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Land-based salmon farming: An assessment of the nearshoring potential of emerging countries in Europe

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Abstract

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By Roy Schjølberg Brevik

Atlantic salmon is the highest valued species in the European aquaculture sector with a production value of almost four billion euros in 2014. The species requires a special farming environment for optimal growth and only a few countries have the right water conditions to farm salmon in the ocean. One of them is Norway, who over the last years has experienced problems with sea lice and escapes of salmon in the traditional “open sea cage” farming method. Thus, several players have started to investigate the opportunities for relocating salmon farming to cages on land. Hence, the objective of this study is to analyze what emerging country in Europe that is most optimal for Norwegian salmon farmers to nearshore land-based salmon farming. Emerging countries in Europe are usually attractive for nearshoring because of geographical proximity, low labor costs and access to highly talented- and skilled labor. The study was supported by secondary research and interviews with industry experts where the MCDM technique SMART were used to evaluate all the emerging countries based on the findings. According to the SMART analysis, Russia is the most optimal country for nearshoring land-based salmon farming, a country that is currently experiencing a boom in the domestic aquaculture sector after the ban on import of seafood in 2014.

O salmão do Atlântico é a espécie de maior valor no setor aquícola europeu, com um valor de produção de quase quatro bilhões de euros em 2014. A espécie requer um ambiente agrícola especial para um crescimento ótimo e apenas alguns países têm condições de água corretas para cultivar salmão no oceano . Uma delas é a Noruega, que nos últimos anos experimentou problemas com piolhos do mar e escapes de salmão no tradicional método de cultivo "gaiola em mar aberto". Assim, vários atores começaram a investigar as oportunidades de realocar a criação de salmão para gaiolas em terra. Assim, o objetivo deste estudo é analisar qual é o país emergente na Europa que é melhor para os produtores de salmão noruegueses para o cultivo de salmão em terra. Os países emergentes na Europa são geralmente atraentes para o nearshoring devido à proximidade geográfica, baixos custos de mão-de-obra e acesso a mão-de-obra altamente qualificada e qualificada. O estudo foi apoiado por pesquisas secundárias e entrevistas com especialistas do setor, onde a técnica MCDM SMART foi usada para avaliar todos os países emergentes com base nos resultados. De acordo com a análise da SMART, a Rússia é o país mais ideal para o nearshoring de cultivo de salmão em terra, um país que está experimentando atualmente um boom no setor de aqüicultura doméstica após a proibição de importação de frutos do mar em 2014.

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1.Introduction

Problem Statement

The aim of this study is to discover the most optimal emerging country in Europe for Norwegian salmon producers to nearshore land-based salmon farming. In order to do so, the following research questions will be answered:

1. What are the most important factors for succeeding with land-based salmon farming?

The output of this question provided substantial information on what factors that had to be analyzed in each of the emerging countries in order to evaluate their attractiveness for land-based salmon farming.

What is the current situation in the aquaculture sector in the respective countries? Learning about the current situation in the aquaculture sector in all emerging countries provided access to information on the availability of both natural- and human resources that are important for farming of salmon.

3. What are the costs related to setting up a land-based salmon farm?

Since it would be difficult to get to know the costs on setting up and running a land-based salmon farm in all emerging countries, related costs such as wages, electricity prices, prices of land and corporate taxation were rather analyzed.

Academic Relevance

Land-based farming of salmon is an alternative to the traditional open sea cage farming technology. Previous studies have mainly been addressing the challenges with traditional farming, but also future solutions on salmon farming, main issues on land-based salmon farming and comparisons between the different salmon farming technologies.

This research is not focusing too much on the land-based farming technology itself and neither on detailed factors related to a nearshoring agreement. The framework rather examines important factors that should be included in an evaluation process when planning to nearshore land-based salmon farming to an emerging country in Europe and is a framework that Norwegian players in the aquaculture sector can leverage on if reaching that decision.

