
# Aquaponics and Plant-Based Consumption: A Nordic Perspective

Evaluating Attitudes Towards Aquaponics Among Vegan and Vegetarian Consumers in Iceland and Sweden

**Stina Edin Johansson**

**Fiskeldis- og fiskalíffræðideild**

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60 ECTS thesis submitted in partial fulfilment of a *Magister Scientiarum* degree in the Nordic Master Program in Sustainable Production and Utilization of Marine Bio Resources

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Fiskeldis- og fiskalíffræðideild
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# Abstract

The Nordic countries, recognised for their innovative approach to sustainable development, are experiencing a rise in part of their populations becoming vegan and vegetarian. However, with limited arable land these nations face challenges in reaching The Sustainable Development Goals of zero hunger and sustainable production, which emphasises the need for advanced food production systems in the region. Aquaponics, a method integrating aquaculture and hydroponics, offers a potential solution but raises ethical concerns for vegans who avoid any use of animal products. This study was conducted with 31 survey participants and 13 interview respondents across Iceland and Sweden to explore the perspectives of vegans, vegetarians, flexitarians, and pescatarians towards aquaponics. The study utilised risk evaluation and moral foundation theories to further deepen the understanding of the participants perceptions, as both internal and external motivations can influence attitudes. Results revealed that 45.2% of respondents considered aquaponics incompatible with vegan principles. Vegans expressed predominantly negative attitudes, vegetarians were neutral, and flexitarians and pescatarians held positive views. Perceptions were shaped by factors such as dietary preference, country of residence, and personal motivations. Key concerns included animal welfare, environmental impact, and health implications. Swedish respondents prioritised environmental concerns, while Icelandic respondents focused on animal rights. Furthermore, current media coverage was identified as a possible external motivation influencing attitudes in Iceland. These findings emphasise the importance of tailored communication strategies to engage vegan and vegetarian audiences in sustainable food practices involving animal-based systems.

# Útdráttur

Á Norðurlöndunum, sem þekkt eru fyrir framsækna nálgun að sjálfbærri þróun, er vaxandi fjöldi íbúa að tileinka sér lífstíl vegan og grænkera. Á sama tíma standa þessara þjóða frammi fyrir því að það er takmarkað landrými til ræktunar og því geta þær átt erfitt með að uppfylla sjálfbærnimarkmið sameinuðu þjóðanna um ekkert hungur og sjálfbæra framleiðslu. Það undirstrikar þörfina fyrir þróuðum aðferðum til framleiðslu matvæla. Vatnsrækt með fiskum (aquaponics), aðferð sem samþættir aðferðir vatnsræktunar og fiskeldis, er möguleg lausn en hefur í för með sér siðferðisleg álitamál fyrir þá sem aðhyllast vegan lífstíl sem forðast alla vöru sem þar sem að dýr eru notuð til framleiðslu. Í Rannsókninni tóku þátt einstaklingar frá Íslandi og Svíþjóð og svöruðu 31 könnun og 13 tóku þátt í viðtölum. Þannig var kannað viðhorf þeirra sem leggja áherslu á grænmeti í fæðu sinni, þ.m.t. vegan, grænkerar, fólk með breytilegt fæðuval (flexiterians) og þeir sem neyta fisks (pescatarians) gagnvart vatnaræktun með fiskum. Til að auka skilning okkar á því hvernig þátttakendur upplifðu viðfangsefnð var beitt kenningum um áhættumat og siðferðislegan grunn, þar sem bæði utanaðkomandi og innri þættir geta haft áhrif á viðhorf viðkomandi. Niðurstöðurnar sýndu að 45,2% aðspurðra töldu vatnsrækt með fiskum vera ósamrýmanlegt grunngildum vegan lífstíls. Viðhorf þeirra sem tileinka sér vegan lífstíl voru gegnumgangandi neikvæð gagnvart vatnsrækt með fiskum, grænkerar voru hlutlausir og þeir sem neyttu fisks höfðu jákvæðara viðhorf. Viðhorfið mótaðist af þáttum s.s. fæðuvali, búsetuland og persónubundnum hvötum. Helstu áhyggjurnar voru út frá velferð dýra, umhverfisáhrifum og afleiðingum á heilsufar. Þátttakendur frá Svíþjóð lögðu megináherslu á umhverfissjónarmið á meðan að Íslendingar lögðu áherslu á velferð dýranna. Niðurstöðurnar undirstrika mikilvægi að þróa leiðir til samskipta við vegan og grænkera þegar kemur að sjálfbærri matvælaframleiðslu sem fela í sér notkun dýra.

*Till min familj. Tack för att ni alltid stöttar mig*.

# Table of Contents

# List of figures

# List of Tables

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# 1. Introduction

In the midst of the climate crisis, the global population is growing and there is a need for nutritious food and sustainable production systems (FAO, 2020). Expanding the existing land-based agriculture can pose a risk of contributing to climate change and biodiversity decline (Costello, Cao, Gelcich, *et al*, 2020). One alternative to conventional agriculture is aquaponics. Aquaponics is the combination of recirculating aquaculture systems (land-based fish farming) with hydroponics (soil-less production of plants). The waste produced by the fish is used as nutrients for the plants, and the plants in turn filter the water for the fish, creating a circular system (Medina, Jayachandran, Bhat *et al*, 2016). Land-based fish farming can relieve pressure on marine ecosystems by moving the farming and catching from marine environments to an enclosed system on land. In turn, hydroponics can relieve pressure from traditional agriculture, especially when it comes to land-use and conversion of forested lands, since hydroponics can be space-saving by using land that is contaminated or infertile. The plants in hydroponics can also be grown vertically, maximising the growing area (Medina *et al*, 2016; Eriksson, Langeland, Wikberg, *et al*, 2017; Butrico & Kaplan, 2018).

The Nordic countries have been suggested as future global leaders for sustainable food production, believed to be able to approach issues together due to their traditionally strong political cooperation and communication (Meltzer, Brantsæter, Trolle *et al*, 2019). All Nordic countries except from Denmark lack sufficient arable land which means that production technologies like greenhouse production have the potential to increase local food production (ibid.). Although these countries are leading in the realisation of the Sustainable Development Goals (SDG), they are facing issues when it comes to SDG 2 (zero hunger), SDG 12 (sustainable production and consumption) and SDG 13 (climate action) (Sachs, Lafortune & Fuller, 2024). Meltzer, Brantsæter, Trolle *et al* (2019) suggest that for the Nordic countries to commit and fulfil all the SDGs, there is a need for dietary changes and a focus on developing integrated food production systems. The Nordic Council (2023) promotes plant-based diets in their recommendations for nutritious and healthy food habits, and the countries now, in line with other European countries face growing vegetarian and vegan populations, explained by an increase in environmental concern, concern for animal welfare as well as increased health awareness (Lawande & Bawkar, 2024).

Vegans and vegetarians have different motivations for their diet, ranging from concerns about animal welfare and environmental sustainability to personal health and sensory concerns (DeBacker & Hudders, 2015). These differing motivations might influence how vegans and vegetarians assess the ethical and environmental acceptability of food production systems, such as aquaponics. According to one of the best-known vegan and vegetarian seals on products V-label (2023), the criteria for a vegan product include that the product can not be of animal origin. Furthermore, animals or animal products can not be part of any stage of the production of the product. For a product to be considered vegetarian, according to the seal, the product

can not be of animal origin; however, animal by-products can be used in the production (V-Label, 2023). Given that aquaponics involves the use of fish or other aquatic animals to cultivate plants (similar to how livestock manure is often employed in traditional soil-based agriculture) the compatibility of these systems with vegan and vegetarian principles becomes a key consideration if the Nordic countries would want to move towards sustainable food production methods and possibly fulfill the SDGs. Currently, research has focused on the general public's attitudes towards aquaponics (see for example Suárez-Cáceres *et al*, 2021; Greenfeld *et al*, 2020; Miličić *et al*, 2017). A knowledge gap on vegan and vegetarian attitudes towards aquaponics exists, which this study aims to fill with empirical evidence.

## 1.2 Aim and Research Questions

This research aims to explore vegan and vegetarian consumers' attitudes and perceptions toward aquaponics as a food production system. Given that the Nordic countries have yet to fully achieve the UN's Sustainable Development Goals (Sachs *et al*, 2024), and aquaponics has the potential to tackle the goal of zero hunger as well as the goal of responsible production, it is of interest to explore Nordic attitudes towards aquaponics. Furthermore, as the V-label (2023) explains that animals cannot be part of the production cycle for a product to be considered vegan, it is of interest to evaluate the attitudes of consumers on the vegetarian scale towards the use of manure as this might impact their view on aquaponics. Attitude studies on the use of livestock manure are limited, and attitudes towards fish faeces used in aquaponics are commonly not measured on consumers with specific dietary preferences (see Miličić, Thorarinsdottir, Dos Santos *et al*, 2017).

By analysing consumer attitudes along the vegetarian scale and uncovering the motivations driving these perceptions, the study could add empirical evidence regarding dietary preferences to current research on attitudes towards aquaponics. The findings are also intended to provide practical insights for aquaponic companies to effectively market their products to consumers across diverse diets, thereby possibly supporting broader adoption of this sustainable practice and contributing to progress toward sustainable and inclusive food systems in the Nordic region.
The research questions for this thesis are therefore:

- What are vegan and vegetarian attitudes towards aquaponic systems?
- How is the use of livestock and fish manure perceived by consumers on the vegetarian scale?
- Is there a difference in vegan and vegetarian attitudes depending on the diet motivation?

The research questions will be answered using empirical data collected through primarily two research phases: surveys and interviews with consumers on the vegetarian scale in Iceland and Sweden. The following chapters will introduce the main concepts in focus for the study to give a clear background for the study as well as to explain the motivations for choosing Iceland and Sweden as countries of interest to the study. The background is then followed by an overview of previous research

and the current research gap, as well as the theoretical framework that will be used to discuss the data.

# 2. Background

## 2.1 Aquaponics

Recirculating aquaculture systems, or RAS, is a form of aquaculture where around 90% of the water is reused and recycled in the system with the help of different biofilters. RAS systems are considered highly productive, have a lower risk of pests and diseases compared to pen-based aquaculture and discharges less effluent compared to similar systems. Aquaponics use the RAS system, whilst incorporating hydroponics, which is the soil-less production of plants (Medina, Jayachandran, Bhat *et al*, 2016). The plants are either suspended over the water surface or placed in pipes or media (such as LECA or pumice) (Medina *et al*, 2016; Eriksson, Langeland, Wikberg, Nilsson & Sundell, 2017; Butrico & Kaplan, 2018).

The waste from the fish produces ammonia ($NH_3$) and ammonium ($NH_4^+$), collectively known as Total Ammonia Nitrogen (TAN). This mixture is toxic to fish in high concentrations and must be processed to make the water safe. TAN flows through a biofilter, where nitrifying bacteria convert it in two stages: first, from ammonia/ammonium to nitrite ($NO_2^-$), and then from nitrite to nitrate ($NO_3^-$). Nitrate is much less toxic and serves as an effective fertiliser for plants in their tank. Once the water is filtered and nitrate levels are controlled, it can be safely returned to the fish tank (Goddek, Adelaide, Mankasingh, *et al*, 2015; Eriksson, Langeland, Wikberg, et al., 2017; Medina *et al*, 2016). Simultaneously air is constantly pumped into both the fish tanks and plant areas (Taha, El Masry, Gounda, *et al*, 2022). The waste accumulated in the biofilter can be used as fertiliser or to create biogas (Medina *et al*, 2016; Goddek, Joyce, Kotzen *et al*, 2019).

The system is considered sustainable since it is water-efficient (reducing water usage by around 93%), produces several products at the same time (ratio of plants to fish is around 10 to 1), limits the use of chemical fertilisers and does not take up as much landmass as agriculture (Taha, *et al*, 2022; Medina *et al*, 2016; Eriksson *et al*, 2017). Aquaponic systems also have the potential to be set-up almost anywhere, making it suitable for both water- and land-scarce areas. The systems enable local and nutritious food with short supply chains, as well as the option to produce food all year around without being dependent on weather and seasons (dos Santos, 2016; Short *et al*, 2018). One sustainability issue raised by Medina *et al* (2016) is the possible higher cost of urban land, when choosing an urban setting for the farm. However, this can possibly be offset with premium prices, consumer interest in locally produced foods and reduced transportation costs (ibid.). Furthermore, energy usage is another sustainability issue with the systems as they are energy intensive. This can be offset with renewable energy sources, such as solar panels (Goddek, Joyce, Kotzen *et al*, 2019).

## 2.2 The Nordic Diet

There is a heuristic concept called The New Nordic Diet that highlights locality of food, and how produce from the Nordic countries is influenced by the climate, landscapes and waters. Outdoor leisure activities are common in the Nordic region and believed to influence food culture and habits (Bergfløt, Amilien & Skuland, 2012; Meltzer, *et al*, 2019). Even though the Nordic countries are different in all of those variables, they are seen as part of what Tholstrup Hermansen (2012) calls the Nordic Sphere. The Nordic Council (2023) promotes healthy, 'Nordic diets', as primarily plant-based. In the Nordic region (excluding Iceland) 19% self-identify as vegetarian, flexitarian, pescetarian or vegan (Motrøen, 2019). The Swedish population has the highest number of vegetarian and vegan consumers at 29% (Motrøen, 2019), whilst the Icelandic lacto-ovo vegetarians and vegans only amount to a total of around 1% each of the nations population (Gunnarsdóttir, Guðmannsdóttir, Þorgeirsdóttir, *et al*, 2022). As Sweden has the largest, and Iceland the smallest, vegetarian and vegan population in the Nordic, it makes them interesting to include in the empirical study. By including countries at each end of the spectrum in the Nordics, a comparison between the two might show a difference in motivations for their attitudes towards aquaponics.

# 3. Previous Research and Research Gap

## 3.1 Attitudes Towards Aquaponics

Attitudes towards aquaponics is a researched subject, and with many varied results. Education and previous knowledge (Suárez-Cáceres, Fernández-Cabanás, Lobillo-Eguíbar, *et al*, 2021; Kralik, Weisstein, Meyer, *et al*, 2022) and environmental-group membership or environmental concern (Short, Yue, Abbey *et al*, 2018; Eichhorn & Meixner, 2020) are factors that influence consumer attitudes towards the production of aquaponics. Greenfeld, Becker, Bornman, *et al* (2020) explain that environmental group membership is an important impact factor for respondents' positive attitudes towards lettuce grown in aquaponics. However, these factors seem to also lead to negative attitudes. There appears to be an overall distrust from consumers regarding positive claims about aquaponics and a worry for animal welfare, cleanliness and environmental impact in and of the production system (Miličić, Thorarinsdottir, Dos Santos *et al*, 2017; Short, Yue, Anderson, *et al*, 2017). Consumers appear to have a negative taste and health bias towards aquaponic products (Kralik, *et al*, 2022). Respondents in a survey distributed in several European countries (Miličić *et al*, 2017) mentioned that they felt negative emotions when thinking about fish faeces being part of their consumable plant products. Feelings of disgust also appear to be connected to the combination of traditionally soil-grown products and marine-living animals, as it might feel 'unnatural' (Miličić *et al*, 2017). In a qualitative part of their study on attitudes towards aquaponics, Miličić *et al* (2017) got the response from one vegan respondent that "I am vegan. Fish farming? Are

you serious?". Suárez-Cáceres *et al* (2021) also mention that a varied diet appears to have a positive correlation to willingness to consume products from aquaponic systems. The previous research on attitudes towards aquaponics provides an insight to overall consumer attitudes towards aquaponics, however, lacks empirical data on possible differences between and within different diet choices. Diets that avoid animal products in various forms are not discussed in the aforementioned studies, meaning that there is little information regarding how people who avoid meat in their diets feel towards aquaponics.

## 3.2 Vegetarian and Vegan Diets and Lifestyles

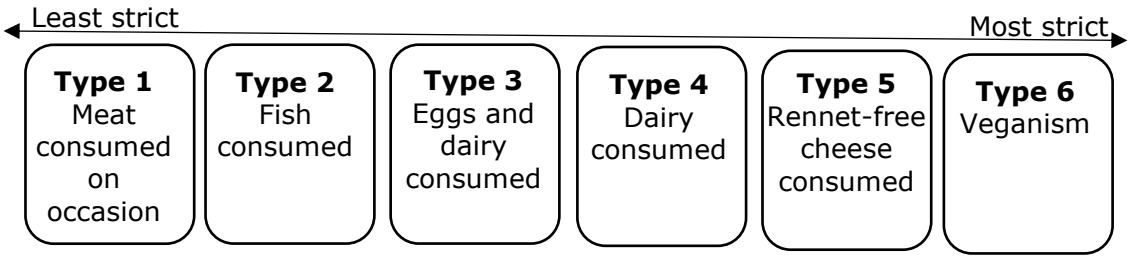


*Figure 1. The Vegetarian Scale. Revised from Beardsworth & Keil (1991).*

In 1991, Beardsworth and Keil created The Vegetarian Scale which defines different forms of meat avoidance onto a scale with six steps. The avoidance ranges from least strict (Type 1) to most strict (Type 6). The least strict vegetarians consume meat on occasion, especially if it is meat that is processed to the point of an unrecognisable form. Type 1 through 5 would commonly be considered different forms of vegetarians, including flexitarians (Type 1), pescetarians (Type 2) and lacto-ovo vegetarians (Type 3). Type 6 vegetarians are those who would define themselves as vegans, where no animal products are consumed (Figure 1) (Beardsworth & Kiel, 1991).

An individual living a vegan lifestyle may also exclude:

- products made from insects (e.g. carmine E-120, shellac E-904 and royal jelly) (Elorinne, Niva, Vartiainen & Väisänen, 2019; V-label, 2023; Urban, Giesey & Delost, 2022),
- products that use animals as a "work force" (e.g. honey, avocados and almonds) (The Vegan Society, n.d.1; Wilkinson, 2019; Urban, Giesey & Delost, 2022),
- products that have an indirect effect on animal life (e.g. palm oil and figs) (Rigby, 2022; Mora, 2022),
- products that are tested on animals (e.g. pharmaceuticals and cosmetics) (The Vegan Society, 2023; Urban, Giesey & Delost, 2022),
- products produced in a factory that also produce animal-based products (i.e. cross-contamination) (Miguel, 2021) and,
- products grown using animal products as fertiliser (i.e. manure, blood meal, feather meal and fish emulsion) (Seymour & Utter, 2021).

However, being able to choose their own definition of veganism appears to be of importance for vegans. Studies by North, Kothe, Klas, *et al* (2021) and Cherry (2006) have shown that vegans prefer the definition put forward by the Vegan Society in 1944:

> *Veganism is a philosophy and way of living which seeks to exclude—as far as is possible and practicable—all forms of exploitation of, and cruelty to, animals for food, clothing or any other purpose; and by extension, promotes the development and use of animal-free alternatives for the benefit of animals, humans and the environment. In dietary terms it denotes the practice of dispensing with all products derived wholly or partly from animals.*
> (The Vegan Society, n.d.2)

Some vegans live by the definition as an absolute, or as "strict vegans", while some vegans appreciate the subjective wording of "as far as possible and practicable" (North, *et al*, 2021; Cherry, 2006). The definition allows interpretations to be made to fit the individual. The respondents in North *et al* (2021) study suggested that some people identify as vegan, although they might not follow a strict vegan diet.

Self-identification studies have also shown that individuals create their own definition of the terms vegetarian and vegan. A Finnish study where respondents self-reported on their diet choices showed that 80% of the self-identified vegetarians did not follow a vegetarian diet as it is defined and actually ate around 90 grams of meat per day (Vinnari, Montonen, Härkänen & Männistö, 2008). Another study, from the United States, showed that 36.5% of self-identified vegetarians consume fish (Rosenfeld & Tomiyama, 2021). Rosenfeld (2019) study showed that 85% of self-identified vegans avoid all animal products. Some vegans admit to eating chicken, fish, milk and eggs on a regular basis (Cherry, 2006; Braunsberger & Flamm, 2019).

