858460025749d003d9eae/\\$FILE/Uppbygging%20gagnagrunns%20um%20landn%C3%BDtingu.pdf](http://www.landbunadur.is/landbunadur/wgsamvef.nsf/0/e31da5b1709858460025749d003d9eae/$FILE/Uppbygging%20gagnagrunns%20um%20landn%C3%BDtingu.pdf)
- The Agricultural University of Iceland. (n.d.). *Agricultural Economics - Hagbjónusta landbúnaðarins*. Retrieved March 20, 2013, from www.hag.is: <http://www.hag.is/kornsk.pdf>
- The Farmers Association of Iceland. (2009). *Food security - Fæðuöryggi*. Retrieved May 13, 2013, from www.bondi.is: <http://www.bondi.is/Pages/1140>
- The Ministry of Fisheries and Agriculture. (2010). *Report of the land use committee. Observation about the use and conservation of arable land. - Skýrsla nefndar um landnotkun. Athugun á notkun og varðveislu ræktanlegs lands*. Reykjavík: Sjávarútvegs- og landbúnaðarráðuneytið.

- The University of Iceland. (2006, September 7). *Siðareglur fyrir rannsóknir í félagsvísindadeild Háskóla Íslands - Ethical Protocol for research in the School of Social Science*. Retrieved December 7, 2012, from www.hi.is: https://docs.google.com/viewer?a=v&q=cache:i8L4-pdOcYcJ:www.hi.is/files/skjol/felagsvisindasvid/deildir/felags_og_mannvisinda/Si__areglur_lok_askjal.pdf+&hl=en&gl=se&pid=bl&srcid=ADGEESjQ28gIdNhJqhJqFgAPUXaNfI2_At3qfeVNDKB36glNRPNByqlhnoSGHe8-ML9kz_zEJtKkr
- Tilman et al. (2011). Global food demand and the sustainable intensification of agriculture. *PNAS* *108*(50), 20260-20264.
- Tischner et al. (2010). *System innovation for sustainability*;3. Sheffield, UK: Greenleaf Publishing Ltd.
- Tregear, A. (2011). Progressing knowledge in alternative and local food networks: Critical reflections and a research agenda. *Journal of Rural Studies*, *27*, 419-430.
- Tukker et al. (2010). The Impacts of Household Consumption and Options for Change. *Journal of Industrial Ecology*, *Vol 14 No 1*, 13-30.
- UNCSD Secretariat. (2011, December). *RIO 2012 Issues Briefs*. Retrieved October 17, 2012, from <http://www.uncsd2012.org>:
<http://www.uncsd2012.org/content/documents/227Issues%20Brief%209%20-%20FS%20and%20Sustainable%20Agriculture%20CLCnew.pdf>