Managerial Relevance

Only 20% of all food that is consumed comes from the ocean. To be able to feed the world`s increasing population in the future we will have to exploit more resources from the water bodies compared to what we are doing today. In terms of salmon, and specifically Atlantic

salmon, there is only a handful of countries that have the right water conditions to practice farming. This limitation on expansion, together with high license prices and problems with parasites and escaping have increased the attractiveness of farming salmon on land which again will lower the barrier for new market entrants.

Emerging countries in Europe could be good alternatives to nearshore land-based salmon farming, as they are usually known for offering cheap and skilled labor, tax advantages and geographical proximity to many European countries.

Scope of Analysis

This dissertation focuses on the aquaculture industry and more specifically on land-based salmon farming in emerging countries in Europe. Currently there are two types of land-based salmon farming:

1. Farming of smolt in freshwater tanks before being released to saltwater cages in the sea

2. Full grown farming where the whole process from roe to harvest is taking place on land.

The latter alternative is also the type of salmon farming that will be emphasized in this dissertation.

2. Literature Review

2.1 Aquaculture

Farming of fish, also known as aquaculture is a practice that started 2,500 years ago when people collected fish from their natural habitat and kept them until consumption on a later stage. It was first in the 1950s when the industry became more organized and people involved in aquaculture started to apply some scientific methods that the production started to increase (Mustafa et al., 2015). Since then, the aquaculture industry experienced a steady growth and with help from new technologies the output was around 14 million mt in the mid- 1980s and twice as much at the end of 1990s. Due to the rapid growth of the human population, the aquaculture industry will most likely double from now until 2050, and because of an increasing demand of food and focus on health, it is the fastest growing within the food-producing sector (FAO, 2012). However, as Mustafa et al. (2015) points out, there are many obstacles that the industry must overcome to continue growing, among them problems related to biosecurity and loss of productivity.

2.1.1 Atlantic Salmon

One of the most produced species in the aquaculture sector is the Atlantic salmon. Since the beginning of the 1970s, the production of farmed Atlantic salmon has increased rapidly, reaching a production volume of two million mt per annum in 2012 (FAO, 2012; Asche et al., 2013; Lekang & Bostock, 2016). It is the highest valued species in the European aquaculture sector with a production value of almost four billion euros in 2014 (Badiola, Mendiola, & Bostock, 2012; European Commission, 2015), where Norway is the largest producer counting for almost one million mt in 2010 (FEAP, 2011; Dalsgaard et al., 2013). Other important salmon farming countries are Faroe Islands, Canada, Scotland and Chile (Bjørndal & Tusvik, 2017). According to Bjørndal & Tusvik (2017) the total quantity of sales in the Norwegian salmon farming industry increased with 1,1 million mt in the period between 1994-2015 where the employment in the sector increased with 56% over the same period. In comparison, the employment in whole Norway have had an average change of 0.32 percent from 1995-2018 (Trading Economics, 2018).

2.1.2 International trade of Atlantic Salmon

EU is the main market for Norwegian salmon traders with Poland (14%) and France (12%) as the two main markets measured in export value (Ernst & Young, 2017). Exports to Eastern Europe has also increased where Norway exported around 17,000 mt of salmon during the first half of 2018 with a value of NOK 770 millions. In 2017 the total direct export volume of Norwegian salmon were 1,004,974 mt with a total value of 64,582,922,000 billion NOK (Norwegian Seafood Council, 2018).