Even "strict vegans" allow some grey areas, such as honey, pharmaceuticals tested on animals and leather products (Greenebaum, 2012). Conducting research on vegan diets is challenging because self-reported dietary choices or restrictions are often grouped under the same label, yet individuals may interpret and define these terms differently (Ruby, 2011).

Consumer attitudes in regard to the use of manure are lacking, however one study showed that environmental concern in regard to the use of livestock manure was high among consumers (Hurley & Kliebenstein, 2001). Another study showed that vegans believe that animal welfare is impossible to achieve in agriculture (Janssen, Busch, Rödinger *et al*, 2016).

### 3.2.1 Vegan and Vegetarian Diet Motivations

There are many different motivations to having a plant-based diet or lifestyle. Altruistic, or prosocial, motivations include concerns for animals, the environment and humankind (Rosenfeld, 2018a). Animal related concerns include animal welfare, animal rights and other ethical aspects related to animals. It is important to note the difference between those who believe in animal rights and those who believe in animal welfare. Animal rights defines that all animal life is valuable, and they have an intrinsic right to eat, sleep, feel pleasure and comfort. Their rights should not be interfered with by humans, even if

humans would benefit from doing so (Bekoff, 2007). Animal welfare on the other hand, has a more utilitarian view of animals. Animals should not be abused or exploited, exist without suffering and be treated with respect, but they can be used to benefit humans if the animal is kept comfortable (Bekoff, 2007).

Environmental concerns include concerns about climate change and global warming, environmental protection and worry about depleting natural resources (Janssen, Busch, Rödinger & Hamm, 2016). Environmental motivations can also correlate or be combined with human-directed empathy. It is believed that an omnivorous diet will cause environmental distress, which in turn will lead to humans suffering from climate change (De Backer & Hudders, 2015). Moreover, this motivation is sometimes explained by the crops that are fed to livestock, aquaculture fish included, and are graded for human consumption (Cassidy, West, Gerber & Foley, 2013; Wu, 2014). The inefficiency of using arable land to grow feed for animals rather than directly producing food for humans is seen as a significant contributor to environmental degradation, resource depletion, and increased greenhouse gas emissions (Wu, 2014). Consequently, this concern has fuelled a push toward plant-based diets as a more sustainable alternative for addressing food security and mitigating climate change impacts (ibid.). Animal related motivations may also tie into health motivated vegetarianism and veganism. Individuals stating health motivations explain that concern over animals being fed "chemicals" and pharmaceuticals give them a heightened concern over their own health (Rosenfeld, 2018b). Other health reasons are personal wellness and eating disorders such as orthorexia (Barthels, Meyer & Pietrowsky, 2018; Phillips, 2005). Research has shown that flexitarians are usually driven by health reasons (De Backer & Hudders, 2015; Fox & Ward, 2008).

Depending on the motivations behind the diet choice, the acceptance of otherwise "prohibited" foods or other products within the diet might be deemed okay. For example, a vegan motivated by environmental concern might consider buying a leather product over a plastic one with the perception that the leather product would have a lower impact on the climate (Green, 2019).

Research indicates that dietary motivations are often multifaceted and interconnected, making it difficult to pinpoint a single driving factor behind an individual's food choices. Studies have shown that individuals rarely adopt plant-based diets for one reason alone. Instead, they are often motivated by a combination of ethical concerns, health benefits, and environmental considerations (De Backer & Hudders, 2015). This overlap complicates the evaluation of the specific motivations behind a person's attitude toward food production systems like aquaponics, as their views may be shaped by a blend of these influences.

*Table 1. Diet motivations on the vegetarian scale*

| Grouping | Diet Motivations | Examples |
|---|---|---|
| Prosocial motivations | • Environment<br>• Animals<br>• Human focused ethics | • Environmental concern, sustainability, climate concern (Janssen, Busch, Rödinger & Hamm, 2016)<br>• Animal rights, animal welfare (Bekoff, 2007; Rosenfeld, 2018)<br>• Human welfare, human rights, equality (De Backer & Hudders, 2015; Cassidy, West, Gerber & Foley, 2013; Wu, 2014) |
| Other motivations | • Culture<br>• Health<br>• Weight gain/loss<br>• Sensory<br>• Constraints | • Religion, peer pressure and social norms (Lestar, 2020; Rosenfeld & Tomiyama, 2019; Eker, Reese & Obersteiner, 2019)<br>• Personal health and wellbeing, weight gain/loss, eating disorders, concerns over parasites and/or pharmaceuticals, medically suggested diet (Rosenfeld, 2018b; Barthels, Meyer & Pietrowsky, 2018; Phillips, 2005; Timko, Hormes & Chubski, 2012; Janssen et al, 2016)<br>• Sensory reasons and disgust towards meat, texture and taste (Ruby, 2012; Rosenfeld & Burrow, 2017)<br>• Social, geographical and/or financial constraints (Rosenfeld & Burrow, 2017) |

## 3.3 Research Gap

Although attitudes towards aquaponics have been well-studied, there is a clear gap when it comes to understanding how specific dietary preferences —particularly vegan and vegetarian diets— shape consumer perceptions. Recent research, such as Edstam and Frisk's (2021) study on upscaling aquaponics, indicated concerns among respondents regarding the acceptance of aquaponic systems by vegan consumers. However, these concerns were not further explored, leaving an important question unresolved: how do dietary ethics influence the acceptance of aquaponics as a sustainable food production system? With a growing vegan and vegetarian consumer group in the Nordic countries it is therefore of interest to understand their attitudes towards aquaponics for potential marketing and adaptation of aquaponic systems to a broad range of consumers. Furthermore, this study contributes to the theoretical field of attitudinal research by integrating diet motivations, offering a more nuanced understanding of how ethical beliefs connected to diet influence consumer acceptance of aquaponics.

# 4. Theoretical Framework

Nilsson and Martinsson (2012) explain attitudes as people's negative or positive outlooks on something. In theory, attitudes are based in either affective, cognitive or behavioural processes. The affective processes are connected to emotions the person is feeling towards the object/subject. The cognitive processes are connected to the person's knowledge or experience on the object/subject. An attitude can also be connected to a person's behaviour, where a person chooses to act (or not act) in a way that soothes or feeds their affect towards the object or subject. Behaviour is not only an effect or response from our attitudes, it can also create an attitude itself. An attitude can also be a mix of several processes, for example the attitude can be a product of both affective and cognitive processes.

Böhm and Tanner (2007) describe that risk evaluation and calculation in environmental psychology involves evaluating several different biases and heuristics. *Availability heuristics* refer to when people retrieve easy to access memories of relevant instances to create attitudes and calculate risk. This means that people sometimes have an attitude towards something based on memories of similar situations, and possibly previous attitudes connected to that memory. Furthermore, *affect heuristics* explain that positive emotions can lead to individuals perceiving the risk of something as low, while negative emotions can lead to risk being perceived as high (Böhm & Tanner, 2007).

*Moral Foundations Theory* (MFT, Haidt, 2012) is a descriptive theory, and not a normative theory, meaning that it focuses on what people do and not what they should do. The theory explains that the foundations are judgements and behaviours that have been moralized and can be used to understand morality across cultures (Ramos, Johnson, VanEpps & Graham, 2024). MFT identifies five moral foundations that shape decision-making. The weight of each foundation varies depending on factors such as culture, religion, and political beliefs. Each foundation is triggered by specific events, evoking emotions that guide individuals toward particular attitudes (Haidt, 2012).

The first foundation, *care/harm*, is typically triggered by witnessing suffering, such as seeing a child, animal, or even a cute cartoon character in need of care. This foundation is characterised by feelings of compassion. The second, *fairness/cheating*, is activated by perceived injustices, such as disproportionate wealth distribution, and evokes emotions like gratitude or guilt.

The third foundation, *loyalty/betrayal*, emphasises in-group loyalty, with betrayal—whether of family, a team, or another group—seen as a moral failure. *Authority/subversion*, the fourth foundation revolves around defending social hierarchies and is characterised by feelings of respect or fear.

*Sanctity/degradation* is the fifth moral foundation and triggers the “behavioural immune system”. The behavioural immune system is believed to be an instinctive drive to avoid pathogens and infection, for instance by washing your vegetables before consuming them or avoiding someone showing signs of sickness. This foundation can also extend to societal norms and taboos, which, depending on cultural or political contexts, may result in the exclusion of out-groups (Haidt, 2012).

The two first foundations, *care/harm* and *fairness/cheating* are sometimes grouped together under *individualizing foundations* as they focus on the welfare and rights of the individual. The last three foundations (*loyalty/betrayal*, *authority/subversion* and *sanctity/degradation*) are grouped together as *binding foundations* as they focus on in-group loyalty and self-control. Individualizing foundations are common within liberal thinking groups, whereas binding foundations are common within conservative thinking groups (Graham, Haidt & Nosek, 2009).

Commonly in research, MFT is used to explain political identification and ideology, however in recent years MFT has been used in consumer studies used to understand consumer decision-making. Ramos, Johnson, VanEpps & Graham (2024) suggests that "to be a consumer is to be concerned with morality, whether people actively realize it or not" (p.519). Moral foundations can be used to explain why a product would evoke aversive emotion in some consumers, whilst it would not in others. Furthermore, Ramos *et al* (2024) explains how since MFT can be distinct across cultural groups (e.g. East vs West) and sub-groups (e.g. social-economic status) it can be used to communicate with specific, perhaps previously unreachable, consumer markets.

MFT has been used in research to explain consumer views on ethical and unethical consumption. Chowdhury (2019) research showed that moral foundations can explain consumer ethics, specifically that the '*care/harm*' foundation positively correlates to altruistic consumer behaviour and that the '*loyalty/betrayal*' foundation negatively correlates with pro-social consumer behaviour. Chowdhury (2019) concluded the research by explaining that the results show how MFT can be used as a framework for exploring and explaining consumer beliefs. In regard to food consumption, MFT has been used to explain people's view on food waste, which showed that people with the '*care/harm*' foundation are more averse to the idea of food waste compared to those with other moral foundations (Bretter, Unsworth, Kaptan & Russell, 2023).

Vegetarians, vegans and omnivores are suggested to have different moral foundations influencing their dietary decisions. Although morality could be considered a central aspect for their dietary choice, other aspects such as taste and social norms play a large role as well.

Meat-eaters tend to score high on the binding foundations (authority/subversion, loyalty/betrayal), whilst vegans tend to score high on individualizing foundations (care/harm, fairness/cheating). Vegetarians are suggested to have a moral foundation that is somewhat in between the two, although leaning more towards the individualizing foundations (Hackert, Voeth & Weger, 2022). A suggestion for vegans' averse feelings towards the authority foundation is that in a society where meat-eating is the norm, meat-avoidance is seen as a deviant act and therefore goes against society's norms (Hackert, Voeth & Weger, 2022; DeBacker & Hudders, 2015). A suggested explanation for meat-eaters favoring binding foundations could be a belief of humans as superior to animals, also known as speciesism (Hackert *et al*, 2022).

Risk evaluation theories and Moral Foundations Theory will therefore be used to discuss the datasets to further explain and give insight to why attitudes might differ between diets.

# 5. Research Design

## 5.1 Geographical Scope

Although the entire Nordic region is in need of sustainable food production systems to reach the SDGs Iceland and Sweden were chosen as the focal countries within the Nordic region due to both practical and research-specific reasons. Firstly, Sweden is the most populous country in the Nordic region (Nordic statistics, 2024) with the largest vegetarian and vegan population of the five (Luciano, *et al*, 2023), which will offer a broad perspective on consumer attitudes. Iceland, on the other hand, has the smallest population (excluding Faroe Island) (Nordic statistics, 2024), as well as a marginal vegetarian and vegan population (Gunnarsdóttir, Guðmannsdóttir, Þorgeirsdóttir, *et al*, 2022). The fisheries industry plays a vastly different role in the two countries' economies. In Iceland, fisheries and aquaculture are an important part of the nation's economy (Luciano, *et al*, 2023; Statistics Iceland, 2022). In Sweden, on the other hand, fisheries and aquaculture are a marginal part of the nation's economy (Fisheries and Agriculture Organization, 2019). This approach aims to allow for contrasting and meaningful comparative analysis. Narrowing the scope to Iceland and Sweden was based upon recent news in both countries, believed to have an impact on the attitudes towards aquaponics similarly to how Simeone and Scarpato (2020) describes how framing in media influences consumers seafood consumption. In Iceland there have recently been protests to ban aquaculture facilities after several farmed salmon escaped from pens, evoking concern for the domestic wild salmon stocks survival (Patagonia, 2024; Kulczycki, 2023; Salmon Business, September 1st, 2023; Salmon Business, October 12th, 2023). Additionally, Sweden has recently experienced a heightened concern regarding resilient food production methods following periods of drought (DS 2023:34). Since the aim of the study is to compare and analyse attitudes towards aquaponics, it was therefore of interest to evaluate two countries where the subject of sustainable food production practices has been of recent interest.

## 5.2 Design and Critical Reflections

The research design of the study is inspired by Flick's (2022) Phase methodology, which involves structuring the research process into different, interconnected, stages. Each phase builds on the insights from the previous one, creating a comprehensive and detailed understanding of the phenomenon researched. The Phase method has been combined with the idea of methodological triangulation (Flick, 2004), where multiple methods are used to gather varied perspectives, thereby increasing the robustness and depth of the findings. The study therefore has a mixed methodology (Schoonenboom & Johnson, 2017), with quantitative and qualitative methods split in three different phases for the purpose of gaining an in-depth understanding of the attitudes.

Phase 1 consists of a pilot study inspired by Oppenheim's (1992) attitude survey design. Oppenheim (1992) and Flick (2022) suggest exploratory interviews to gather statements from similar minded respondents as the study is aimed for. This is to make sure that when the attitude survey (Phase 2) is published, the respondents of that phase should be able to

recognize themselves in the statements. The pilot study was in the form of an online written interview, similar to an email interview (Bowden & Galindo-Gonzalez, 2015), where respondents who identified themselves to be on the vegetarian scale got to answer five questions regarding aquaponics in their own words. Structured interviews are similar to surveys, in that the interviewer cannot ask follow-up questions (Bryman, 2018). The written answer also allowed for easier data analysis, as the interviews did not need to be transcribed. This phase creates an overview of existing attitudes, and the statements collected work as a base for formulating the statement questions in Phase 2. A second part of the pilot study consists of interviews with experts and food producers relevant for the research questions. The purpose of these semi-structured interviews is to gain insights into perception of aquaponic systems from a production and industry perspective, specifically in relation to the vegan market. The expert and producer input on the matter will then work as a baseline, together with the first part of the pilot study, for questions asked in interviews with consumers (Phase 3).

In Phase 2, a structured survey with a five-point Likert scale response measurement was created. This was also inspired by Oppenheim (1992) and Flick (2022) suggestion. The survey was designed to collect and measure attitudes towards aquaponics, as well as collect information regarding diet motivation to then be able to discuss possible correlation between diet motivations and attitudes on a Likert Scale. Likert scales were introduced in 1932 (Likert, 1932) and has been widely used in attitude studies since (Batteron & Hale, 2017). Likert scales intend to measure attitudes or opinions on a subject, by having respondents answer on a scale of (most commonly) 1-5 to gather a quick and efficient overview of a population's opinions (ibid.). The survey statements were a combination of statements collected in the pilot survey (Phase 1) as well as statements from, or inspired by, The Animal Rights Scale (Wuensch, Jenkins and Poteat, 2002), The Meat Eating Justification Scale (MEJ) (Rothgerber, 2013), The Dietary Identification Questionnaire (DIQ) (Rosenfeld and Burrow, 2018) and Rosenfeld and Tomiyama (2021) survey questions for self-identified vegetarians, vegans and pescetarians. This phase provides quantitative results for the research questions, to be further explored in Phase 3.

Phase 3 consists of in-depth, semi-structured (Alvehus, 2013) interviews with consumers on the vegetarian scale. These interviews aim to provide a deeper, more nuanced, insight to the reasoning behind the vegetarian and vegan attitudes towards aquaponics. This phase was created to ensure that the underlying factors that a survey might not capture would be identified. The semi-structured method was chosen to be able to ask follow-up questions when clarification was needed (Bryman, 2018). Furthermore, this method allowed the interviewer to accommodate the participant, allowing them to talk about what they found important as well as the interviewer guiding them back to the research questions at hand, when needed (ibid.).

To further increase the validity of the study, qualitative triangulation (Flick, 2004) was part of the research design. In addition to using multiple methods, the study ensured diversity within the consumer group by including participants across the vegetarian scale. This variation allows for a more comprehensive understanding of how different dietary choices might affect attitudes toward aquaponics. The sample of experts and producers were chosen for their relevance to both aquaponic systems and vegan food production,

and they add another layer of triangulation, ensuring that the study captures perspectives from both consumers and industry stakeholders.

By combining these diverse methods and perspectives, the study aims to achieve a discriptive analysis of the factors influencing the acceptance of aquaponics, contributing to both theoretical knowledge and practical applications in sustainable food systems.

Mixed methodology has faced substantial criticism in academia, specifically for its time-intensive nature and the complexities associated with integrating diverse data sources effectively (Vivek & Chandrakumar, 2023). Recognizing these challenges, this study was designed with an extended timeframe of one year to accommodate the methodological demands. The year-long timeframe was not only a school criterion, but also allowed for ensuring incorporation of both the qualitative and quantitative data in the discussion section of the research. However, additional challenges emerged, notably in the areas of participant recruitment and language.

Participants for Phases 1-3 of this study were recruited primarily through social media, with a focus on Facebook groups in Iceland and Sweden centred around vegan and vegetarian diets and lifestyles. Given the study's specific target population, Facebook proved to be an efficient platform for reaching and engaging with relevant groups, minimising geographical barriers and time costs (Oudat & Bakas, 2023). However, the use of social media for recruitment also presented several limitations and challenges. The recruitment method leads to nonprobability sampling, or haphazard sampling. Nonprobability sampling means that the sample was not random, but rather a specific group that was reached out to through social media. Nonprobability sampling poses risks when it comes to bias, and the results can therefore not be generalised (Kalton, 1983).

Another key issue highlighted by Oudat & Bakas (2023) is the demographic bias inherent in social media platforms. Users tend to be younger and often belong to specific ethnic groups, raising concerns about the representativeness of the sample (ibid.). Additionally, privacy concerns can discourage potential respondents from participating. Many individuals are hesitant to engage with recruitment efforts on social media due to fears that their personal information might be accessed or misused (ibid.). While privacy concerns may have impacted the sample size, the recruitment materials clearly emphasised the protection of respondents' anonymity by avoiding the collection of any identifiable information, such as email addresses.

A more study-specific challenge arose during the preliminary phase when Facebook was used to identify potential groups for recruitment before the pilot study was launched. On the day of data collection, one of the planned groups had been deleted. Although this was initially seen as a setback, other groups were successfully utilised instead. Additionally, efforts to improve transparency by contacting group moderators or administrators to explain the purpose of the posts, as suggested by Gelinas, Pierce and Winkler (2018), occasionally led to access being denied, which further limited recruitment.

Recruitment through private social media networks was also done to expand the sample size. However, this approach raised clear concerns regarding bias and representativeness. Despite maintaining participant anonymity in the survey, the recruitment of interview respondents through personal connections (friends or friends of friends) introduced the

possibility of bias, particularly social desirability bias, in the interviews. While all respondents met the study's criteria's, it is important to acknowledge that these biases may have influenced some of the responses. Social desirability bias describes the tendency to present information in a way believed to be socially normative or acceptable but might not reflect one's reality (Bergen & Labonté, 2019). In qualitative research, specifically interview settings, it is common that social desirability bias occurs when subjects are deemed controversial. However, it is also common when the subject at hand has "widely accepted attitudes, behaviours, or norms" (Bergen & Labonté, 2019, p. 783). There are different ways to mitigate the social desirability bias, and for this study the suggestions put forward by Bergen and Labonté (2019) were used. They suggest transparency and assurance as tools to combat the bias. At the beginning of each interview the respondents were informed that the recording of the interview would only be available for the interviewer and that the transcribed version would exclude traceable information about the respondent - ensuring full anonymity. Furthermore, the use of humour and displays of respect were given throughout the interview to further make the respondents feel comfortable.