Country	***Value 1000 NOK***	***MT***
Poland	7,653,419	131,698
France	6,455,862	103,013
Denmark	5,018,127	85,516
Spain	3,905,257	62,566
Great Britain	3,546,238	56,676
Netherland	3,423,526	54,589
Sweden	3,097,105	38,889
Italy	2,973,014	47,027
Germany	2,820,356	41,679
Lithuania	2,064,183	35,659

Table 1: Ten largest European export markets for Norwegian salmon in 2017 (Norwegian Seafood Council, 2018)

2.1.3 Traditional salmon farming

The standard production process in traditional salmon farming is conducted in two phases; First, the eggs are placed in freshwater tanks on land where they are until they develop to smolt (100 g). The smolts are then transferred to open sea cages in seawater and stays there during the whole grow out-phase until they reach the size of harvesting which is normally around 4-6 kg. This process has been the most convenient and effective way of farming salmon, but it has also raised some problems. When the smolt are placed in open cages in seawater they are exposed to sea lice and possibilities of escaping, which have resulted in major players in the sector now looking at alternative methods for salmon farming, including full grow-out on land to overcome these problems (Lekang & Bostock, 2016).

2.2 Industry challenges

According to Torrissen et al. (2013) "salmon lice, *Lepeophtheirus salmonis* are naturally occurring parasites of salmon in sea water". It occurs in sea-based salmon farming because it provides better conditions for parasite growth compared to natural conditions (Torrissen et al., 2013). The sea lice have proved to be costly for fish farmers in terms of its capabilities of killing and injuring fish which consequently is stagnating the growth rates and increases costs used for treatments (Watershed Watch Salmon Society, 2004). Costello (2009) indicated that the costs of sea lice in 2006 was around 6% of the total production value of farmed salmon in the areas that are affected by sea lice, and in some instances the salmon in the cages cannot be used for consumption (Lekang, Salas-Bringas & Bostock, 2016). Consumers are also becomming more aware of health, nutrition, traceability and sustainability in food production and the major use of medication and antibiotics for treatment of parasites have affected the reputation of the sector (Bjørndal & Tusvik, 2017).

Many methods have been used to combat the sea lice, for instance medical- and mechanical treatments and cleaning fish, all with mixed results. However, one of the most advanced and newest method is the sea lice laser canon which is a technology that uses a camera and laser to detect sea lice. The canon is placed in the open sea cages and when a lice is recognized, the canon fires a laser beam to kill it (Beck Engineering, 2014; Lekang & Bostock, 2016).

The escape of salmon is mainly due to bad weather conditions or defects on the net in the sea cages. When farmed fish is escaping it composes a significant threat to the local strains in terms of genetic mixing (Jonsson and Jonsson, 2011; Liu et al., 2011; Sepúlveda et al., 2013; Lekang, Salas-Bringas & Bostock, 2016). As argued by Thorstad et al. (2008) the negative effects of breeding of wild salmon stocks with farmed salmon are among others lowered individual fitness, reduced lifetime and decreases in production over several generations.

As well as in the case with sea lice, many things have been tried to reduce the escapes of salmon where one of the newest methods includes installing electrical wires in the net bag which makes it possible to discover defects through the wires (Maitri and Kevin, 2013; Havtek, 2014; Lekang & Bostock, 2016).

However, even though laser canons and electrical wires in the threads of the net bag can scale down the headache in the industry, land-based salmon farming will to a high degree solve these problems by offering the possibilities of water treatment or taking water from deep sea

levels with a low concentration of sea lice (Lekang et al., 2016) and undoubtedly preventing the fish to escape.

2.3 Land-based salmon farming

Land-based salmon farming is by many seen as an innovative- and alternative technology in the industry, but there was also an interest for the technology in the 1990s when ten land-based salmon farms were operative in Iceland and Norway (Lekang, 1991; Lekang and Fjæra, 1992; Lekang & Bostock, 2016). However, due to negative economic results the farms eventually had to shut down their operations (Lekang & Bostock, 2016). The technology at that time mostly used flow through water, but in recent years a new technology called RAS (Recirculation Aquaculture System) has entered the market, a technology that reuses 95-99% of the water (Holm et al., 2015; Bjørndal & Tusvik, 2017). RAS was mainly developed for usage in areas with low or no water supply (Badiola et al., 2012) and as Dalsgaard et al. (2013) points out, the RAS technology makes it possible to control different parameters on water quality and temperatures of the water. Bjørndal & Tusvik (2017) find that a controlled farming environment "promotes greater fish health, better quality, superior growth rates, improved feed conversion ratios, reduced disease outbreaks and lower use of therapeutants". However, investment costs related to RAS plants are considered to be higher than the traditional method that consist of traditional flow through (Bjørndal & Tusvik, 2017), and the high reuse of water will lead to higher electricity costs (Shepherd and Bromage, 1988). According to Dalsgaard et al. (2013) "the technical complexity puts large demand on system management, challenging the profitability of such systems even further" while Schneider et al. (2006) emphasizes the difficulties in treating diseases that comes with the RAS technology.

2.4 Advantages of land-based salmon farming

2.4.1. Control of environment, transportation cost and geographical proximity

As demonstrated earlier (see land-based salmon farming) farming salmon on land makes it possible to treat and maintain control of the environment and prevent salmon escape. (Lekang & Bostock, 2016). According to Bjørndal & Tusvik (2017) players in the sector would also save costs by avoiding to pay the license fee that is required in traditional farming. Additionally, lower transportation costs can occur by exploiting location-specific advantages by being closer to major markets. Because of the relative low consumption of salmon in the countries where most of the farming takes place, the majority are transported to major markets

such as EU with Poland and France as the largest markets, Japan, USA and Russia. These are relative distant destinations from where the farming takes place which implies long transportation distances (Bjørndal & Tusvik, 2017). By rellocating the farming on land, the salmon will be closer to major markets which again will incur into saved costs from transportation, especially to those destinations that requires expensive air freight (Bjørndal & Tusvik, 2017). The cost of transportation represent a significant amount of the total production costs in the salmon farming industry, and as discovered by DNB Markets (2017) the transportation of salmon per kg from Norway to Asia or USA can be as much as 14 NOK/kg, which will make the overall production costs per kg more expensive compared to land-based salmon farming.

	Sea-based (Norway) NOK/kg	***Land-based (market) NOK/kg***
Farm gate cost of production	28.5	38.7
Harvesting	3	3
Total per kg (WFE)	**31.5**	**41.7**
Total per kg (HOG)	**35.5**	**46.9**
Air transport packaging	1	0
Inland transport	1	1
Air transport (US/Asia)	14	0
Total per kg (HOG)	**51.5**	**47.9**

Table 2: Costs to Asia or USA for sea-based salmon farming in Norway and land- based salmon in Asia or USA (DNB Markets, 2017; Bjørndal & Tusvik, 2017)

The flexibility of land-based salmon farming also opens the window of chosing locations with good operating conditions. Atlantic Sapphire is a company that currently is constructing a land-based salmon farm in Florida to serve the US market. The company has a goal to reach a production volume of 90,000 mt in 2026 and to be the most competitive supplier of salmon to the american market. In order to reach their target they are planning to use scale to reduce operating costs together with low transportation costs because of their proximity to their market (Undercurrentnews, 2017; Bjørndal & Tusvik, 2017).

2.5 Future expectations

Several land-based salmon farms are currently being planned and set up in Norway, North America and China (Liu et al., 2016; Bjørndal & Tusvik, 2017). According to DNB Markets (2017), the production capacity of more than 20 land-based salmon sites will reach 150 thousand mt in the beginning of 2020, with the majority using the RAS technology. To continue the positive development of establishing land-based salmon farms, Bjørndal & Tusvik (2017) assumes that investment grants and subsidies, tax conditions and locational advantages in forms of logistics, transportation and the regulatory environments will be important parameters to consider. In addition comes knowledge on managing fish biology and competences to operate a fish farm.