When designing the research, surveys were initially considered in Icelandic, Swedish, and English to accommodate respondents who might feel uncomfortable using English, thereby enhancing their understanding of the subject (Lundmark, Sandelin & Rönnerstrand, 2023; Im, Kim, Tsai, et al., 2015). It was anticipated that offering multiple languages could increase the sample size. However, during the creation of the Phase 2 survey, it became evident that certain nuances in words and phrases changed significantly when translated, which could affect the neutrality and clarity of the questions. To avoid the risk of misinterpretation, the survey was ultimately conducted only in English. Nonetheless, respondents were allowed to answer in Swedish, Icelandic, or English for the open-ended questions and in all sections of the pilot study as well as the survey. Furthermore, research has shown that offering surveys in multiple languages does not necessarily increase response rates (Lundmark, Sandelin & Rönnerstrand, 2023).

For the interviews in Phase 3, participants were given the option to conduct them in Swedish, Icelandic, or English. All but one of the Swedish respondents opted for Swedish, while all the Icelandic respondents chose English. While offering participants the option to speak in their preferred language was intended to meet their needs, it introduced challenges during transcription. As with the surveys, nuances were sometimes lost in translation, particularly with culturally specific elements like humour, idioms, and sarcasm, as highlighted in previous research (Vishwakarma, 2023).

To minimise misinterpretations during transcription, respondents were contacted during this phase to clarify how they wanted their attitudes or opinions translated, ensuring the final version accurately reflected their intended meaning. Despite these efforts, the possibility remains that some linguistic nuances may have been altered or lost in translation.

# 6. Phase 1

The first part of the study was a pilot study, collecting attitudes from consumers as well as experts and producers, to gain insight to then develop the methodology for the following phases.

## 6.1 Material and Participants

### 6.1.1 Consumer Interviews

The first part of the pilot study was online, written interviews with consumers on the vegetarian scale. Interviews were set-up in an online survey-programme (Google Forms). The respondents first were introduced to the study, and then got introduced to aquaponics. They were then asked demographic questions. The questions for statement-collection were formulated from the research questions to avoid limiting the respondents' opinions and attitudes. Five questions were given to the respondents:

- What are your initial thoughts on aquaponics?
- What are your opinions or thoughts on the involvement of fish in aquaponic systems?
- What are your opinions or thoughts on the use of fish faeces as nutrients for plant production in aquaponic systems?
- What are your thoughts on consuming plants grown in aquaponic systems?
- Do you have any other comments, concerns or opinions regarding aquaponics?

Social media was chosen as a recruitment method. Particularly Facebook proved to be useful for targeted recruitment as it allows for easy access to hard-to-reach groups of populations (Gelinas, Pierce & Winkler, 2018). The groups were found using the Facebook search tool, with keywords such as: “Iceland”, “Sweden”, “vegan” and ”vegetarian” as well as city specific names. After the initial search, several Facebook groups were chosen as fitting for the purpose and a message to the group administrators was sent to present the aim of joining the group and explain the research conducted. This resulted in access to four groups. A message presenting the research, explaining their anonymity and a link to the form with the interview questions was posted in the groups (Appendix A).

Answers were collected between February and March 2024, with a total of 25 respondents resulting in 22 respondents measured as valid. The three respondents excluded from the data were labelled invalid since two of them lived in other countries than the ones measured, and one of them chose not to answer the demographic questions. The latter also showed the need for the following survey to have obligatory answers, which was quickly adapted for Phase 2. Of the respondents in the pilot study, 17 identified as women, 4 identified as men and 1 respondent answered that they prefer not to say. Respondents ranged from 18 to >50 years old, with the two largest respondent groups being 18-25 year olds as well as 25-30 years old, consisting of 12 respondents in total. One of the respondents chose not to give an answer on their age group, but was included in the results

as they provided all other demographic information which was deemed the more important for the data collection in this phase.

The geographical differences were split even with 12 of respondents answered that they live in Sweden, and 10 of respondents answered that they live in Iceland (Table 2). A majority of the respondents had a vegan diet (*n*=14), five of the respondents had a vegetarian diet and one respondent answered that they were flexitarian. For this first phase of the study, it was important to receive answers from the vegetarian spectra, however two omnivorous respondents were also included in the data since this phase is just to be used for statements in the following phases. Their statements were deemed suitable to use even in a vegetarian context for Phase 2.

*Table 2. Detailed demographic information, respondents Phase 1*

| ID | Country | Diet | Gender identity | Age-group |
|---|---|---|---|---|
| R1 | Sweden | Vegetarian | F | 18-25 |
| R2 | Sweden | Flexitarian | F | 18-25 |
| R3 | Iceland | Vegan | M | 18-25 |
| R4 | Iceland | Vegan | M | 18-25 |
| R5 | Sweden | Vegan | M | 25-30 |
| R6 | Iceland | Vegan | F | 25-30 |
| R7 | Iceland | Vegan | F | 35-40 |
| R8 | Sweden | Vegan | M | >50 |
| R9 | Sweden | Vegetarian | F | 25-30 |
| R10 | Sweden | Vegan | F | 35-40 |
| R11 | Sweden | Vegan | F | 35-40 |
| R12 | Iceland | Vegan | F | 45-50 |
| R13 | Sweden | Vegetarian | F | 25-30 |
| R14 | Sweden | Vegan | F | 30-35 |
| R15 | Iceland | Omnivorous | F | 25-30 |
| R16 | Iceland | Omnivorous | F | 40-45 |
| R17 | Sweden | Vegan | F | 35-40 |
| R18 | Sweden | Vegetarian | F | 25-30 |
| R19 | Iceland | Vegetarian | F | 30-35 |
| R20 | Iceland | Vegan | F | 18-25 |
| R21 | Iceland | Vegan | * | * |
| R22 | Sweden | Vegan | F | 18-25 |

*F: Female, M: Male, *: Prefer not to say/not specified*

### 6.1.2 Expert Interviews

The second part of the pilot study was the semi-structured interviews with experts and companies. The interviews were held online, via Teams and lasted between 30 minutes to one hour. The companies were first asked to describe their companies, what they produce and for whom. All the respondents were then asked to describe what they consider constitutes a vegan product and if they consider products from aquaponic

systems to be vegan. As clarification was needed after the interviews, further questioning was then done as an email structured interview (see Appendix B for interview guides). The interviews were recorded via phone to then be transcribed, and all participants signed a consent form.

To gain deeper insights, three expert interviews were conducted with professionals from three institutions. To ensure a broad sample, experts from companies specialising in vegan and vegetarian diets, as well as those focused on aquaponics, were included. The selection of aquaponics companies and specialists, as well as vegan food cultivation companies is narrow in the Nordic region. Companies were therefore searched for using google search, with keywords such as 'Iceland', 'Sweden', 'aquaponics', 'vegan' and 'vegetarian'. Companies and experts of interest were contacted via email, which resulted in successful contact with three respondents. The first interview was with Peter Albrecht, founder of Villands Vånga Veganträdgård, a Swedish vegan gardening company. The second interview was with Anke van Lenteren, co-founder and head of horticulture at Johannas Stadsodlingar, an aquaponics company in Sweden. Lastly, in Iceland there is currently one aquaponics company, managed by the supervisor of this thesis. To avoid internal interests and biases, an external Icelandic aquaculture and aquaponics specialist was contacted instead. Due to Iceland's small population, they desired to stay anonymous for the study due to possible traceability issues.

## 6.2 Results Phase 1

### 6.2.1 Consumer Interviews

Drawing inspiration from the business industry and studies, as well as behavioural user experience studies, Affinity Diagramming was used to analyse the results from the Pilot study. Affinity diagrams is an inductive approach to data, where statements are clustered together from their similarities and themes or categories are then created from that. The affinity diagram helps to visualise themes and keywords from the data collected (Hartson & Pyla, 2012). A digital whiteboard was used to copy and paste the statements to. Starting with one statement the next was then compared to it to see if it was similar, or if it was entirely different. The next statement was then compared to the two previous ones, and so on. From this process, themes, keywords and clusters emerged. The themes identified in Phase 1 were 1) sustainability and resource effectiveness, 2) feelings of disgust, 3) captivity/confinement, cruelty, abuse, suffering and exploitation, 4) ethics and values as well as 5) nature/natural and ecosystem (Table 3).

*Table 3. Themes from pilot study, consumer interviews*

| Themes/keywords | Examples of statements |
|---|---|
| Sustainability and resource effectiveness | *"Clever, useful for reaching food sustainability and use our resources better (water)"* |
| | *"Seems like a decent idea to reuse water for fish and plants thus not wasting resources"* |
| | *"From what I know, waste from fish give nutrients to the plants, which is absent in hydroponics. Therefore, aquaponics makes more sense to me, because there is no need to add other substance to the water, and makes it sustainable"* |
| Feelings of disgust | *"Honestly it sounds disgusting to me"* |
| Captivity/confinements, cruelty, abuse, suffering, exploitation | *"Exploiting sentient beings instead of letting them live free"* |
| | *"I am against animal farming of any kind"* |
| | *"The animals are used as means of production, which is non-consensual, i.e. abuse"* |
| Ethics and values | *"Its not vegan"* |
| | *"Immoral and cruel"* |
| Nature/natural, ecosystem | *"Its natural"* |

### 6.2.2 Expert Interviews

The interviews were transcribed and then coded in NVivo. The aquaponics specialist and van Lenteren also requested to look through the transcripts before they were analysed. Traceable information for the aquaponics specialist was redacted after their review, and private information was redacted from the interview with van Lenteren. The answers were originally only coded into themes regarding the suitability of the systems for vegan consumers. However, when the data was processed, animal welfare was added as a theme as well since this was a common theme among the respondents.

None of the experts considered aquaponic produce to be suitable for vegan consumers. Although, both the aquaponics specialist and van Lenteren mentioned that it might depend on the vegan consumers diet motivations. Van Lenteren mentioned that if environment is the diet motivation of the vegan, it could be considered vegan, however felt unsure if animal welfare would be the motivation for the consumer. Both the aquaponics specialist and van Lenteren mentioned that the welfare of the fishes in aquaponics systems is good. The aquaponics specialist also mentioned that the welfare must be good for the fish to be sold for consumption.

Albrecht mentioned that aquaponic systems are inherently non-vegan since animals are used in the production. He also prefaces this by saying that he has not read up too much

about aquaponics and does not know this for certain. Firstly, he mentions that aquaponics is possibly a waste of resources since nutrients solvable in water and therefore aren't all picked up by the plants. He continues by explaining the aquaponic system as a form of 'quasi-farming', since it is artificial. Secondly, using animal faeces, from farmed animals cannot be considered vegan at all since that would be to exploit animals.

Furthermore, the aquaponics specialist in Iceland mentioned that aquaponics could be used to address global food insecurity. This is because aquaponics doesn't necessarily need high-tech equipment and expensive animal feeds. However, he continues by saying that aquaponics in Iceland specifically would not contribute to global food security since it would probably be land-based salmon farming and salmon is a luxury product.

*Table 4. Themes from pilot study, expert interviews*

| **Themes/keywords** | **Examples of statements** |
|---|---|
| Diet motivation | "*This is a question of philosophy, ehm, salmon farming, not to mention large farming of salmon is intensive farming of animals, eh, and utilising waste products from that would not, in my opinion, be suitable for vegans.*" (Aquaponics specialist).<br><br>"*I think it depends on what the vegan, you know why they're vegan. I think from a sustainability and circularity point of view and health point of view yes it does. But from an animal welfare point of view, no I cannot say that for certain, personally no*" (van Lenteren). |
| Exploitation | "*The fishes are individuals and they wouldn't choose to swim around in a tank like that. As soon as an animal is used as a resource, you start to disregard their wellbeing.*" (Albrecht) |
| Welfare | "*The recent news from land based salmon farmers has shown that the animal welfare has been dramatically.. It has been very good, the quality of the fish, the diseases are not a problem, eh, no parasites… For us to do good we have to think alot about the welfare of the animals, but what it all comes down to is that it is produced to become food.*" (Aquaponics specialist). |
| Sustainability and food security | "*A part of the crisis is also affordability of food. Therefore I think that a salmon-based aquaponics in Iceland is maybe not a part of a food shortage crisis. The salmon is a high priced luxury product and we will be using high-tech farming equipment both for the salmon and plants giving people a sustainable option when it comes to luxury goods.*" (Aquaponics specialist).<br><br>"*It's an excuse to say that you can recirculate the nutrients in a great way there, and you can grow vegetables with the help of aquaponics as an excuse to not take care of the land you have left." (Albrecht).* |

# 7. Phase 2

Building on the results from the pilot study a survey was developed to collect data regarding vegan and vegetarians' attitudes towards aquaponics.

## 7.1 Material and Participants

The survey was designed in Google Forms and included 12 sections (see Appendix C for survey questions). All questions in the survey were obligatory, and a free-writing option for each demographic section was given to make sure that any participant not residing in Iceland or Sweden, or that were not on the vegetarian scale would be easily identified and then excluded from the dataset.

The first two sections introduced the participant to the study and gave them a short introduction to aquaponics, as well as a simple, visual example (Appendix C). In the following section the participants were given demographic questions, and in section four they were asked about their diet strictness and diet motivations.

In section five to nine of the survey the respondents were asked to rate statements on a five-point Likert scale. The statement questions were split into five sections to measure attitudes towards aquaponics, attitudes toward the system being suitable for plant-based diets, attitudes towards fish welfare, attitudes towards the use of manure and consumer habits and motivations.

The five attitude statement sections were designed as a five-point Likert-scale, with answers stretching from strongly agree to strongly disagree with the choice of "I don't know/neutral" as the middle option. The 10th section of the survey included two questions with a dichotomous yes/no answer scale. 'Unsure' was added to the scale to avoid skewed data due to forced answers (Oppenheim, 1992). These questions were designed to see if the answers analysed from the previous sections matched with the overall self-identified attitude towards aquaponics. The respondents were then given an open-ended question asking them to write their initial thoughts on aquaponics. This was to further deepen the results and collect more attitude statements. Lastly, the participants had the option to leave their email address, whilst still being ensured anonymity, to be contacted for a follow-up interview in Phase 4.

Similarly to Phase 1, recruitment to the survey was done using social media. The survey was posted in the same Facebook groups. A message was again sent to the group administrators for full transparency (Gelinas, Pierce & Winkler, 2018). And then a message was posted in the group with a link to the survey, as well as an explanation about their anonymity. In addition to the Facebook groups, private social media channels were used to distribute the survey. This was done to increase the sample size.

## 7.2 Method for Data Analysis

Seeing as the sample size was small ($n$=31), the data is not thought to be representative for the population and therefore descriptive statistics were used to summarize the sample attitudes instead of using inferential statistics (Christopher, 2017).

The results were analysed using SPSS, and each answer on the Likert scale was scored 1 (strongly disagree) to 5 (strongly agree) with scores reversed for negative statements (Oppenheim, 1992). To analyse the Likert scale responses, descriptive statistics were employed, including mean, median, standard deviation (SD), minimum, and maximum values. These measures provide insights into central tendencies, variability, and response distributions (Harpe, 2015; Vetter, 2017). The mean was used to determine the overall tendency of responses, categorizing attitudes as negative (1.0–2.4), neutral (2.5–3.4), or positive (3.5–5.0). This was done by splitting the five-point scale into three intervals, similarly to Lindner and Lindner (2024) interval suggestions. The median was included to identify the central tendency, which is particularly useful when distributions were skewed (Vetter, 2017). Since five-point Likert-scale data have relatively narrow intervals (Boone & Boone, 2012), a difference of >0.5 between the mean and median was chosen as a threshold to indicate significant skewness or possible outliers affecting the data. This is not a formally standardised threshold, but it is a practical criterion for the data used in this study to aid for more accurate interpretations.

To assess variability of the aggregated means, the standard deviation (SD) was calculated (Vetter, 2017). An SD below 0.5 was considered indicative of low variability, suggesting high agreement among respondents. An SD between 0.5 and 0.9 was classified as moderate variability, reflecting some degree of dispersion among attitudes. Finally, an SD equal to or above 1.0 was interpreted as high variability, indicating strong disagreement or highly diverse opinions within respondent groups.

However, seeing as the study sample size, and therefore also the group sample sizes (for example diet groups or motivation groups) are all small, the SD is more sensitive to outliers (Vetter, 2017). Therefore, the minimum and maximum values provided insight into the full range of responses, helping to identify whether extreme values influenced the overall distribution.

Furthermore, the internal consistency of the statement items within their section was then measured using Cronbach's Alpha (Cronbach, 1951). All statements within all categories contributed positively to the internal consistency, except from one statement within suitability for vegan consumers that was consequently moved to attitudes towards aquaponics for a better Alpha score, and one statement in attitudes towards fish welfare that was discovered to be an ambivalent statement, not really measuring any attitudes. This resulted in attitudes towards aquaponics involving 10 statements (α=0.9), suitability for vegan consumers involving three statements (α=0.86), attitudes towards fish welfare involving three questions (α=0.71) and attitudes towards the use of manure involving seven questions (α=0.93) (Table 5). In social science an Alpha above 0.7 is acceptable, with 0.8 representing good reliability (Field, 2013; Bryman, 2018; Nunnally, 1978). The strong reliability of the statement items measuring attitudes toward aquaponics, as evidenced by a high Cronbach’s Alpha, supports the use of these items as a cohesive

scale. This result suggests that respondents interpreted the items consistently, making the overall scale a reliable measure of their attitudes.

*Table 5. Cronbach's Alpha Results*

| Theme/category | Cronbach's Alpha, before adjustments | Cronbach's Alpha, after adjustments | Cronbach's Alpha Based on Standardised Items |
|---|---|---|---|
| Attitudes towards aquaponics | 0.91 | 0.90 | 0.90 |
| Suitability for vegan consumers | 0.71 | 0.86 | 0.86 |
| Attitudes towards fish welfare | 0.68 | 0.71 | 0.74 |
| Attitudes towards the use of manure | 0.93 | 0.93 | 0.93 |

The three point (yes/no/unsure) questions were coded 0-2 on a nominal scale. The open-answer question was analysed using affinity diagrams, similarly to the Phase 1 statements (Hartson & Pyla, 2012). The diet motivations from the respondents were coded using the following themes: environment, animals, health, weight, humans, sensory and culture. Since the diet motivations were multiple response questions; the motivations were coded separately.

By utilizing these descriptive measures, patterns in attitudes towards aquaponics and related themes were examined systematically, ensuring a comprehensive understanding of respondent attitudes.