2.6 Offshore Outsourcing

One opportunity for Norwegain salmon producers is to outsource land-based salmon farming to other regions. There are several types of outsourcing, and the most common one is called offshore outsourcing. As stated by Di Gregorio et al. (2009) "offshore outsourcing is an organization`s business process outsourcing to foreign contractors", usually taking place in countries that are more distant. Kotabe & Murray (2004) considers offshore outsourcing as a strategy firms use to preserve and expand their competitive advantages while Gupta et al. (2006) points out that "due to increased supply of low cost-and high skilled labor, both large mulitnational enterprises and small companies feel the pressure to outsource processes". Di Gregorio et al. (2009) also emphasizes cost reductions as the main reason for offshore outsourcing together with increased efficiency. Other parameters are access to capabilities, knowledge and unique resources, location and firm-specific advantages, expansion of relationships with strategic partners and the opportunity to serve customers more efficiently.

2.7 Nearshoring

An alternative to offshore outsourcing is nearshoring. According to Tate and Petersen (2013) "nearshoring refers to locating a manufacturing plant within one`s region" and compared to offshore outsourcing the activities are placed in a market that is closer to the home market with lower wages and similar culture (Robinson, 2005; Kvedaraviciene, 2008). However, labor costs have proved to be higher in nearshoring markets compared to offshore markets, and therefore many companies do not see the benefits of it. Nevertheless, nearshoring is often seen as a strategy used by companies to reduce risk because of the cultural – and geographical

proximity (Kvedaraviciene, 2008). This proximity also opens the opportunity for building trusted relationships that are not affected by cultural and linguistic misunderstandings (Eastwood, 2005). The cultural- and geographical proximity will also lower the management costs compared to offshoring (Kvedaraviciene, 2008) because it is easier to manage frequent meetings, and due to the equal time zones and relative similar cultural the communication barrier will be lower. This will again result in better supervision of resources capital and higher quality of the output (Kvedaraviciene, 2008). According to KLG (2005), it is rare to find a lower productivity level in nearshoring locations compared to the home country. Eastwood (2005) also mentions that "most nearshore partners tend to come with a more robust technology offering than offshore partners, thus the need to purchase, enhance or build is less than what may typically be true with an offshore partner".

2.7.1 Nearshoring to emerging countries in Central- and Eastern Europe

Because of the cultural- and geographical proximity, different parts of EU and especially emerging countries in Central and Eastern Europe (CEE) have proved to be lucrative destinations among Western European countries for nearshoring services and processes (Meyer, 2006). Gal (2014) also argues that CEE is an attractive region because of the geographical proximity, but also emphasizes low labor costs, the access to highly talented- and skilled labor, in addition to close political and cultural ties with Western Europe. He further argue that labor costs in the CEE region are between 40-60% lower compared to Western Europe (Gal, 2014). Several countries have also worked actively to increase their attractiveness for foreign investments by reudcing taxes. According to Emerging Europe (2018) "countries such as Poland, Ukraine and Romania have implemented substantial tax incentives for businesses to set up shop in their territories". In comparison, the government in Norway is considering to increase the taxes in the Norwegian aquaculture sector in 2020 by implementing a tax on the use of natural resources (Reuters, 2018).

Some of these aspects, in addition to other important parameters such as industrial policies, financial support, groundwater quality, corporate taxes, prices on land, electricity prices and transportation infrastructure will be thoroughly analyzed in a portfolio analysis for all emerging countries in Europe to find the most optimal country for Norwegian salmon producers to nearshore land-based salmon farming.

3. Methodology

The methodology that is used to answer the research questions and consequently the problem statement is mainly secondary research. The literature review made it clear what information that are easily accessible from secondary research and what information that had to be extracted from interviews with industry experts. Important topics such as industrial policies, financial support to the aquaculture sector, groundwater quality, labor costs, corporate taxes, prices of land, electricity prices, transportation infrastructure and geographical proximity were mainly covered through secondary research, while qualitative research in form of expert interviews was used to get an fundamental understanding of land-based salmon farming in general, the current situation in the aquaculture sector in the emerging countries and the level of education related to aquaculture studies in all countries. Additionally, the expert interviews provided information about the prevalence of salmon farming in the selected countries, information that were not available through secondary research.

RQ 1: *What are the most important factors for succeeding with land-based salmon farming?*

As mentioned by Bjørndal & Tusvik (2017), there are several parameters to consider if wanting to succeed with establishing and running a land-based salmon farming with RAS technology. However, it was necessary to conduct an interview with a different type of source as well, to get a more integral understanding of the topic. This interview was the first one and was conducted with the Deputy Director and Head of the Aquaculture Department in Akvaplan niva, a company that specializes in providing expert knowledge to the aquaculture sector.

RQ 2: *What is the current situation in the aquaculture sector in the respective countries?*

After gaining an understanding about what factors that are substantial for succeeding with land-based salmon farming, a total of seven interviews were conducted with industry experts with broad experience and knowledge about the aquaculture sector in their own country. All the respondents were employed in an institution or federation with connection to aquaculture, and the aim of these interviews were to address research question two.

Below are the main topics that were addressed in the interviews in order to give a fulfilling answer to the research question:

- *Main challenges in the aquaculture sector*

- *Selection and quality of aquaculture studies and labor in the sector*

Following is an overview of the different countries, respondents and the federations/research institutes they represented:

Country	Name	Institution
Bulgaria	Dimitar Taskov, PhD student	Institute of Aquaculture, Stirling University
Czech Republic	Otomar Linhart, Director of CENAKVA	Faculty of Fisheries and Protection of water, University of South Bohemia
Greece	Secondary Research	
Hungary	Peter Lengyel, Head of Aquaculture Development and deputized Head of Fisheries Management	The Ministry of Agriculture
Poland	Secondary Research	
Romania	Secondary Research	
Russia	Svetlana V. Korolkova, Head of Chair of Water Bioresource, Aquaculture and Hydrochemistry	Russian State Hydrometeorological University
Turkey	Bilal Akbulut, Researcher Recayi Cimagil, Researcher	Central Fisheries Research Institute, Trabzon
Ukraine	Vitaliy Bekh Head of the Fish Selection Department	Institute of Fisheries of NAAS

Table 3: Information about respondents for primary research

In order to answer research question three, the last part of the analysis was conducted through secondary research.

RQ 3: *"What are the costs related to setting up a land- based salmon farming site in the different emerging countries?*

According to the International Salmon Farmers Association (n.d.), challenges to overcome when establishing and running a land-based salmon farm includes costs related to energy and land. In terms of electricity prices, also Summerfelt et al. (2012) and Gievær (2018) emphasized choosing a location with low electricity prices. In that case, the average price per kWh of industrial units are analyzed for each country. With regard to costs of land, the average price of one hectare of agriculture/arable land in most countries are presented, in addition to the average rental price of one hectare agriculture/arable land. The reason why agriculture/arable land is used as a point of reference in this section is mainly because that this type of land is used by the world`s largest land-based salmon farming company, Atlantic Sapphire.

Wages was another important parameter to analyze. Bjørndal & Tusvik (2016) estimated that the annual wages for employees working on a land-based production site in Norway is 665,000 NOK, which equals around 68,415 EUR (XE Currency Converter, 2018). This make room for cost savings by nearshoring to countries with lower level of wages. Thus, average wages on national levels were compared with the average wage in the aquaculture and fishery sector in all countries. In addition to costs related to energy, land and labour, the corporate tax rate in each country is presented. Moreover, all countries are in possession with a double tax treaty agreement with Norway, which will prevent double taxation.

3.1 Framework Analysis

In order to evaluate the most optimal emerging country to nearshore land-based salmon farming, the simple multi attribute rating technique SMART is used. According to Barfod & Steen (2014) “The SMART technique is based on a linear additive model which mean that an overall value of a given alternative is calculated as the total sum of the performance score (value) of each criterion (attribute) multiplied with the weight of that criterion”.

4. Findings

4.1 Part I

In this section the main findings from the interview with Akvaplan niva and secondary research will be presented where the aim was to answer research question one, and consequently figure out what factors that are the most important for succeeding with land-based salmon farming.