## 7.3 Results Phase 2

*Table 6. Detailed demographic information of survey respondents, Phase 2*

| ID | Country | Diet | Gender identity | Age-group |
|---|---|---|---|---|
| R1 | Sweden | Vegetarian | F | 25-30 |
| R2 | Sweden | Flexitarian | F | 18-25 |
| R3 | Sweden | Vegan | F | 30-35 |
| R4 | Sweden | Vegan | M | 35-40 |
| R5 | Sweden | Vegan | F | 30-35 |
| R6 | Iceland | Vegan | F | 40-45 |
| R7 | Sweden | Vegetarian | M | 18-25 |
| R8 | Sweden | Vegetarian | F | 25-30 |
| R9 | Sweden | Vegan | F | 25-30 |
| R10 | Iceland | Vegetarian | F | 18-25 |
| R11 | Iceland | Vegetarian | F | 30-35 |
| R12 | Sweden | Vegan | M | 25-30 |
| R13 | Iceland | Vegan | F | 30-35 |
| R14 | Iceland | Vegetarian | F | 18-25 |
| R15 | Iceland | Vegan | * | 40-45 |
| R16 | Iceland | Vegan | F | 18-25 |
| R17 | Iceland | Vegan | F | 40-45 |
| R18 | Iceland | Vegetarian | F | 35-40 |
| R19 | Iceland | Vegan | M | 45-50 |
| R20 | Sweden | Vegan | N-B | 30-35 |
| R21 | Iceland | Vegan | F | 30-35 |
| R22 | Iceland | Flexitarian | F | 25-30 |
| R23 | Sweden | Pescetarian | F | 30-35 |
| R24 | Sweden | Flexitarian | M | 30-35 |
| R25 | Sweden | Vegan | N-B | 25-30 |
| R26 | Sweden | Vegetarian | F | 25-30 |
| R27 | Sweden | Flexitarian | F | 18-25 |
| R28 | Sweden | Vegetarian | F | 18-25 |
| R29 | Sweden | Vegetarian | F | 25-30 |
| R30 | Sweden | Pescetarian | F | 25-30 |
| R31 | Sweden | Flexitarian | M | >50 |

*F: Female, M: Male, *: Prefer not to say/not specified, N-B: Non-binary*

In total, 35 people responded to the survey, however four of the respondents were not considered valid since they answered that they resided in countries outside of the research areas, resulting in 31 valid responses. A majority, *n*=22, of the respondents identified as women, six of the respondents identified as male and three as non-binary or not specified. 19 respondents answered that they live in Sweden, and 12 lived in Iceland. Most of the respondents *n*=14 self-identify as vegan and *n*=10 as vegetarian, whilst *n*=5 identified as flexitarian. Two of the flexitarian respondents self-identified as omnivorous, yet when

their diet descriptions were compared to the vegetarian scale they were included in the dataset as it matched with a type 1 vegetarian. As a result, they were therefore included in the flexitarian group. Two of the respondents self-identified as pescetarian (Table 7). Overall the sample sizes for the different diet groups are small, particularly when it comes to the flexitarians and pescatarians. These results should therefore be interpreted cautiously.

*Table 7. Number of respondents within country of residence, diet and gender identity.*

| | | | **Diet** | | | | |
|---|---|---|---|---|---|---|---|
| **Country** | **Gender** | **Age** | **Vegan** | **Vegetarian** | **Flexitarian** | **Pescetarian** | **Total** |
| **Iceland** | Female | 18-25 | 1 | 2 | - | - | 3 |
| | | 25-30 | - | - | 1 | - | 1 |
| | | 30-35 | 2 | 1 | - | - | 3 |
| | | 35-40 | - | 1 | - | - | 1 |
| | | 40-45 | 2 | - | - | - | 2 |
| | Male | 45-50 | 1 | - | - | - | 1 |
| | Prefer not | 40-45 | 1 | - | - | - | 1 |
| | **Total** | | **7** | **4** | **1** | **-** | **12** |
| **Sweden** | Female | 18-25 | - | 1 | 2 | - | 3 |
| | | 25-30 | 1 | 4 | - | 1 | 6 |
| | | 30-35 | 2 | - | - | 1 | 3 |
| | Male | 18-25 | - | 1 | - | - | 1 |
| | | 25-30 | 1 | - | - | - | 1 |
| | | 30-35 | - | - | 1 | - | 1 |
| | | 35-40 | 1 | - | - | - | 1 |
| | | >50 | - | - | 1 | - | 1 |
| | Non-Binary | 25-30 | 1 | - | - | - | 1 |
| | | 30-35 | 1 | - | - | - | 1 |
| | **Total** | | **7** | **6** | **4** | **2** | **19** |
| **Total** | | | **14** | **10** | **5** | **2** | **31** |

### 7.3.1 Vegetarian and Vegan Attitudes Towards Aquaponics

The results showed that the respondents have a positive attitude towards aquaponics (*M*=3.7, *SD*=0.84). The vegan respondents showed a negative attitude towards aquaponics (*M*=2.4, *SD*=0.54), with responses clustered within the negative-to-neutral range. Vegetarians had a neutral attitude (*M*=3.1, *SD*=0.74). Both pescatarians (*M*=4.1, *SD*=0.07) and flexitarians (*M*=3.9, *SD*=0.37) showed positive attitudes towards aquaponics, with little variation between responses.

Although the overall sample mean (3.7) was higher than the median (3.1), indicating slight skewness possibly influenced by a few outliers, the differences between mean and median were minimal across most dietary groups, thus supporting the validity of the data despite moderate variation in responses (Table 8).

*Table 8. Descriptive statistics for attitudes towards aquaponics*

| Diet | *n* | Mean | Median | Max. | Min. | SD |
|---|---|---|---|---|---|---|
| Vegan | 14 | 2.4 | 2.3 | 3.6 | 1.7 | 0.54 |
| Vegetarian | 10 | 3.1 | 3.0 | 4.2 | 2 | 0.74 |
| Pescetarian | 2 | 4.1 | 4.15 | 4.2 | 4.1 | 0.07 |
| Flexitarian | 5 | 3.9 | 4.1 | 4.4 | 3.5 | 0.37 |
| Total | 31 | 3.7 | 3.1 | 4.4 | 1.7 | 0.84 |

Overall, respondents had a positive attitude towards fish welfare with a mean of 4.0, with answers varying between respondents (*SD*=0.75). Vegans had the highest score on attitudes towards fish welfare (*M*=4.5, *SD*=0.56), scoring above the mean. That was closely followed by vegetarians (*M*=3.7, *SD*=0.69) and flexitarians (*M*=3.6, *SD*=0.30). Pescatarians had a neutral attitude towards fish welfare (*M*=2.8, *SD*=0.28) (Table 9).

*Table 9. Descriptive statistics for attitudes towards fish welfare*

| Diet | *n* | Mean | Median | Max. | Min. | SD |
|---|---|---|---|---|---|---|
| Vegan | 14 | 4.5 | 4.8 | 5 | 3.6 | 0.56 |
| Vegetarian | 10 | 3.7 | 4 | 4.6 | 2.6 | 0.69 |
| Pescetarian | 2 | 2.8 | 2.8 | 3 | 2.6 | 0.28 |
| Flexitarian | 5 | 3.6 | 3.6 | 4 | 3.3 | 0.30 |
| Total | 31 | 4 | 4 | 5 | 2.6 | 0.75 |

The respondents attitudes towards the suitability of the systems for vegan consumers showed that vegans (*M*=2.1, *SD*=0.89) and vegetarians (*M*=2.1, *SD*=0.95) had a negative attitude, whilst flexitarians (*M*=2.9, *SD*=0.79) had a neutral attitude and pescatarians a positive attitude (*M*=3.6, *SD*=0.49). However, answers varied significantly in all groups except from pescatarians (Table 10).

*Table 10. Descriptive statistics of attitudes towards aquaponics being suitable for vegan consumers*

| Diet | *n* | Mean | Median | Max. | Min. | SD |
|---|---|---|---|---|---|---|
| Vegan | 14 | 2.1 | 2 | 4 | 1 | 0.89 |
| Vegetarian | 10 | 2.1 | 2 | 3.3 | 1 | 0.95 |
| Pescetarian | 2 | 3.6 | 3.6 | 4 | 3.3 | 0.49 |
| Flexitarian | 5 | 2.9 | 3 | 4 | 2 | 0.79 |
| Total | 31 | 2.3 | 2 | 4 | 1 | 0.95 |

A qualitative question provided further insight. When the respondents were directly asked if they considered aquaponics to be a vegan production method 45.2% answered 'no,' 32.3% were unsure, and 22.6% answered 'yes.' Furthermore, 51.6% indicated willingness to consume vegetables from aquaponic systems, with 25.8% unsure and 22.6% opposed (Table 11).

*Table 11. Attitudes towards consuming greens from aquaponic systems and aquaponics as a vegan production method*

| | Would you consume greens grown in an aquaponic system? | | Do you consider aquaponics to be a vegan production method? | |
|---|---|---|---|---|
| | N | % | N | % |
| **Unsure** | 8 | 25.8 | 10 | 32.3 |
| **Yes** | 16 | 51.6 | 7 | 22.6 |
| **No** | 7 | 22.6 | 14 | 45.2 |

Additionally, the results show that the respondents had a positive attitude towards the use of manure in food production (*M*=3.6, *SD*=0.91). When looking at the results from the different diets, vegans showed a neutral attitude towards manure (*M*=3, *SD*=0.92) whilst vegetarians (*M*=3.9, *SD*=0.66), flexitarians (*M*=4.3, *SD*=0.51) and pescatarians (*M*=4.3, *SD*=0.49) showed a positive attitude towards the use of manure. Again, moderate variability was observed among respondents, particularly within the vegan group (*SD*=0.92). The identical mean and median (*M*=3.0) suggest a symmetrical distribution around a neutral attitude, although the broad response range (*Min*=1.8, *Max*=4.7) indicates polarization within this group (Table 12). Therefore, a few negative responses (around the minimum value) could be outliers significantly influencing variability. These findings suggest that while the overall vegan attitude appears neutral, significant internal disagreement exists, warranting further qualitative exploration.

*Table 12. Descriptive statistics of attitudes towards the use of manure in food production*

| Diet | *n* | Mean | Median | Max. | Min. | SD |
|---|---|---|---|---|---|---|
| Vegan | 14 | 3 | 3 | 4.7 | 1.8 | 0.92 |
| Vegetarian | 10 | 3.9 | 4 | 5 | 2.7 | 0.66 |
| Pescetarian | 2 | 4.3 | 4.3 | 4.7 | 4 | 0.49 |
| Flexitarian | 5 | 4.3 | 4 | 5 | 3.8 | 0.51 |
| Total | 31 | 3.6 | 3.8 | 5 | 1.8 | 0.91 |

### 7.3.2 Differences in Attitudes Between Icelandic and Swedish Consumers

When comparing the two countries, Icelandic respondents showed a negative attitude towards aquaponics (*M*=2.3, *SD*=0.55), while Swedish respondents had a neutral attitude towards aquaponics (*M*=3, *SD*=0.79). Icelandic respondents also did not consider aquaponics to be suitable for vegan consumers (*M*=1.9, *SD*=0.71), whilst Swedish respondents had a neutral attitude towards the systems suitability for vegan consumers (*M*=2.6). However, responses varied significantly between the Swedish respondents (*SD*=1.0).

Icelandic respondents also had a higher mean score when it came to attitudes toward fish welfare (*M*=4.5, *SD*=0.44) compared to Swedish respondents (*M*=3.7, *SD*=0.75). Both Icelandic and Swedish respondents held similar attitudes to the overall mean (*M*=3.6, *SD*=0.91) regarding manure use, with Swedish respondents showing a mean of 3.7 (*SD*=0.89) and Icelandic respondents a mean of 3.4 (*SD*=0.92). Results varied between the respondents, specifically between the Icelandic vegans (*SD*=1.0) when it comes to attitudes towards the use of manure. With only a small difference of 0.1 between the mean and median, the high SD combined with the wide range of answers (*Min*=1.8, *Max*=4.7) could indicate that outliers are influencing the variability.

Icelandic vegans and vegetarians were the most consistent with their responses when it came to attitudes towards fish welfare, with both groups showing very little variance (*SD*=0.28). Swedish vegans had more varied responses to fish welfare (*M*=4.3, *SD*=0.70), however none of the Swedish vegans fell below the positive range (*Min*=3.6, *Max*=5) Table 13).

*Table 13. Descriptive statistics of differences in attitudes between Iceland and Sweden*

| Theme | Country | Diet | *n* | Mean | Median | Max. | Min. | SD |
|---|---|---|---|---|---|---|---|---|
| Attitudes towards aquaponics | Iceland | Vegan | 7 | 2.3 | 2.3 | 2.7 | 1.7 | 0.47 |
| | | Vegetarian | 4 | 2.5 | 2.5 | 3.2 | 2 | 0.62 |
| | | Flexitarian | 1 | 3.5 | . | 3.5 | 3.5 | . |
| | | Total | 12 | 2.3 | 2.3 | 3.5 | 1.7 | 0.55 |
| | Sweden | Vegan | 7 | 2.5 | 2.4 | 3.6 | 1.9 | 0.60 |
| | | Vegetarian | 6 | 3.5 | 3.8 | 4.2 | 2.8 | 0.63 |
| | | Pescetarian | 2 | 4.15 | 4.15 | 4.2 | 4.1 | 0.03 |
| | | Flexitarian | 4 | 4 | 4.1 | 4.4 | 3.5 | 0.32 |
| | | Total | 19 | 3 | 3.7 | 4.4 | 1.9 | 0.79 |
| Attitudes towards suitability for vegans | Iceland | Vegan | 7 | 1.9 | 2 | 3.3 | 1 | 0.78 |
| | | Vegetarian | 4 | 2 | 2 | 3 | 1 | 0.81 |
| | | Flexitarian | 1 | 2 | . | 2 | 2 | . |
| | | Total | 12 | 1.9 | 2 | 3.3 | 1 | 0.71 |
| | Sweden | Vegan | 7 | 2.3 | 2 | 4 | 1 | 1.0 |
| | | Vegetarian | 6 | 2.2 | 2.5 | 3.3 | 1 | 1.0 |
| | | Pescetarian | 2 | 3.6 | 3.6 | 4 | 3.3 | 0.49 |
| | | Flexitarian | 4 | 3.1 | 3.1 | 4 | 2.3 | 0.70 |
| | | Total | 19 | 2.6 | 3 | 4 | 1 | 1.0 |
| Attitudes towards fish welfare | Iceland | Vegan | 7 | 4.7 | 5 | 5 | 4.3 | 0.28 |
| | | Vegetarian | 4 | 4.3 | 4.4 | 4.6 | 4 | 0.28 |
| | | Flexitarian | 1 | 3.6 | . | 3.6 | 3.6 | . |
| | | Total | 12 | 4.5 | 4.6 | 5 | 3.6 | 0.44 |
| | Sweden | Vegan | 7 | 4.3 | 4.6 | 5 | 3.6 | 0.70 |
| | | Vegetarian | 6 | 3.3 | 3.3 | 4 | 2.6 | 0.58 |
| | | Pescetarian | 2 | 2.8 | 2.8 | 3 | 2.6 | 0.28 |
| | | Flexitarian | 4 | 3.7 | 3.8 | 4 | 3.3 | 0.34 |
| | | Total | 19 | 3.7 | 3.6 | 5 | 2.6 | 0.75 |
| Attitudes towards the use of manure | Iceland | Vegan | 7 | 3.1 | 3 | 4.7 | 1.8 | 1.0 |
| | | Vegetarian | 4 | 3.7 | 4.1 | 4.2 | 2.7 | 0.7 |
| | | Flexitarian | 1 | 4 | . | 4 | 4 | . |
| | | Total | 12 | 3.4 | 3.8 | 4.7 | 1.8 | 0.92 |
| | Sweden | Vegan | 7 | 3 | 3.1 | 4.2 | 1.8 | 0.87 |
| | | Vegetarian | 6 | 4.1 | 4 | 5 | 3.2 | 0.65 |
| | | Pescetarian | 2 | 4.3 | 4.3 | 4.7 | 4 | 0.49 |
| | | Flexitarian | 4 | 4.3 | 4.3 | 5 | 3.8 | 0.56 |
| | | Total | 19 | 3.7 | 4 | 5 | 1.8 | 0.89 |

### 7.3.3 Differences in Attitudes According to Diet Motivations

As respondents often have more than one motivation for choosing a vegetarian or vegan diet (De Backer & Hudders, 2015), the survey allowed them to select multiple motivations from a list. Additionally, an option was provided for respondents to specify any additional or unique motivations not covered by the pre-written choices (Table 14).

*Table 14. Detailed information on the respondents diet motivations*

| | | | Diet Motivation | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **ID** | **Country** | **Diet** | **Environment** | **Animal focused** | **Health** | **Weight** | **Human focused** | **Sensory** | **Culture** |
| R1 | Sweden | Vegetarian | X | X | X | | | | |
| R2 | Sweden | Flexitarian | X | X | X | | | | |
| R3 | Sweden | Vegan | X | X | | | | | |
| R4 | Sweden | Vegan | X | X | | | X | X | |
| R5 | Sweden | Vegan | X | X | | | X | | |
| R6 | Iceland | Vegan | X | X | X | X | X | X | |
| R7 | Sweden | Vegetarian | X | | X | X | | | X |
| R8 | Sweden | Vegetarian | X | | | | | | |
| R9 | Sweden | Vegan | X | X | | | | | |
| R10 | Iceland | Vegetarian | X | X | | | | | |
| R11 | Iceland | Vegetarian | X | X | X | | | | |
| R12 | Sweden | Vegan | X | X | | | | | |
| R13 | Iceland | Vegan | X | X | X | X | X | X | |
| R14 | Iceland | Vegetarian | X | X | X | | | | |
| R15 | Iceland | Vegan | | X | | | | | |
| R16 | Iceland | Vegan | X | X | | | | | |
| R17 | Iceland | Vegan | X | X | X | X | X | X | |
| R18 | Iceland | Vegetarian | X | X | | | X | | |
| R19 | Iceland | Vegan | | X | | | | | |
| R20 | Sweden | Vegan | X | X | | | | X | |
| R21 | Iceland | Vegan | X | X | | | X | | |
| R22 | Iceland | Flexitarian | X | | X | | | X | |
| R23 | Sweden | Pescetarian | X | | | | | | |
| R24 | Sweden | Flexitarian | | | X | X | | | |
| R25 | Sweden | Vegan | X | | | | | | |
| R26 | Sweden | Vegetarian | X | X | | | | | |
| R27 | Sweden | Flexitarian | | | X | X | | | |
| R28 | Sweden | Vegetarian | X | | X | | | | |
| R29 | Sweden | Vegetarian | X | | | | X | | |
| R30 | Sweden | Pescetarian | X | X | X | | X | X | |
| R31 | Sweden | Flexitarian | X | | X | | | | |
| | ***n*** | | **27** | **21** | **14** | **6** | **9** | **7** | **1** |

Most respondents indicated environmental concern and animal rights as their primary motivations. Health was the third most common motivation, with 14 respondents selecting it, followed by human-focused ethics, sensory issues, weight management, and one respondent who cited cultural or religious beliefs. In Iceland, the most common diet motivation within the vegetarian scale appears to be animal rights (*n*=11), whilst environmental concern appears to be the most common diet motivation in Sweden (*n*=17). For both vegans and vegetarians in Sweden, environmental concern was the biggest diet motivation, whilst flexitarians in Sweden mentioned health as their diet motivation. In Iceland, vegans were primarily motivated by animal rights, whilst vegetarians were split between animal rights and environmental concern (Table 15).

*Table 15. Number of respondents within each diet motivation, and in each country*

| | | Country | | |
|---|---|---|---|---|
| | | **Iceland** | **Sweden** | **Total** |
| **Diet Motivation** | **Diet** | | **n** | |
| **Environment** | Vegan | 5 | 7 | 12 |
| | Vegetarian | 4 | 6 | 10 |
| | Pescetarian | 0 | 2 | 2 |
| | Flexitarian | 1 | 2 | 3 |
| | **Total** | **10** | **17** | **27** |
| **Animals** | Vegan | 7 | 6 | 13 |
| | Vegetarian | 4 | 2 | 6 |
| | Pescetarian | 0 | 1 | 1 |
| | Flexitarian | 0 | 1 | 1 |
| | Total | 11 | 10 | 21 |
| **Health** | Vegan | 3 | 0 | 3 |
| | Vegetarian | 2 | 3 | 5 |
| | Pescetarian | 0 | 1 | 1 |
| | Flexitarian | 1 | 4 | 5 |
| | **Total** | **6** | **8** | **14** |
| **Weight gain/loss** | Vegan | 3 | 2 | 5 |
| | Vegetarian | 1 | 1 | 2 |
| | Pescetarian | 0 | 1 | 1 |
| | Flexitarian | 1 | 0 | 1 |
| | **Total** | **5** | **4** | **9** |
| **Human focused** | Vegan | 3 | 2 | 5 |
| | Vegetarian | 1 | 1 | 2 |
| | Pescetarian | 0 | 1 | 1 |
| | Flexitarian | 1 | 0 | 1 |
| | **Total** | **5** | **4** | **9** |
| **Sensory** | Vegan | 3 | 4 | 5 |
| | Pescetarian | 0 | 1 | 1 |
| | Flexitarian | 1 | 0 | 1 |
| | **Total** | **4** | **3** | **7** |
| **Culture** | Vegetarian | 0 | 1 | 1 |
| | **Total** | **0** | **1** | **1** |

The results show that within every diet motivation, the respondents are neutral towards aquaponics. Health motivated respondents generally held mildly positive attitudes, indicated by a median of 3.6. The mean of 3.4, slightly below the median, suggests negative skewness, indicating most respondents leaned positively while a smaller group exhibited negative attitudes. A moderate standard deviation (*SD*=0.73) and range (*Min*=2, *Max*=4.4) reflect some disagreement or uncertainty within the group. Therefore, although attitudes were predominantly positive, a subset of respondents had notably more negative perceptions.

Similarly, respondents motivated by weight concerns showed attitudes leaning slightly positive (*M*=3.2, *SD*=0.70), slightly below the threshold of positivity (3.5), yet higher than the overall mean for several other groups. Their moderate variability (*Min*=2.3, *Max*=4.2) indicates the presence of both neutral and moderately positive attitudes within this group.

Respondents motivated by animal rights concerns exhibited slightly more negative attitudes towards aquaponics (*M*=2.6, *SD*=0.76) compared to the overall mean across groups. The median (2.5) being marginally lower than the mean indicates a slight positive skewness, suggesting that most respondents within this group leaned toward neutral-to-negative responses, with a smaller number providing slightly more positive answers. The moderate variability (*SD*=0.76) coupled with the broad range (*Min*=1.7, *Max*=4.4) suggests considerable internal disagreement. While the majority held negative-to-neutral perceptions, a few respondents within the animal-focused group reported distinctly positive attitudes towards aquaponics, warranting further qualitative research to understand underlying concerns.

Similarly, respondents motivated by human-focused reasons showed slightly negative-to-neutral attitudes towards aquaponics (*M*=2.8, *SD*=0.67). The median of 2.8, matching closely with the mean, indicates a relatively symmetrical distribution, meaning responses were evenly balanced around this neutral-to-negative midpoint. The moderate variability (*SD*=0.67) and relatively wide range (*Min*=1.9, *Max*=4.1) indicate varied perceptions within this group, though without extreme polarization. This suggests that while most human-focused respondents tended toward neutral or slightly negative views, there was still some disagreement or uncertainty regarding aquaponics (Table 16).

*Table 16. Descriptive statistics for attitudes towards aquaponics, within diet motivations*

| | **Environment** | **Animal focused** | **Health** | **Weight** | **Human focused** | **Sensory** | **Culture** |
|---|---|---|---|---|---|---|---|
| ***n*** | 27 | 21 | 14 | 6 | 9 | 7 | 1 |
| **Mean** | 3 | 2.6 | 3.4 | 3.2 | 2.8 | 3 | 3.8 |
| **Median** | 2.9 | 2.5 | 3.6 | 3.3 | 2.8 | 3.1 | . |
| **Max** | 4.4 | 4.4 | 4.4 | 4.2 | 4.1 | 4.1 | 3.8 |
| **Min** | 2 | 1.7 | 2 | 2.3 | 1.9 | 2.3 | 3.8 |
| **SD.** | 0.80 | 0.76 | 0.73 | 0.70 | 0.67 | 0.59 | . |

Regarding attitudes towards fish welfare, the results show that the respondents motivated by animal rights (*M*=4.3, *SD*=0.66), weight (*M*=4.3, *SD*=0.58) and human-focused ethics (*M*=4.2, *SD*=0.74) had the highest means, indicating that they are the most positive towards fish welfare.

Those motivated by the environment (*M*=4.0, *SD*=0.76), health (*M*=3.9, *SD*=0.69) and sensory issues (*M*=4, *SD*=0.79) on the other hand scored closer to the overall mean. However, all diet motivation groups had a positive attitude towards fish welfare, and within each group the maximum score answered was 5, and all with similar moderate-to-wide ranges (*range*=2-2.4), except from those with weight motivations (*Min*=3.6, *Max*=5).

Those with environmental motivations had the widest range of responses when it comes to attitudes towards fish welfare (*Min*=2.6, *Max*=5). This, however, could depend on almost all respondents (27 out of 31) reporting environmental concern as one of their motivations, meaning that the wide range of responses within the group can depend on other motivations weighing heavier for them (Table 17).

*Table 17. Descriptive statistics for attitudes towards fish welfare, within diet motivations*

| | **Environment** | **Animal focused** | **Health** | **Weight** | **Human focused** | **Sensory** | **Culture** |
|---|---|---|---|---|---|---|---|
| ***n*** | 27 | 21 | 14 | 6 | 9 | 7 | 1 |
| **Mean** | 4 | 4.3 | 3.9 | 4.3 | 4.2 | 4 | 4 |
| **Median** | 4 | 4.6 | 4 | 4.3 | 4.6 | 3.6 | . |
| **Max** | 5 | 5 | 5 | 5 | 5 | 5 | 4 |
| **Min** | 2.6 | 3 | 2.6 | 3.6 | 3 | 3 | 4 |
| **SD** | 0.76 | 0.66 | 0.69 | 0.58 | 0.74 | 0.79 | . |

Finally, within all diet motivations the respondents had a neutral attitude towards the use of manure, and all scored close to the overall mean (Table 18). Within all groups there was a wide range of responses, with SD ranging from 0.93-1.3. This indicates that diet motivation might not affect attitudes towards the use of manure, however the variance could also be explained by the small sample sizes as the data points therefore are limited. The mean being close to the median could indicate that the distribution is somewhat symmetrical and clustered. With the maximum answer of 4 and minimum of 1.6 and a median close to the mean for sensory motivated respondents the outliers could be affecting the statistical variance for the group, meaning that those motivated by sensory issues might be clustered around the mean of 2.9, indicating a neutral attitude and the lowest score towards the use of manure compared to the other diet motivation groups.

*Table 18. Descriptive statistics for attitudes towards the use of manure, within diet motivations*

| | Environment | Animal focused | Health | Weight | Human focused | Sensory | Culture |
|---|---|---|---|---|---|---|---|
| ***n*** | 27 | 21 | 14 | 6 | 9 | 7 | 1 |
| **Mean** | 3.6 | 3.3 | 3.8 | 3.5 | 3.4 | 2.9 | 5 |
| **Median** | 4 | 3.7 | 4 | 3.8 | 4 | 3 | . |
| **Max** | 5 | 5 | 5 | 5 | 4.2 | 4 | 5 |
| **Min** | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 5 |
| **SD** | 0.93 | 0.96 | 1.0 | 1.3 | 0.95 | 1.0 | . |

### 7.3.4 To me Aquaponics is…

Lastly, the survey included an open-ended question where respondents could end the sentence "to me aquaponics is…". The results show that those who had a negative attitude towards aquaponics mentioned that the systems are unnecessary, strange, not natural and a way to exploit animals. "*A sterile and unnatural environment.*" (Survey respondent 9).

The respondents with a positive attitude towards aquaponics mentioned resource efficiency, that the systems are clever and smart, and that it would be good for the future. One respondent said "*Just a clear use of animal waste. Good system to grow plants and green veggies. I still wouldn't eat fish, but it's good that we are saving marine life at least by shifting to a closed system*" (Survey respondent 7).

Similar comments were left by those who had a neutral attitude towards aquaponics, but with the addition of words like exploitation and abuse. There were also more questions left by those with a neutral attitude. For example regarding the layout of the system, such as: "*Is the tank big enough to mimic an entire lake for example? With the fish being able to fully exercise their natural needs*?" (Survey respondent 24).

# 8. Phase 3

The last phase of the data collection consisted of interviews with vegans and vegetarians, to gain a deeper insight to the attitudes and possible underlying reasons for the attitudes.

## 8.1 Materials and Participants

The interviews were held online (over Teams and Zoom) or in person, depending on what the participant felt more comfortable with and regarding geographical distance. The interviews were recorded on the interviewers' phone, with the consent of the participant. The interviews lasted between 14 and 78 minutes, with the average time being ~30 minutes.

The participants were first asked demographic questions, followed by questions regarding their diet and diet motivation. Participants were then introduced to aquaponics and a PowerPoint slide was available for them to see at all times (Appendix E). The slide contained bullet points providing participants with easy-to-understand information on aquaponics and as images giving them a visual aid. The aim of the slide was to give the respondents a helping hand, if they felt like they lacked information on the subject, or forgot the information given to them in the introduction.

After the introduction on aquaponics, participants were asked questions regarding their attitudes towards the systems. Towards the end of the interview, participants were prompted to consider if they thought aquaponics should have certain rules and regulations to better suit the plant-based diet. The first three interviewees were asked about the systems' potential to tackle food security; however, this proved to be a difficult question to answer and for the following ten interviews they were instead asked to envision what local food production could look like. Respondents were asked to envision and describe local food production to assess whether aquaponics aligns with their vision. The results for the first three participants therefore differ in that section, however the coding showed that useful information was given in all cases - although discussions on local food production were lacking from respondent 1, 2 and 3 (see Appendix F for interview guide).

In Phase 2, respondents were given the option to provide their contact information if they were interested in participating in an interview. Recruitment continued through Facebook, as it had proven effective in reaching respondents during earlier phases. Additionally, interview participants were encouraged to share information about the study with acquaintances, which proved highly efficient. Many respondents shared the study details, leading to new participants showing interest. This approach was particularly successful when participants asked their friends to reach out to other vegetarians and vegans, possibly because individuals felt more comfortable participating in a study referred by someone they knew. This did, however, also lead to some respondents being acquaintances with the interviewee and the potential implications of this are discussed in Section 5.2. The participants were informed about their anonymity through a consent form before participating (see Appendix G).

## 8.2 Method for Analysing Data

The respondents' answers regarding their diet were coded and given a number between 1-6 following Beardsworth and Keil (1999) Vegetarian Scale. Only one respondent did not fit into this scale and was therefore given Type X. This respondent identified as a vegetarian, however they stated that they consumed meat once or twice per week. This does not fit into Beardsworth and Keil (1999) scale, but the respondent is still considered relevant for the data since they identify as vegetarian, prefer vegetarian food and expressed motivations for their preferred diet that were in line with the motivations mentioned in Table 2 (section 7.3). The interviews were transcribed, and for those that were conducted in Swedish they were then translated to English. After transcribing the interviews, they were run through NVivo. NVivo was used as it allows the researcher to collect and sort different statements or quotes into categories or themes. The coding was done following Ryan and Bernard (2003) suggestions for thematic analysis. Finding themes in the data was done by looking for repetitions, similarities and differences, linguistic connectors and theory related material (Ryan & Bernard, 2003). Repetitions is the most common method of finding themes in qualitative research, where you look for recurring themes within one interview. Similarities and differences can be found by comparing the interviews with each other, specifically comparing each answer one by one (ibid.). Furthermore, linguistic connectors as "because of" or "as a result of" indicate that the respondent sees a causal relation which could be interesting for the analysis of perceptions of a phenomenon. Lastly, theory related material are indicators of "the perspectives of the informants, and informants' ways of thinking about people, objects, processes, activities, events, and relationships" (Ryan & Bernard, 2003, p. 93) in connection to social science theories. The codes and themes were then named and analysed to see their popularity, and if they were believed to have significance for the study (Bryman, 2017).

## 8.3 Results Phase 3

In total, 13 interviews with vegetarians and vegans were conducted. Nine of the respondents live in Sweden, and four in Iceland. Four of the respondents identify as male and all the respondents were between the ages of 20-60. A majority ($n$=9) of the respondents were between 20-30 years old. The majority ($n$=6) of the respondents identified as vegan, whilst three respondents identify as lacto-ovo vegetarians. One respondent mentioned that they slip between a type 3 and 4 vegetarian, and another one that they move between a type 2 and 3 vegetarian, and they were therefore coded as that (Table 19). The themes collected from the interviews ended up being environmental sustainability, fish welfare, speciesism, feelings of disgust, diseases and pathogens and authority and transparency.

*Table 19. Demographic information, interview respondents phase 3*

| ID | Gender | Age | Country of residence | Vegetarian scale |
|---|---|---|---|---|
| R1 | Male | 24 | Sweden | Type 4 |
| R2 | Female | 25 | Sweden | Type 2-3 |
| R3 | Male | 26 | Sweden | Type 6 |
| R4 | Female | 25 | Sweden | Type 3 |
| R5 | Female | 60 | Sweden | Type 2 |
| R6 | Female | 40 | Sweden | Type 6 |
| R7 | Female | 20 | Sweden | Type X* |
| R8 | Male | 25 | Sweden | Type 6 |
| R9 | Female | 30 | Sweden | Type 3 |
| R10 | Female | 25 | Iceland | Type 6 |
| R11 | Female | 37 | Iceland | Type 6 |
| R12 | Female | 24 | Iceland | Type 3-4 |
| R13 | Male | 50 | Iceland | Type 6 |

**. respondent did not fit the vegetarian scale (Beardsworth & Keil, 1990) but identified themselves as vegetarian.*

### 8.3.1 Environmental Sustainability

Many respondents highlighted environmental sustainability as a key appeal of aquaponic systems, particularly their resource efficiency. One respondent showed concern over the climate, mentioning "*Us as the human race will never be able to leave meat consumption. Eh, we are also not hard enough at work to stop a climate [. . .] catastrophe [. . .] I think that this is something that you should put effort into because I think this is the future.*" (R9, type 3). However, the positive view on aquaponics sustainability was often mentioned with a tone of ambivalence. Several participants referred to aquaponics as "the best of a bad situation," expressing that while using animals may not be ideal, maximising the benefits from them makes the system more justifiable, with one vegan respondent saying "*I like the concept eh, just because I think even though I choose not to consume animals, fish are going to be farmed anyway, and I think utilising waste in a sustainable way is better than not. Like if, if we're going to have waste products from the production of animals at least it's being utilised in a productive way*." (R10, type 6). A similar response was mentioned by a vegetarian respondent saying "*it feels like if you're using the fish in this way you might as well use the by-products and make something out of it. I thought it felt sustainable. [. . .] you're trying to do something good from a shit system."* (R2, type 2-3).

### 8.3.2 Fish Welfare

At the same time, the respondents showed concern over the fish welfare, indicating that they feel a strong moral obligation towards the treatment of animals in food production systems. Common themes mentioned were animal abuse, exploitation and captivity. One vegan respondent said "*But I would say that it's usually less space than they would have in nature. And my prior distribution is that it leads to some suffering*." (R3, Type 6), and another vegan mentioned that "*you exploit a living being, and that's not okay*" (R6, Type 6). Some of the respondents mentioned that having fish in aquaponics is to exploit them

as a “work force”, with one respondent explaining that she does not consider honey to be a product suitable for vegans because the “bees worked for it” and therefore plants in aquaponics can not be vegan because that would be a similar practice. Another respondent said “*It's also the issue of having the fish serve you, they are then working for you. Sometimes it's like, how do you know if the working conditions for the animals are good then, it's difficult*” (R8, Type 6).

Icelandic respondents referenced recent media coverage of aquaculture and compared the treatment of fish depicted in those reports with the treatment of fish in aquaponic systems. Like previously mentioned, media attention on aquaculture in Iceland rose last year after farmed salmon escaped from their pen. This led to massive protests against aquaculture, with companies and celebrities joining the demonstrations (Negrete, 2024; Patagonia, 2024). One respondent referred to the events when mentioning her negative view on aquaponics by stating “*I think in Iceland it's quite like people are very against all this aquaculture that you are having like this animals like fish you know in these, because of all the bad consequence of it. So how is it then okay to do it in a tank?*” (R11, Type 6).

Furthermore, many of the respondents mentioned that the system is unnatural for the fish with one respondent saying “*this is an enclosed system for the fish so it's not their natural environment*” (R13, Type 6). Most respondents envisioned ways to make aquaponic systems more suitable for vegan consumers, with a common suggestion being a system where fish could live in their natural environment, thereby avoiding captivity. Interestingly, most of them mentioned the fish living in a lake, where the faeces could still be utilised as a fertiliser but the fish would not be ‘exploited’. Respondent 2 (Type 2-3) said “*Maybe if you could get water from a lake [. . .]allowing them to be wild but still using the manure so that you're not affecting their… I was about to say everyday life [laughter], but like their natural way of living, then it might be vegan.*”.

### 8.3.3 Speciesism

One similarity between the respondents was the mention of fish as either equal or unequal to other animals. Specifically, the respondents were discussing if aquatic animals are sentient beings or not, and how that would affect how they are treated. One respondent mentioned that she rarely eats fish but that she “*had mussels on my birthday but I don't think that counts because I don't think they have a central nervous system.*” (R2, Type 2-3). Some even considered aquatic animals to evoke feelings of disgust, and therefore felt less empathy towards them with one respondent saying “*No one cares about how snails are doing because they are nasty. And how far away is a fish from a snail?*” (R4, Type 3). She mentioned that it might depend on how much an animal displays human-like qualities, or how physically close she is to an animal stating that “*the more human-like the easier it is to sympathise with it. And because we have lived alongside cows forever [. . .] it feels worse if a cat dies than if a cow dies. Because the cat is closer. I think that's some sort of theory, the closer you are the more it will affect you. If I was a mermaid I might care more for the fish.*” (R4, Type 3).

One respondent argued that fish should be considered equal to humans, suggesting that the treatment of animals in food production mirrors the mistreatment of humans in certain historical events stating that “*So. I often think about this in terms of slavery, its because it is true that eh, a good hearted farmer that takes care of his animals is, it's in a way its*

*beautiful, you know, and I know that the old time farmers it was very personal they loved their animals and tried to you know, offer them a decent existence. But at the end of the day it's still captivity, and in the same way that a slave owner is treating his slaves truly well then he still owns them, he still can, you know, do whatever he wants, you know, they are not free.*" (R13, Type 6).

### 8.3.4 Feelings of Disgust

In connection to talking about how the aquaponic cycle functions, regarding the use of fish faeces as a fertiliser, most of the respondents displayed feelings of disgust. One respondent said "*My first thought is that it sounds a little disgusting.*" (R7, type X) when asked about her initial thoughts about the systems, and another respondent said "*Eh, I don't know. It's like when you are reading about it the fish poop, like euw*." (R11, type 6). Respondent 11 further developed her argument stating that she felt like there is a difference between the use of manure in aquaponic systems and in traditional agriculture stating that "*the fish is literally pooping in the water and so that is kind of like its a bit different it's like eh, because if you are going to think about the animal [manure] in the soil I mean the soil like filters everything like… I mean people when they die they are also put in the soil so think about that.*" (R11, Type 6).

Respondent 5, who eats fish regularly for health reasons, discussed that she had a concern regarding the effect of manure on the taste of the plant products. She mentioned that it felt illogical, since livestock manure does not have that effect on the plant products she eats currently, but still felt like it was a concern regarding aquaponic products, and that the reason might be that it is a new concept for her. "*[. . .]if the fish live in the water, poop in the water, then the water wouldn't taste that good. And that fertilises what grows there and maybe that will get that taste. At the same time the cow manure does not affect the taste of the plants, so…[. . .] the more I say it out loud the more I start to question it? The potatoes I grow in cow manure don't taste like cows… [. . .] Well it is a worry, so I'll stand for it. I think that if it would have been the other way around, that we would have always grown in those systems and then someone would come and say that we can farm in the soil and use manure. That would have been weird."* (R5, type 2).

### 8.3.5 Disease and Pathogens

Several of the respondents showed concern over disease. Some of them showed concern over disease influencing animal health, and others discussed it having an effect on human life. Commonly, the vegans appeared to be more concerned over the fish health when mentioning diseases and pathogens whilst respondents on the other points of the vegetarian scale appeared concerned over human health. One vegan respondent mentioned that "*there's a lot of spreading of diseases*" (R8, Type 6) in fish farms, and another vegan respondent mentioned that the news in Iceland had shown images of fish showing signs of stress in aquaculture systems. She concluded that "*it was so devastating because the fish like they started to get sick and had parasites that started eating the skin and everything and many fishes they looked awful*" (R13, Type 6). Comparatively, one pescetarian mentioned concern for human health stating "*like if a fish gets sick and starts bleeding or whatever, the risk of other fishes getting sick is quite high, and that can be dangerous to eat*" (R2, Type 2-3). One respondent mentioned that aquaponics felt less clean than traditional fishing practices saying "*I also think that it feels less clean than if*

*we would continuously pump water through the system. But that would be insane. But that's why it feels cleaner with fish caught by trawlers, but you shouldn't eat that either*" (R5, Type 2).

### 8.3.6 Authority and Transparency

Several respondents mentioned that they felt like companies tend to overlook fish welfare to increase profit. Some of them mentioned that they felt like the governmental subsidies and budgets are misplaced. The capitalistic system was mentioned as a common threat to animal welfare and sustainable food production systems. "*I think most companies abuse how easy it is to overcrowd and increase profit [. . .]and then you get the greed from the capitalistic thinking and then eh, we have a terrible situation like we have here in Iceland*" (R13, Type 6). Similarly, one vegan said "*But I think the biggest problem is like often the government give much more money to farmers that produce meat and milk than they give to the ones that are producing vegetables*" (R11, Type 6).

Furthermore, transparent chains of production was a common theme among the respondents. They showed an interest in knowing how their foods are produced and what stakeholders are involved. Most commonly an interest of transparency regarding animal treatment was mentioned. "*The most important part for me is that the chain of production is transparent. And if that's visible it's up to the consumer to decide where your veganism aligns with it.*" (R4, Type 3).

# 9. Discussion

The aim of this study was to examine vegan and vegetarian attitudes toward aquaponic systems and to identify potential strategies for appealing to diverse consumer groups. The research addressed two key questions: *What are vegan and vegetarian attitudes toward aquaponic systems?* and *do these attitudes vary based on diet motivation?*

Since the study had a small sample size, the results are to be treated as to applying to the respondents in this study, and not to be generalised to apply all vegans and vegetarians. The results indicate that the vegans, in this study, generally hold negative attitudes toward aquaponic systems, whereas the vegetarians exhibit more neutral perspectives. Most of the respondents, across diets, do not consider aquaponic systems to be suitable for vegan consumers. Additionally, the findings reveal differences in attitudes based on diet motivations and between Sweden and Iceland. In the following sections, the results will be discussed in regard to the aim of the study by incorporating risk evaluation theories and MFT.

## 9.1 Vegan and Vegetarian Attitudes Towards Aquaponics

### 9.1.1 Attitude Consistency

The respondents in the study showed attitude consistency. The vegan respondents had a negative attitude towards aquaponics. This would be expected, as vegans usually have prosocial motivations and a moral motivation to a higher rate than other diets (Rosenfeld, 2019). This means that vegans value for example animal rights higher than other vegetarians and make attitudinal decisions on what is considered wrong or right (ibid.). The results showed that the vegans mentioned animal rights motivations at a higher rate than the other diets and the interviews showed a heightened concern towards animal welfare in the systems, specifically by mentioning how fish are treated in aquaculture. Believing that fish farming systems are harmful towards fish would therefore lead to a negative attitude towards them.

Comparatively, pescatarians and flexitarians showed a lower concern for fish welfare compared to the other vegetarians. Seeing as fish is part of their diets to start with, it would also be consistent with their previous attitudes to be more positive towards aquaponics. In the survey, all the flexitarians mentioned health as their diet motivation which is also consistent with previous research (DeBacker & Hudders, 2015; Fox & Ward, 2008). It could be that pescatarians and flexitarians are more open towards aquaponics as fish and vegetables are both believed to be nutritious foods (Lusk, 2019) which also could be a reason for them being more positive towards aquaponics. However, in the interviews, one of the pescatarians mentioned that health was their sole motivation for eating fish which, interestingly, led to her being more sceptical towards aquaponics. Her concern, which is consistent with previous research (Rönnerstrand, Armbrecht, Lundberg & Sundell, 2020) is that wild-caught fish 'feels healthier' than fish cultivated in captivity. This might highlight deep-seated purity concerns linked to Moral Foundations Theory. The idea of faeces involved in the production of foods might evoke aversive reactions to aquaponics.

Furthermore, pescatarians and flexitarians may not view aquatic animals with the same ethical consideration as other animals. In the interviews, participants often described aquatic animals as lacking sentience or central nervous systems. Fish were seen as slimy or too distantly related to humans to evoke feelings of compassion. This showed that the respondents on the lower end of the vegetarian scale motivated their consumption of fish with the notion that fish are not seen as being part of their "moral circle". In contrast, vegan participants argued that fish should not be exploited within food production systems, valuing their lives comparably to human lives and drawing parallels between animal rights and historical human rights struggles.

Vegetarian respondents also appeared to be consistent in their attitudes. The survey showed that all the vegetarians were motivated by environmental motivations in their diet choice. This means that a production method that is considered environmentally sustainable would be seen as preferable for them. In the interviews the sustainability of aquaponic systems was mentioned as what they find appealing. Vegetarians have also been shown to be more accepting of others consuming meat, compared to vegans

(Rosenfeld, 2019). This could mean that a food production system combining food fit for their diet (vegetables) and for other diets (fish) would be acceptable for a vegetarian, especially when the sustainability of combining two food products in one production system is highlighted. The second biggest diet motivation for vegetarians was animal concerns. Many vegetarians also mentioned concern for the welfare of fish in fish farming. This could explain why the overall attitude towards aquaponic systems was neutral for vegetarians.

As mentioned in the theoretical framework, a distinction exists between animal rights and animal welfare (Bekoff, 2007). Vegan respondents may be more aligned with animal rights, viewing fish as autonomous beings with intrinsic rights, while vegetarian respondents may be more concerned with animal welfare, focusing on the conditions and treatment of fish within the system. This distinction could explain the variation in diet motivations and attitudes found in the study.

For many vegan participants, fish were described as a "workforce" within aquaponic systems, seen primarily as serving human needs. This perception aligns with a rights-based view, where the fish's presence in the system is interpreted as a violation of their right to exist freely. In contrast, vegetarian respondents appear to adopt a more utilitarian perspective, recognizing the fish as an essential component within a closed-loop, sustainable system. Given their environmental motivations, vegetarians may view the combined production of plants and fish to optimise resource use and reduce environmental impact.

This rights-based approach among vegans also manifested in their questions about whether fish could "live freely" within these systems. Rather than rejecting aquaponics outright, these respondents seem to be weighing their animal rights perspective with broader ethical considerations, such as providing a population with nutritious food and promoting sustainable food production. This suggests that vegan participants may be open to considering aquaponics if it aligns more closely with their moral values, showing an interest in exploring modifications that could make the system less human-centred and more in tune with animal rights. Previous research has shown that vegans and vegetarians often face moral dilemmas when sustainability and ethical considerations conflict (DeBacker & Hudders, 2015). A hypothetical aquaponic system where fish "live freely" in a lake might therefore be considered more compatible with vegan principles. However, as Bekoff (2007) emphasizes, rights-based approaches inherently reject systems that subordinate animals for human benefit, making it unlikely that even an adapted system would fully align with vegan principles. Furthermore, while such a system might align with vegan ethics by supporting fish autonomy, it would compromise some of aquaponics' core sustainability benefits, such as water recycling and efficient resource use. Consequently, this approach could risk alienating consumers who prioritise environmental concerns, as it would forfeit the water conservation and resource efficiency that make aquaponics a sustainable option.

The results therefore indicate that if aquaponics is to be viewed as an attractive production method by vegans and vegetarians there are two important areas to focus on: animal rights and welfare as well as environmental impact. While existing studies have explored dietary motivations such as health, environmental concerns, and animal welfare (DeBacker & Hudders, 2015; Fox & Ward, 2008), few have applied these motivations to emerging food

technologies like aquaponics. These findings possibly offer a deeper understanding on how specifically vegans and vegetarians perceive food production systems that include animals in various forms. Specifically, the vegan respondents in this study align with a rights-based approach regarding animals, which results in a heightened aversion for aquaponic systems. Comparatively vegetarians prioritize environmental sustainability and animal welfare, resulting in a neutral standpoint for aquaponic systems. By analysing these attitudes through the lens of Moral Foundations Theory (Graham *et al*, 2013), this study underscores how purity and care foundations influence acceptance of food systems, adding depth to our understanding of moral motivations in dietary decision-making.

### 9.1.2 Differences in Attitudes Between Iceland and Sweden

There was a clear difference between the attitudes of Swedish and Icelandic respondents in the survey. Icelandic respondents had a negative attitude towards aquaponics, which also is consistent with previous opinion polls (Negrete, 2024), whilst Swedish respondents had a neutral attitude towards aquaponics.

Like vegans and vegetarians, Icelandic respondents largely cited animal rights as their primary diet motivation, while Swedish respondents were more motivated by environmental concerns. This difference in motivation may influence attitudes toward aquaponics, especially if fish farming is perceived as harmful to fish welfare. Icelandic respondents in the interview phase specifically referenced the recent negative media coverage surrounding aquaculture in Iceland, which has emphasised concerns about fish welfare.

This recent media attention may have influenced Icelandic respondents' attitudes toward aquaponics, particularly for those driven by animal rights. It is common when evaluating risk to rely on affect and availability heuristics (Böhm & Tanner, 2007) and it is possible that Icelandic respondents, perhaps unconsciously, are using these heuristics to shape their perspectives on aquaponics. With widespread media highlighting the negative aspects of aquaculture, such as poor fish welfare (Patagonia, 2024; Kulczycki, 2023; Salmon Business, September 1st, 2023; Salmon Business, October 12th, 2023), these respondents may instinctively associate aquaponics with traditional aquaculture practices. Consequently, images and narratives from the media might be replayed in their minds when considering fish farming in any form, contributing to a generally negative attitude toward aquaponics.

Similarly, for Swedish respondents' recent news about the need for sustainable and resilient food production practices (DS 2023:34) might influence their attitudes towards aquaponics - especially when environmental concern was their main diet motivation. By evaluating the risk of potential food scarcity, the Swedish respondents might rely on affect heuristics to form attitudes towards aquaponics. Believing aquaponics to be a sustainable production practice therefore aligns with environmental diet motivations, leading to the Swedish respondents having a more positive attitude towards aquaponics compared to the Icelandic respondents.

This contrast in attitudes toward aquaponics may also reflect varying levels of awareness and cultural significance of fisheries in Iceland and Sweden. As mentioned in the background, the fishing industry is economically and culturally central to Iceland, playing

a significant role in national identity and economic interests (Luciano, *et al*, 2023; Statistics Iceland, 2022). In contrast, the fishing industry in Sweden is relatively marginal, with less direct economic and cultural impact (Fisheries and Agriculture Organization, 2019). This difference may lead to lower awareness among Swedish respondents regarding fish farming issues, possibly explaining their neutral attitudes toward aquaponics.

This finding highlights the importance of cultural context in shaping public acceptance of food technologies, contributing to broader discussions on how cultural identity intersects with environmental and ethical considerations. This could be important if Icelandic aquaponic companies want to distance themselves from the negative connotations aquaculture has in the nation, as well as for future Swedish sustainable and resilient production methods.

## 9.2 Differences in Diet Motivations

The results showed that those motivated by animal rights and human focused ethics in the study leaned towards a negative attitude towards aquaponics, whilst those motivated by health and weight leaned towards a positive attitude towards aquaponics. This difference in attitudes can be understood through risk evaluation and moral foundations theory.

From a risk evaluation perspective, health-motivated respondents likely perceive the potential benefits of aquaponics, such as reduced pesticide use and controlled environmental conditions, as aligning with their personal health goals (DeBacker & Hudders, 2015). This positive association likely lowers their perceived risk, with affect heuristics playing a role: the favourable emotions linked to health benefits could reduce concerns, leading them to evaluate aquaponics as a desirable food production method with low risks. Consequently, these respondents demonstrate a positive-leaning stance, viewing aquaponics as a ‘healthier’ alternative to conventional agriculture. This supports previous research by Lusk (2019), which emphasizes that perceptions of food 'healthiness' often drive acceptance of novel production systems.

In contrast, respondents motivated by animal rights concerns appear to view aquaponics with suspicion and high perceived risk. This could be explained by availability heuristics. These respondents likely draw on readily available negative images and narratives surrounding fish exploitation in traditional aquaculture (Rönnerstrand et al., 2020), leading to heightened perceived risk. Such associations reflect findings by Bekoff (2007), who distinguishes between animal welfare and animal rights motivations: individuals prioritizing animal rights are more likely to reject systems they perceive as exploitative, regardless of sustainability benefits. The conflation of aquaponics with conventional aquaculture practices reinforces this risk perception, resulting in negative attitudes.

These results also align with MFT (Graham *et al*, 2013). Animal rights-motivated respondents may experience an emotional response rooted in the care/harm moral foundation, which is activated by the perception that fish in aquaponics systems may suffer or be exploited. If respondents believe that fish experience harm or lack autonomy within these systems, this perception evokes moral concern, positioning aquaponics as an unethical system. Previous research (Rosenfeld, 2019) has shown that vegans and

individuals driven by animal rights motivations are particularly sensitive to harm inflicted on animals, as they view animals as autonomous beings with intrinsic value. This moral perspective fosters a negative emotional response to aquaponics, reinforcing a risk-laden and unethical perception of the system. Additionally, the fairness/injustice foundation (Graham *et al*, 2013) likely influences their attitudes, as they may view aquaponics as unjust—an exploitation of fish for human benefit, which reflects broader critiques of human-centric food production practices (Bekoff, 2007). This belief that fish are subordinated for human gain intensifies their negative stance, reinforcing the perception that aquaponics violates fundamental principles of fairness and animal rights. This belief aligns with research on moral circles (Singer, 1981), where individuals who extend their moral concern to non-human animals are more likely to reject systems that exploit or commodify animals.

This highlights how diet motivations might influence attitudes towards aquaponics, specifically how ethical and risk-based evaluations might interact in the acceptance of sustainable food production systems involving animals.

## 9.3 The Use of Manure

The results show that the respondents are neutral towards the use of manure, with those motivated by sensory issues for their diet having the lowest overall score towards the use of manure. This might stem from the sanctity/degradation moral foundation (Graham *et al*, 2013), as it might cause feelings of disgust. Faeces is a contaminant, which in turn evokes the behavioural immune system to warn against its use (Schaller & Park, 2011). It could also be that feelings of disgust are evoked, which make sense as the respondents are motivated by sensory issues. Disgust sensitivity has been shown to be particularly heightened in individuals with sensory concerns (Curtis, Aunger & Rabie, 2004), which may explain why respondents in this group expressed aversion to fish faeces in aquaponics. In the interviews several respondents mentioned feeling disgusted by the use of fish faeces with one respondent mentioned being worried about the vegetables ‘catching the taste’ of the fish faeces. This reflects how affective reactions, driven by sensory and purity concerns, may influence attitudes toward food production practices.

For vegetarians, flexitarians and pescatarians, who had a more neutral attitude towards the use of manure, the reverse effect of the sanctity/degradation foundation (Graham *et al*, 2013) might be observed. It may be that they see manure as a natural part of a cyclic system, which would align with environmentally continuous values seeing as that was a common motivation for vegetarians. Combining this with the care/harm foundation (Graham *et al*, 2013) using every part of an animal, even the commonly bypassed products, would be a respectful way to use an animal as well as for the ecosystem. This perspective would prioritise environmental health over personal purity, which aligns with a more utilitarian approach to the use of manure and therefore might outweigh aversions based on affect. However, the flexitarians mentioned that they are health motivated, meaning that they might consider the care/harm foundation in connection to their own health. They might consider the use of manure similarly to the vegetarians, to use all parts of an animal. Sustainable practices in food production are perceived to be ‘healthier’ (Aksakalli, Oral, Bulut, *et al*, 2023), which could explain that they had a more positive view on the use of manure compared to those motivated by sensory concerns.

For vegans, who also maintained a neutral stance toward manure, there may be an internal conflict. Although they may perceive animal-derived inputs as generally misaligned with their values, manure as an organic byproduct could introduce an ambivalence. While they may view manure use as contradictory to animal-free food systems, the fact that it's a waste product rather than a directly exploitative practice might temper their opposition. This internal tension between minimising animal involvement and supporting ecologically sound practices could contribute to their neutral stance, as they weigh the ecological benefits against a fully animal-free system.

# 10. Conclusions and Practical Implications

Aquaponic systems as a measure to tackle sustainability issues in the Nordic countries might have several hurdles. This study measured the attitudes of consumers on the vegetarian scale to evaluate the consumer acceptance towards the systems. Previous studies have measured consumers acceptance regardless of diet (see for example Edstam and Frisk, 2021; Miličić *et al*, 2017), whilst this study can give an indication of a diet specific consumer group views on aquaponic systems. If consumers in the Nordic countries continue to shift towards a more plant-based diet, as suggested by The Nordic Council (2023), it might be that implementation of aquaponics in the Nordics needs to evaluate how to promote and tackle the sustainability, animal welfare and possible health concerns that the consumers on the vegetarian scale in this study have shown to have. For the Nordic countries to reach the Sustainable Development Goals, through sustainable food production, whilst incorporating all dietary needs, the respondents in this study indicate that there are hurdles to tackle but that it is not impossible.

The results indicate a consensus among the respondents in the study that aquaponic systems are not inherently compatible with vegan principles, primarily due to the involvement of animals. Based on this study consumers on the vegetarian spectrum show a neutral stance toward aquaponics and manure use, though attitudes vary significantly by diet type and country. While Nordic consumers' attitudes differ between Iceland and Sweden, similar attitudes are observed within the same diet groups across these borders.

Analysing these results through the lens of moral foundations theory and risk evaluation reveals possible reasons behind the divergent attitudes toward aquaponics. Theoretically, the results in this study show that individualising foundations could be prevalent among vegans as previously seen in research (Hackert *et al*, 2022). Furthermore, this could be used practically as it has been suggested that moral foundations are usually similar among consumer sub-groups (Ramos *et al*, 2024).

Interestingly, the results suggest that vegan consumers may be open to considering aquaponics if modifications to fish captivity are introduced, indicating some willingness to explore alternative approaches to sustainable food production that does not involve animals in captivity.

Aquaponics companies in the Nordic countries might have to consider their possible consumer market, and if they want to reach vegetarian, flexitarian, and pescetarian consumers, marketing efforts could focus on sustainability, animal welfare, and health benefits. Emphasising these aspects could help align aquaponics with the values and motivations of these diet groups, broadening its appeal within the Nordic consumer market. Given the differences in attitudes between countries, marketing strategies aimed at vegetarian and vegan consumers may need to be tailored to each Nordic country. Icelandic respondents, motivated largely by animal rights and potentially influenced by availability heuristics from recent negative news on aquaculture, may respond best to messaging that emphasises fish welfare and ethical standards within aquaponic systems. Furthermore, a focus on distancing aquaponics from negative connotations tied to aquaculture practices in the country could be valuable for reaching vegetarian and vegan consumers. In contrast, Swedish respondents, who are primarily motivated by environmental concerns, may be more receptive to messaging focused on the sustainability and ecological benefits of aquaponics. While vegan consumers may currently be an unreachable section of the consumers due to the perceived incompatibility of aquaponics with vegan principles, there may be potential for system modifications that could make aquaponics more appealing to this group. An aquaponic system that would allow for the fish to live in their natural environment, for example a lake, whilst still including the sustainability parts of an aquaponic system could possibly be interesting for vegan consumers.

Finally, respondents expressed distrust toward governmental institutions concerning the promotion and subsidisation of certain food products. This reflects a call for a transparent food production chain and a shift in national budgets to emphasise and subsidise more sustainable options for consumers.

# 11. Limitations and Future Research

Several limitations have been identified in this study. Most noticeable, is the small sample size for the study. This study should therefore be seen as a pilot study, and the results should not be generalised to apply to everyone on the vegetarian scale.

As mentioned, the methodology and its variables have their limitations. The methodology for this study was practical for the geographical areas chosen, however led to a limitation in regard to generalisability due to the haphazard sample size. A haphazard sample, in this case recruited through social media, leads to high probability of bias, which in turn means that the results cannot be generalized (Kalton, 1983). Language was also identified as a possible limitation for the research as the language barrier might have led to nuances such as humour could have been misinterpreted and therefore skewed the results (Vishwakarma, 2023). Furthermore, the results showed clear differences between the countries attitudes which further complicates the results as generalisable for the Nordic area. Future research might need to be country-specific, to give a clearer image of what attitudes consumers on a national level have. However, as Ramos *et al* (2024) explains, identifying moral foundations within a group can be descriptive of that entire group in

society, giving indication on how people within that same sub-group would react to certain situations. This means that there is a possibility that parts of the study can be generalisable to the vegetarian scale consumer groups.

The empirical evidence in this study suggests the possible underlying moral and ethical questions for the attitudes of consumers on the vegetarian scale. Although MFT is a descriptive theory, meaning that it explains the underlying moral that affects behaviour, it is important to note that several variables impact behaviour and action. Although you might have certain values you live by, it is common to not actually live by these guidelines, which is referred to as attitude-behaviour gap or the value-action gap (Ajzen & Fishbein, 2005). This means that although the moral foundations, diet motivations and actual attitudes of the respondents in this study suggests that they might perceive aquaponics as either positive, neutral or negative - their future actions might differ. Future research should therefore focus on possible differences between attitudes and behaviour to further evaluate vegan and vegetarian attitudes towards aquaponics.

This study collected extensive data from vegetarian and vegan consumers, some of which extended beyond the scope of the original research questions. Nevertheless, this data presents valuable opportunities for further research. The study collected empirical data regarding gender identity, views on local food production, self-reported consumer behaviours and dietary strictness which was not used for the study. Future research could explore attitudes towards aquaponics in relation to gender studies, food culture, local food production, and dietary strictness within vegetarian and vegan consumer bases. Additionally, the visual aids used during interviews sparked significant discussion among respondents, highlighting an interest in what is perceived as "natural" in food production. This could be interesting to further deep dive into, especially given that the Nordic food culture is focused on locality and nature (Bergfløt, Amilien & Skuland, 2012). This raises the question of what “natural” means to the respondents. Furthermore, future research could evaluate, in detail, what vegans would consider a suitable aquaponic production system as suggestions of systems where fish live ‘free’ combined with the closed-loop systems were suggested. It could be of interest to research what entails a free-living fish in a closed-loop system and furthermore, if it would be technically doable. Previous eye-tracking studies have concluded that visuals of aquaponic systems that include greenery are preferred over visuals that do not show the greenery in aquaponic systems (Schröter & Mergenthaler, 2019). A possibility for future research would be to conduct similar research with the vegan consumer in mind to explore what they consider “free-living fish” as well as “natural” to be. Perhaps floating sea farms that grow crops on rafts at sea, combined with IMTA-systems could be a possibility to approach the vegan consumers. But still, the definition of ‘free-living’ would need to be assessed. Furthermore, the respondents on the vegetarian scale that did not eat fish but valued other aquatic life as non-sentient might be more interested in aquaponic systems that cultivate mussels rather than fish.

Finally, the feasibility of aquaponic systems in the Nordic countries would need to be further researched. Although some aquaponic systems exists in the countries, sustainability issues as well as economic issues tend to disrupt the longevity of companies. Is aquaponics what Sweden needs to tackle not only the SDG’s, but also the need of resilient food production systems? And could Iceland tackle the media fed

perception of fish farming as inherently ‘bad’? These are themes that might need to be further researched for aquaponics to be able to grow in the Nordic countries.

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# Appendices

# Appendix A: Message for Facebook Groups

Hi!
I am studying sustainable production and utilisation of marine bioresources at Hólar university and Gothenburg university, and right now I am doing my masters thesis. The thesis is focused on vegan attitudes towards plant products grown in aquaponic systems, and I was wondering if you would like to answer my survey? Participating is voluntary, and your answers are anonymous.

[*Pilot study specific message:* The answers from this questionnaire will be analysed and used as a basis for an upcoming, in-depth, survey on the same subject. ]

If anyone in the group would be interested in participating in an interview for the study, you can email me at *email address*

Many people find the subject of aquaponics complicated, even within science. If you find the idea of aquaponics difficult to approach there is information on the subject in the survey to give you a quick overview before giving your answers.
You may answer the questions in Icelandic, English or Swedish!

Thank you,
Stina

# Appendix B: Interview question guides, experts

## B1: Interview guide, Villands Vånga Veganträdgårdar

| | |
|---|---|
| **Introduktion till studien**<br>Tack så mycket för att du tar dig tid att delta i min masteruppsats. Uppsatsen är mitt examensarbete på Nordiska masterprogrammet inom hållbar produktion och nyttjande av marina bioresurser vid Hólar universitet på Island, och i samarbete med Göteborgs Universitet. Min uppsats fokuserar på veganska attityder gentemot grönsaker odlade i akvaponiska system. Studien kommer i slutändan att baseras på data från flertalet enkäter och intervjuer med potentiella konsumenter, samt intervjuer med olika företag. Mitt intresse i att intervjua Villands Vånga är för att jag är intresserad av hur Ni odlar veganskt och vad som avgör att en grönsak har odlats veganskt. Jag är även intresserad av att höra huruvida Ni anser akvaponiska odlingar som potentiellt veganska.<br>Min förhoppning är att min studie kommer lyfta ett annars relativt outforskat ämne. | **Introduction to the study**<br>Thank you for taking the time to be a part of my Masters thesis. This Thesis is my final work at the Nordic Masters programme in Sustainable Production and Utilisation of Marine Bioresources at Holar University, in collaboration with Gothenburg University. My thesis is focused on vegan and vegetarian views and attitudes towards products grown in aquaponic systems. The study consists of several consumer surveys and interviews, as well as interviews with aquaponic actors. My interest in interviewing Villands Vånga is because I am interested to hear how you produce in a vegan way and what constitutes a vegan production method. I am also interested to hear if you consider products from aquaponic systems as potentially suitable for vegan consumers.<br>My hope is that the thesis will shine a light on a relatively unexplored subject. |
| **Information**<br>Frågorna i intervjun är inte ett kunskapstest. Det finns inga rätt eller fel svar, och om du skulle känna dig obekväm med någon av frågorna så är det bara att säga till så hoppar vi över den frågan. | **Information**<br>The questions are not a knowledge test. There are no right or wrong answers, and if any of the questions makes you feel uncomfortable please let me know and we will skip it. |
| **Introduktion till intervju, och inspelningsmaterial**<br>**Samtyckesformulär och anonymitet**<br>**Se om det är några frågor innan start** | **Introduction of interview, and recording device**<br>**Consent forms and confidentiality**<br>**See if there are any questions before start** |
| **Frågor**<br>Skulle du vilja börja med att berätta lite om ditt företag - och vad det är som gör din odling vegansk? | **Questions**<br>Would you like to start by telling be about your company - and what it is that makes your production method vegan?<br><br>What would you say is the big difference between your production and traditional |

| | |
|---|---|
| Vad skulle du säga är den stora skillnaden mellan din odling och traditionell agrikultur/kommersiell grönsaksodling?<br><br>Vad tror du är några av de viktigaste sakerna att ha i åtanke när det kommer till att anpassa sina odlingar till veganska konsumenter?<br><br>**Information om akvaponi:** *Akvaponi är ett odlingssystem där fisk och grönsaker odlas i samma system. Fiskens avföring fungerar som näring för grönsakerna, och grönsakerna filtrerar i sin tur vattnet för fisken.*<br><br>Anser du att akvaponi är ett veganskt odlingsalternativ? Varför/varför inte? | agriculture/commercial production of vegetables?<br><br>What do you think the most important things are to have in mind when it comes to making sure your food production method is suitable for vegan consumers?<br><br>**Information about aquaponics:**<br>*Aquaponics is a food production system where fish and greens are cultivated together. The fish faeces works as nutrients for the greens, and the greens in turn filtrate the water for the fish.*<br><br>Do you consider aquaponics to be a vegan food production alternative? Why/why not? |

## B2: Interview guide, Johannas Stadsodlingar

**Introduction to the study**
Thank you for taking the time to be a part of my Masters thesis. This Thesis is my final work at the Nordic Masters programme in Sustainable Production and Utilisation of Marine Bioresources at Holar University, in collaboration with Gothenburg University. My thesis is focused on vegan and vegetarian views and attitudes towards products grown in aquaponic systems.
The study consists of several consumer surveys and interviews, as well as interviews with aquaponic actors. My interest in interviewing Johannas is to get the producers view on their own products as potentially suitable for vegan consumers.
My hope is that the thesis will shine a light on a relatively unexplored subject that might be vital for future sustainable production of food products.

**Information**
The questions are not a knowledge test. There are no right or wrong answers, and if any of the questions makes you feel uncomfortable please let me know and we will skip it.

**Introduction of interview, and recording device**
**Consent forms and confidentiality**
**See if there are any questions before start**
**Information on veganism**

There is no clear definition on veganism or vegetarianism, and the dietary pattern of those who identify as vegetarian or vegan changes from individual to individual. In my preliminary literature review for this study, I discovered that most vegans consider the definition "*Veganism is a philosophy and way of living which seeks to exclude—as far as is possible and practicable—all forms of exploitation of, and cruelty to, animals for food, clothing or any other purpose"* from the Vegan Society, as best describing their lifestyles. This definition is considered attractive, as it allows the vegan to be as strict as best suits them and their moral compass. For example, a vegan motivated by environmental reasons might buy leather products instead of plastic products in the belief that it is a more sustainable choice - whilst a vegan with animal rights motivations wouldn't buy leather products.

**Warm-up**
Would it be okay if we start off with you describing your aquaponic company and what products you offer (currently, or planning to)? And to whom is the product available for? (restaurants, processing companies, private consumers.. etc)

**Aquaponics and the vegan consumer**
How would you define a product suitable for vegans?

Would you consider the plant products that are grown in an aquaponic system to be vegan? Why/why not?

If not: do you think that there are changes that can be done to an aquaponic system that would make the products suitable for vegans?

According to you, do you think that aquaponic production resonates with vegan values? (sustainability, animal welfare, health etc.)

From my understanding, you currently deliver products to restaurants, and not private customers. But have you received any feedback or questions from vegan consumers regarding your product?

Are there any other questions or comments that you would like to add!

## B3: interview guide, Aquaponics specialist

**Introduction to the study**
Thank you for taking the time to be a part of my Masters thesis. This Thesis is my final work at the Nordic Masters programme in Sustainable Production and Utilisation of Marine Bioresources at Holar University, in collaboration with Gothenburg University. My thesis

is focused on vegan and vegetarian views and attitudes towards products grown in aquaponic systems.
The study consists of several consumer surveys and interviews, as well as interviews with aquaponic actors. My interest in interviewing you is to get an aquaponics specialist view on the potential suitability of aquaponics products for vegan consumers. My hope is that the thesis will shine a light on a relatively unexplored subject that might be vital for future sustainable production of food products.

**Information**
The questions are not a knowledge test. There are no right or wrong answers, and if any of the questions makes you feel uncomfortable please let me know and we will skip it.

**Introduction of interview, and recording device**
**Consent forms and confidentiality**
**See if there are any questions before start**
**Information on veganism**
There is no clear definition on veganism or vegetarianism, and the dietary pattern of those who identify as vegetarian or vegan changes from individual to individual. In my preliminary literature review for this study, I discovered that most vegans consider the definition "*Veganism is a philosophy and way of living which seeks to exclude—as far as is possible and practicable—all forms of exploitation of, and cruelty to, animals for food, clothing or any other purpose"* from the Vegan Society, as best describing their lifestyles. This definition is considered attractive, as it allows the vegan to be as strict as best suits them and their moral compass. For example, a vegan motivated by environmental reasons might buy leather products instead of plastic products in the belief that it is a more sustainable choice - whilst a vegan with animal rights motivations wouldn't buy leather products.

**Questions**
How do you define a product as suitable for vegans?

Would you consider the plant products that are grown in aquaponics systems suitable for vegans?

Do you think that aquaponic production resonates with vegan values?

Are there any other questions or comments that you would like to add?

## B4: Structured interview questions guide for email follow-up interview with Aquaponics specialist

Why would a decoupled system be better/worse than a coupled system?
Do you think Iceland is a good place for aquaponics systems, looking specifically at sustainability?

From your expertise: do you think that aquaponics is necessary to supply the nation with sustainable greens?
If exporting the greens is the best option, do you think that is still a sustainable solution to the (potential) future global food crisis?

# Appendix C: Phase 2 survey questions

## Attitudes towards aquaponics

This survey is part of my Masters Thesis for the Nordic Master Program in Sustainable Production and Utilisation of Marine Bioresources, via Hólar University and Gothenburg University. The focus of the study is **vegan and vegetarian attitudes towards aquaponics.** The statements you will be asked to answer are created using real attitudes and opinions expressed by vegans and vegetarians in a previous survey.

This survey is **not** a knowledge test. There are no right or wrong answers to the questions.

**Participating in this survey is voluntary, you may at any point cancel and leave the survey. Your answers will be anonymous, and your participation is much appreciated. Your answers will remain anonymous even if you choose to leave your email for further participation.**

**In free-writing questions, you can answer in English, Swedish or Icelandic.**

The survey takes about **10 minutes** to answer.

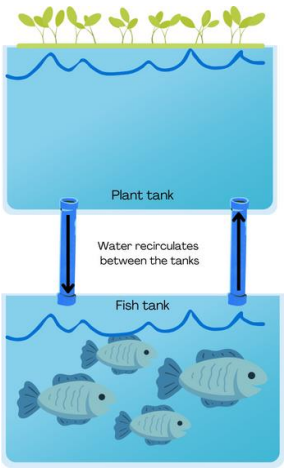
Best Regards,
Stina Edin Johansson
Masters student at Hólar University & Gothenburg University

Any **questions** can be sent to: *email-address*

Image credit:
Header and closing page: AI-generated using ImageFX
Aquaponics scheme: Private

## What is aquaponics?

Aquaponics is a method for producing foods. Aquaponics combines plant cultivation with fish cultivation in an ecosystem-like system where water recirculates between the fish and plants. Nutrients are transferred between the fish and plants via water: the fish faeces work as nutrients for the plants, and the plants filter the water for the fish.




There are many different kinds of aquaponics, and they can operate and look in several different ways. For example some systems combine the fish and plants in one tank, while others separate the two. The core of the system stays the same: water circulates between fish and plants to transfer nutrients and filter the water.

Species of fish and plants differ between systems. In some systems the fish could be harvested for food consumption, in others the fish are ornamental and can be sold as aquarium fish.

Aquaponics can be considered a sustainable option of food production for several reasons, some of them being: limited water use, limited landmass use and limited use of chemical products. Aquaponics can be set up almost anywhere, even in areas that face water scarcity, landmass scarcity and areas that are otherwise difficult to cultivate both fish and plants in (Taha, El Masry, Gounda, *et al*, 2022).

| **I Identify as** | **My age is** | **I live in** | **I consider myself as (diet and/or lifestyle)** |
|---|---|---|---|
| ▪ Female | ▪ <18 | ▪ Iceland | ▪ Vegan |
| ▪ Male | ▪ 18-25 | ▪ Sweden | ▪ Vegetarian |
| ▪ Non-Binary | ▪ 25-30 | ▪ Other… | ▪ Other… |
| ▪ Prefer not to answer | ▪ 30-35 | | |

- Other…

- 35-40
- 40-45
- 45-50
- >50

**I consume/buy the following products…** (*Please select the products you consume, or could consider consuming. Even if you consume the product on a non-regular basis, please tick that box. Please select "none of the above" if you do not consume any of the mentioned products*).

- Red meat
- White meat
- Fish
- Honey
- Leather products
- Soy-based products
- Silk products
- Figs
- Gelatine
- Medicine or vitamins containing animal by-products
- Make-up containing animal by-products
- Medicine tested on animals
- Make-up tested on animals
- None of the above

**I follow my dietary pattern/lifestyle because…**

I am concerned about the effects of my consumption choices on the environment
I am concerned about the effects of my consumption choices on animal rights
I am concerned about my well-being and health (including allergies)
I am concerned about weight loss/weight gain
I am concerned about the effects of my consumption on human rights
I feel disgust towards certain textures and/or smells
Other…

**Dietary strictness**

- I can be flexible and sometimes eat foods that go against my dietary pattern
- I would eat a food product that goes against my dietary pattern if I were to hear that it tastes exceptionally good
- I would rather buy leather shoes than pleather (plastic leather) shoes because I believe it's better for the environment
- I sometimes eat foods that go against my dietary pattern/lifestyle for the sake of the environment
- I sometimes consume products that go against my dietary pattern/lifestyle for the sake of animal rights
- I sometimes consume products that go against my dietary pattern/lifestyle for the sake of human rights
- Animal welfare is more important to me than environmental concern when I buy products
- Environmental concern is more important to me than animal welfare when I buy products
- My own well-being is more important to me than environmental concern or animal rights
- My own well-being, environmental concern and concerns about animal rights are equally important when it comes to my consumption
- Other…

**Please answer these following questions in a way that best reflects your attitudes and opinions. They can be based on previous knowledge on aquaponics, based on what you learned at the start of this survey or based purely on intuition.**

| | Strongly agree | Agree | Don't know/neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Aquaponics are sustainable | | | | | |
| Aquaponics are a clever use of resources | | | | | |
| Aquaponics are cruel towards the fishes | | | | | |
| It is immoral to keep fish in tanks | | | | | |
| I am against animal farming of any kind | | | | | |
| Aquaponic systems appear to support my values | | | | | |
| Having fish in tanks in exploitative | | | | | |
| Having fish in tanks is animal abuse | | | | | |
| Traditional farming is more sustainable than aquaponics | | | | | |

| | Strongly agree | Agree | Don't know/neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Plants grown in aquaponics systems are vegan | | | | | |
| Eating greens grown from aquaponics sounds disgusting | | | | | |
| As long as the fish isn't sold or consumed the aquaponic system is vegan | | | | | |
| If the fish used in aquaponics system are sold as ornamental fish, the system is vegan | | | | | |

| | Strongly agree | Agree | Don't know/neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Fish welfare is important | | | | | |
| Fish welfare is just as important as the welfare of other animals | | | | | |
| Buying vegetables grown in an aquaponic system supports the fish meat industry | | | | | |
| Having fish in tanks is bad for the fish | | | | | |

| | Strongly agree | Agree | Don't know/neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| Using manure to grow plants is natural | | | | | |
| Using fish faeces to grow plants is natura | | | | | |
| The use of manure is disgusting | | | | | |
| The use of fish faeces is disgusting | | | | | |
| Using fish faeces in aquaponics is the same as using manure in traditional farming | | | | | |
| Using fish faeces to grow greens is unethical | | | | | |
| Using manure to grow greens is unethical | | | | | |
| Using manure of any kind (fish or livestock) is unethical | | | | | |

| | Strongly agree | Agree | Don't know/neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| I pay attention to how the products I buy have been produced | | | | | |
| It is important to me no animals have been involved in the process of producing the product I buy | | | | | |
| When thinking about which products to consume, I consider the effects of my food choices on the environment | | | | | |
| When thinking about which products to consume, I consider the effects of my food choices on animal welfare | | | | | |
| Sometimes, thinking about the way a food is produced can make the food seem unappetizing | | | | | |
| When thinking about which products to consume, I consider the effects of my food choices on my own health | | | | | |

| | Yes | No | Unsure |
|---|---|---|---|
| Would you consume plants grown in aquaponics systems? | | | |
| Do you consider aquaponics to be a vegan production method? | | | |

**Finally, please write what first comes to mind when you think about aquaponics. You may answer in English, Swedish or Icelandic.**

...

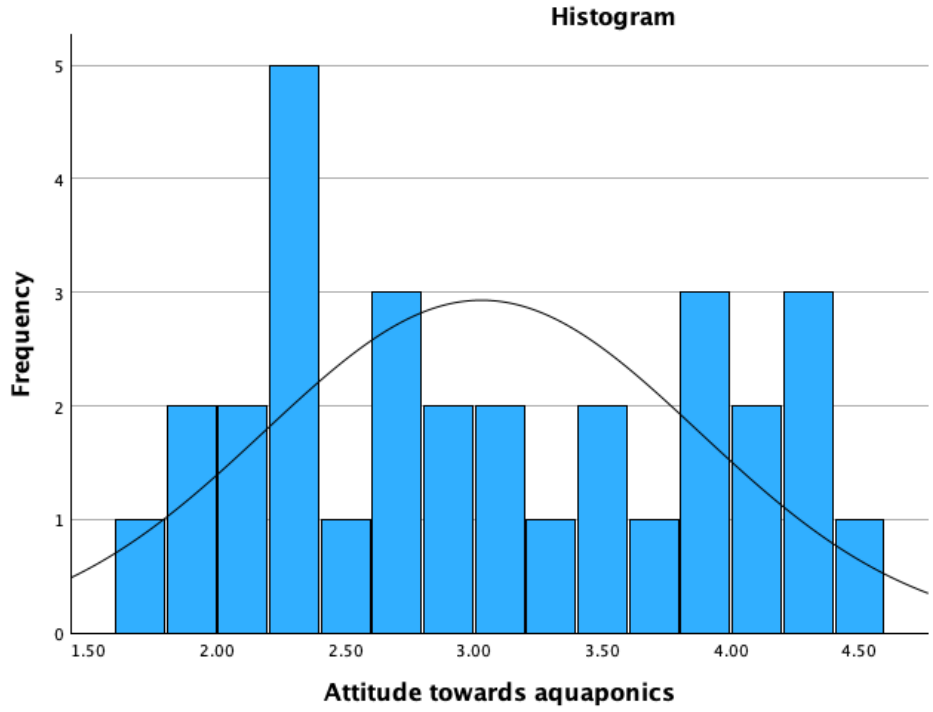
Thank you so much for taking your time to answer this study!

**Would you like to participate in an interview regarding the same subject? If yes: please fill out your email below. Your previous answers will still be handled anonymously.**

...

# Appendix D: Histogram, testing for normality

## Figure D1




## Figure D2

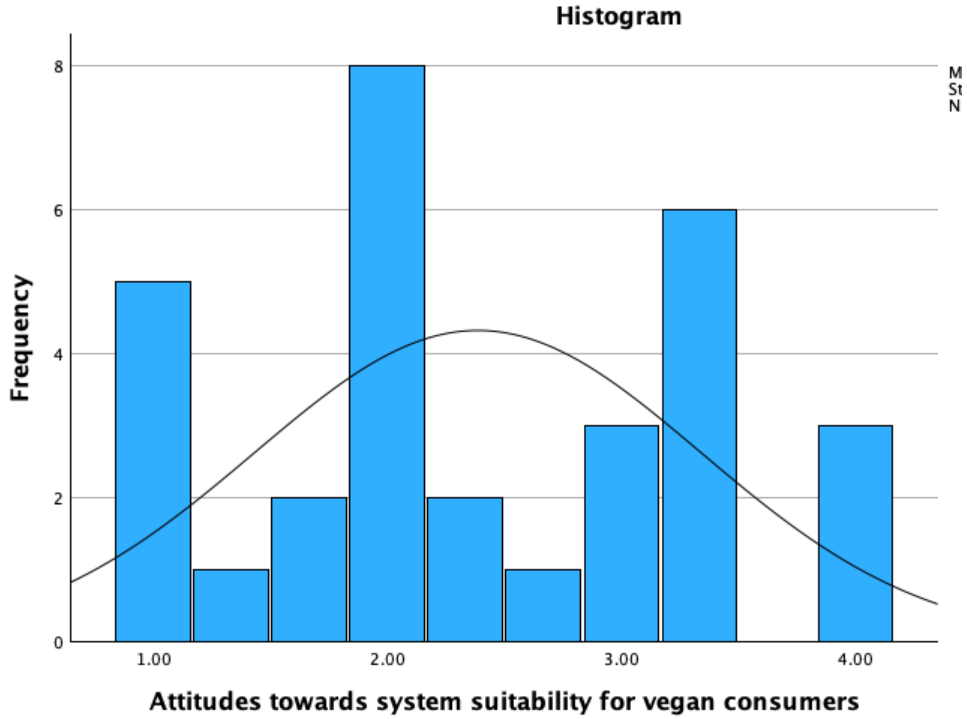


**Figure D3**

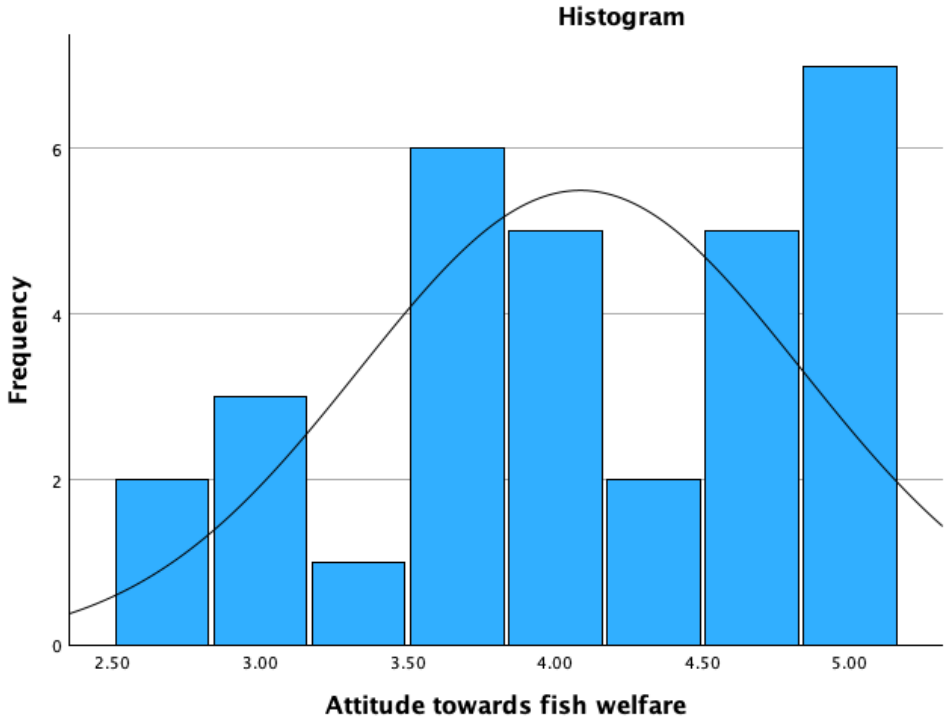
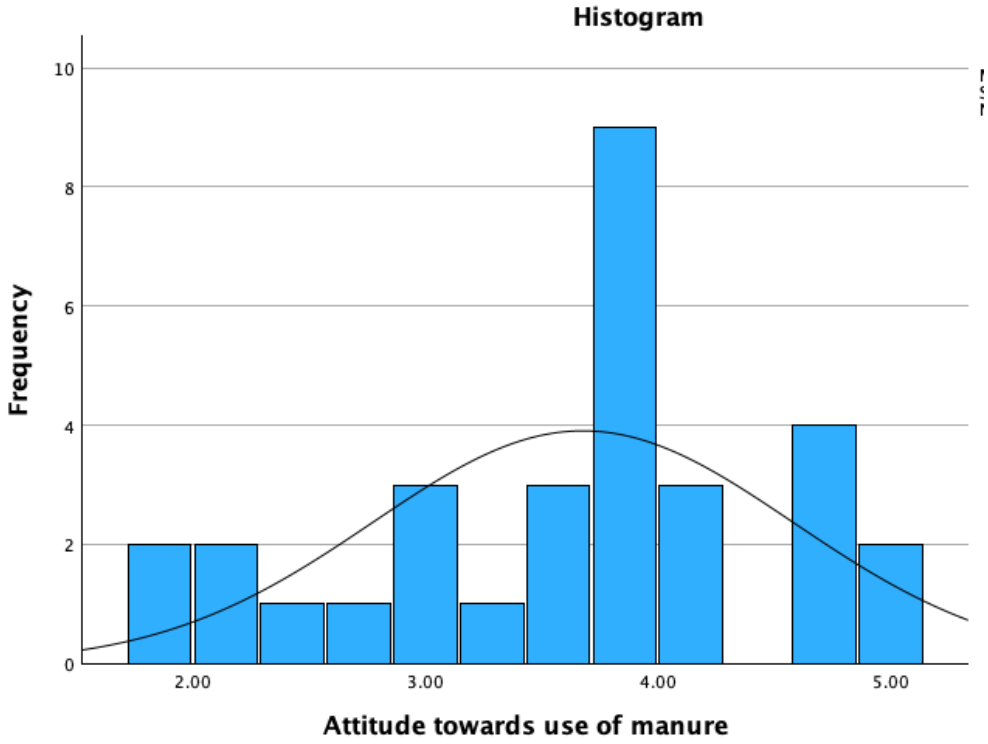
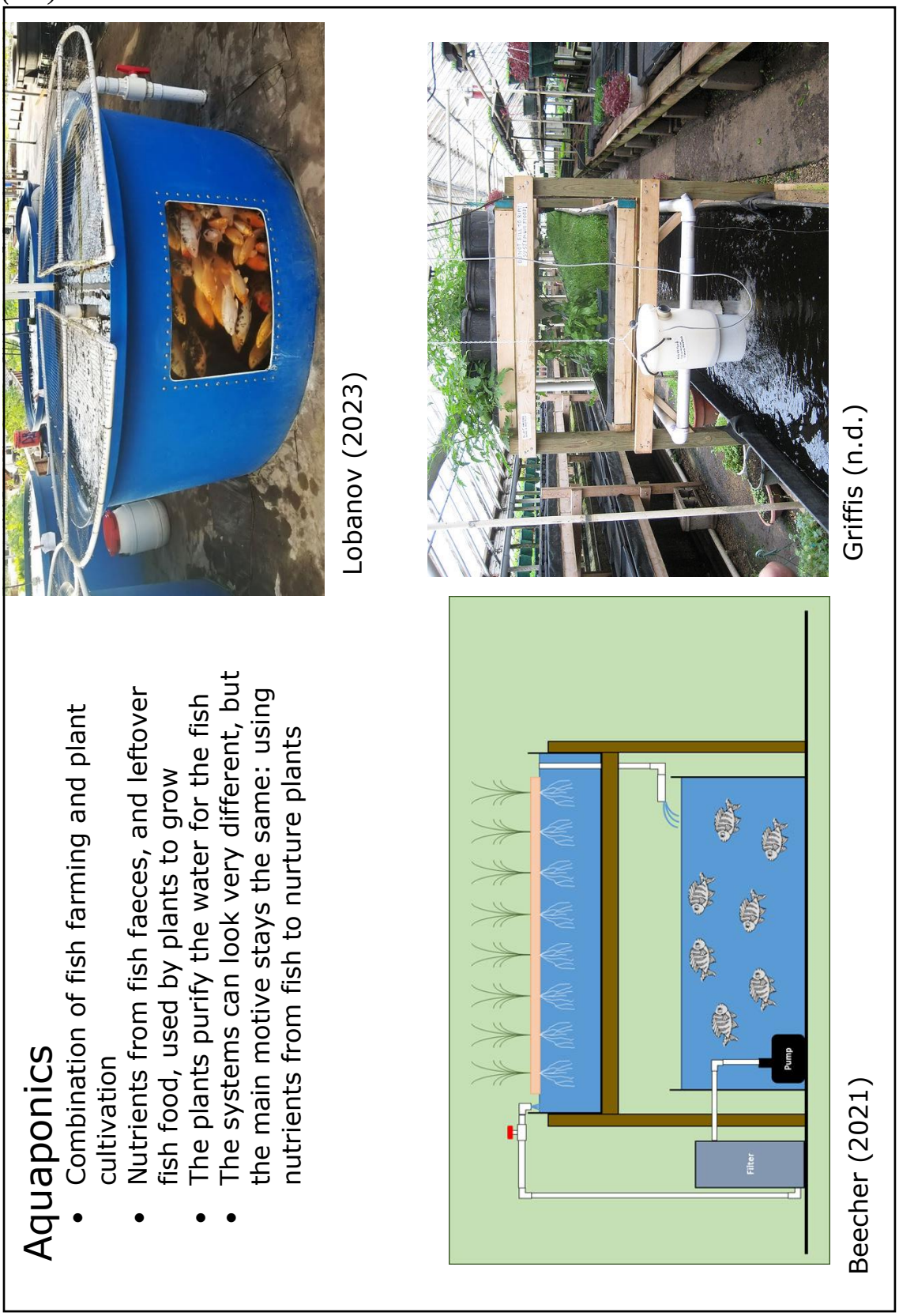



**Figure D4**



# Appendix E: PowerPoint slide visible for respondents during interviews

*Credit: Private, composed by images from Beecher (2021), Lobanov (2023), Griffis (n.d.).*



# Appendix F: Interview question guide, consumers

**QUESTIONS TO VEGANS/VEGETARIANS**

**Introduction**

Thank you so much for taking the time to participate in this study. This study is part of my Masters Thesis at the Nordic masters program in sustainable production and utilisation of marine bio-resources at Hólar University, and in collaboration with Gothenburg University. My thesis is focused on vegan and vegetarian attitudes towards plant products grown in aquaponic systems.
The study will contain data received from several surveys and interviews.
My interest in interviewing you is to hear about your lifestyle, diet and your attitudes towards aquaponic systems. I will soon introduce aquaponics for you, so that you get a quick overview of the subject. It is also okay to ask questions during the interview at any time.
The purpose of the study is to explore a knowledge gap within academia.
**Introduction to interview**
The interview is not a knowledge test. There are no right or wrong answers, and if you feel uncomfortable with any of the questions just let me know and we will skip that one.
**Consent forms and confidentiality, recording device**
This interview will be recorded and saved on my phone with a code lock. The only persons with access to this recording are me and my supervisor, and you have contact information to both of us in the form you have received.
Information about you, and the information you are giving us today is going to be treated anonymously and it will not be traceable back to you through the study.

Have you read through the information and feel like you understand it?
Are you giving consent to being recorded?
Do you have any questions before we get started?
*Start recording*
I just need you to state for the record that you consent to being recorded.

**Demographic questions**
Do you identify as female, male, non-binary or other?
How old are you?
Do you live in Iceland or Sweden?
Do you identify as vegan, vegetarian or other?

- If other: what?

Does your diet extend to areas outside of foodstuffs? Clothing?

- If yes: what?

**Questions on motivation and dietary strictness**
What initially motivated you to adopt a vegan/vegetarian diet?

- Can you elaborate on the ethical, environmental, or health reasons (or other) behind your dietary choices?

Does that motivation affect how strict you are with your dietary pattern? For example: would you buy leather as a vegan in the belief that it is better for the environment?

- How strictly do you adhere to your vegan/vegetarian diet, and what factors influence your level of adherence?

What would you say is important when you buy a product? Organic products, vegan labelling, supply-chain..etc?

**Questions on what makes a product vegan or vegetarian**

What would you say makes a product vegan or vegetarian? What is the criteria?

**Introduction to aquaponics**

Aquaponics is an alternative to traditional farming. Aquaponics combines cultivation of fish (or other aquatic organisms) with the cultivation of plants in water instead of soil. In aquaponic systems, the waste produced by fish serves as a nutrient source for plants, while the plants, in turn, purify the water for the fish. This symbiotic relationship creates a closed-loop ecosystem. This is in part because of limited water resource use, in comparison to traditional farming. Aquaponics can also be set up in different settings, including urban areas and areas with limited arable land. Aquaponics is land-based farming, and the fish is kept in tanks. The plants are either grown in the same tank, or kept in a separate tank close by. The premise is the same though: water circulates between the fish and plants in a closed-loop system.

**Questions on aquaponics**

How familiar are you with aquaponic systems, and what are your initial thoughts or impressions about them?

Have you ever consumed food produced from aquaponic systems?

- If so, what was your experience?

Are there any aspects of aquaponics that you find particularly appealing or concerning?

How do you feel about the idea of consuming plants that have been fertilised by fish waste in aquaponic systems?

Do you believe there is a clear difference between growing plants in aquaponic systems, with the help of fish faeces compared to traditional farming with the help of livestock manure? What is that difference? Does it evoke different emotions?

- Do you know what fertiliser has been used when you buy greens?

Can you discuss any experiences you've had or knowledge you have about the treatment of fish in aquaponic systems? (if unsure about aquaponics, ask about aquaculture)

What concerns, if any, do you have about the welfare of fish in aquaponic systems?

Would you consider the aquaponic system vegan if the fish in the system wasn't sold for consumption?

- Would it be vegan if the fish was sold as aquarium fish?
- If unappealing: why?

Do you see aquaponics as a more sustainable method of food production compared to traditional agriculture? Why or why not?

Do you believe aquaponic systems align with the principles or values of veganism/vegetarianism? Why or why not?
Are there any improvements or changes you would like to see in aquaponic practices to better align with vegan/vegetarian values?

Are there any specific regulations or certifications you believe should be in place for aquaponic food products to meet the standards of vegan/vegetarian consumers?

**Question asked to respondent 1-3, then changed:** How do you envision the role of aquaponics in addressing food insecurity and promoting food sovereignty, particularly in urban areas?
**Question changed to:** If you were to envision and describe local food production, how would that look? What means of production do you envision?

# Appendix G: Participant information and consent form

**INTERVIEW PARTICIPANT INFORMATION SHEET**
**Research:** Vegan attitudes towards plant products grown in aquaponic systems
**Masters Programme:** Nordic Masters programme in sustainable production and utilisation of marine bio-resources. Hólar University.
This is an invitation to participate in a research study, undertaken as part of a Master's Thesis at Hólar University (Iceland) in collaboration with Gothenburg University (Sweden) conducted by Stina Edin Johansson. Before you decide whether or not you want to take part in this research, you should understand what is involved. This form will provide detailed information about the study. Once you understand the study, you will need to sign the consent form if you wish to participate. Please take your time on this decision.

**WHAT IS THIS FORM?**
This form is to respect and acknowledge your rights, and to let you know what is involved when participating in the interview.

**WHAT IS THE PURPOSE OF THIS STUDY?**
The purpose of this study is to achieve a greater understanding of how consumers and producers perceive products from aquaponic systems as suitable for vegan consumers.

**WHAT WILL YOUR ROLES AND RESPONSIBILITIES BE IF YOU TAKE PART IN THE STUDY?**
You will be invited to participate in an individual interview. The individual interview will last between 30-50 minutes. The content of the interview will be used for later analysis. Participants will be required to accept a consent form, either online or in person, for the interview to be valid. You have the right to, at any point during the interview, withdraw your participation and cancel the interview.

**WHAT WILL HAPPEN TO THE INFORMATION YOU GIVE?**
**The research is completely confidential.** Your name will not be used in the study (unless you want to have the company name mentioned, in which case written consent is needed) and any information attributable to you will not be included in any analysis. The tape recordings will be reviewed by the researcher and supervisor, for the sole purpose of this research and will be securely stored on a password protected phone. The interview will begin with your consent, which you will indicate orally after being read your rights. The results *will* be published on the university websites and *may* be published in academic journals or conference papers; however, your name will have been changed and any information traceable to you will not be included. If you would like to take part in the upcoming defence of the thesis, or in the finished written report, please let the researcher know and leave your contact information with her.

**IF YOU HAVE ANY QUESTIONS OR PROBLEMS, WHOM CAN YOU CONTACT?**

Student (researcher): Stina Edin Johansson, *email address*
Supervisor: Amber Monroe, *email address*

**CONSENT TO PARTICIPATE IN THE INTERVIEW**

**Research:** Vegan attitudes towards plant products grown in aquaponic systems
**Masters Programme:** Nordic Masters programme in sustainable production and utilisation of marine bio-resources. Hólar University.

- I have been provided with adequate information relating to the nature and objectives of this research project.
- I have understood this information and have been given the opportunity to seek further clarification or explanations.
- I understand that I will be participating in an audio-recorded interview.
- I understand that any information or opinions I provide will be kept confidential and reported only in an aggregated/non-attributable form.
- I understand that the results may be published in academic journals, and/or conference papers but my name will have been changed, and no identifiable information that is traceable to me will be included.
- I understand the information will be used only for the purpose indicated, and any other use would require my written consent.

**Name of participant: _____**
**Signature of participant: _____**
**Date: _____**