Interview Anton Gievær – Deputy Director and Head of the Aquaculture Department

Background: *General education in fish biology from the University of Tromsø*

According to Mr. Gievær, there are three main things that are crucial for succeeding with land-based salmon farming:

1: Access to groundwater or water with good raw quality:
It is important to have clean water entering the RAS system. If the water brings bacterias into the RAS system it will be impossible to get it out (Gievær, 2018). According to the International Salmon Farmers Association (n.d.), there have been a number of cases where problems with fish health have been caused by pathogens (bacterias) in the land-based systems.

2. Competencies of employees:
The production biological- and technological competencies of employees is seen by Mr. Gievær as crucial for succeeding with land-based salmon farming. More detailed, to possess knowledge on how to run a land-based production facility with RAS system and to know how the salmon will respond in every stage of the farming is a "winner" for succeeding. This parameter is also seen by Mr. Gievær as the most challenging to implement.

3. Low electricity prices:
In general, the land-based salmon is farmed in environments with a temperature of 14-16 degrees celsius. During the summer period when the temperature increases, more energy has to be allocated on cooling down the production hall. According to Mr. Gievær, this can compose a significant extra cost.

Several of the above-mentioned factors are confirmed by Bjørndal & Tusvik (2017) who emphasizes that the degree of success with land-based salmon farming has been variating so

far because of "the level of understanding with respect to the biological needs in land-based systems, new challenges including bacteria and water management, differences in regulatory support, access to financing and other resources such as land, water, energy, knowledge and competent labour". According to Summerfelt et al. (2012) the potential of farming Atlantic salmon on land depends on selecting sites close to major markets and with cheap power.

Both Bjørndal & Tusvik (2016) and Gievær (2018) emphasized the importance of the right human competencies for succeeding with land-based salmon farming. In that manner, the educational systems related to aquaculture, fishery and fish biology in each country were analyzed to see if the countries are putting in some efforts in educating students within the field of aquaculture and fishery. Moreover, it was important to analyze the general quality of the labor force in the sector.

Industrial Policies was not mentioned as one of the key success factors for succeeding with land-based salmon farming. However, it was included on the background of seeing if any of the aquaculture sectors in the countries were emphasizing the development of land-based farming of fish or RAS systems. In this section it was important to distinguish between EU countries and countries outside EU. As for EU countries, the Common Fishery Policy reform (CFP) has been initiated to promote a sustainable development of the aquaculture sector in EU. All countries in the union have had to develop their own Multiannual Strategic Plan that is addressing the different growth objectives in each country the coming years, in addition to strategic guidelines on how to achieve them. For countries outside EU (Ukraine, Russia and Turkey), country-wised strategic plans for development of the aquaculture sector is presented.

According to Bjørndal & Tusvik (2016) regulatory support was an important aspect of succeeding with land-based salmon farming. In this section, financial support from the governments are presented together with support from other unions and associations.

Both Bjørndal & Tusvik (2016) and Gievær (2018) emphasized raw water with good quality as one of the most important factors for succeeding with land-based salmon farming. In this section the access to groundwater and the general groundwater quality in nearly all countries are presented. Another element that was analyzed was the transportation and logistics in the respective countries, which was important parameter to consider according to Bjørndal & Tusvik (2016). In this section the Logistics Performance Index (LPI) were used, an index that measures the efficiency of customs, quality on transport infrastructure, the ease of arranging

international shipments, the quality of logistics services, the ability to track and trace consignments and the timeliness of shipments.

The last parameter in the analysis were geographical proximity to major markets. According to Summerfelt et al. (2012) the potential of farming Atlantic salmon on land depends on selecting sites close to major markets and with cheap power. In this section a "capital to capital" method was used using "Viamichelin", a route planner that provides information on distances and costs from one location to another location. The capitals that were included in this section were the capitals in the ten countries that provides most value for Norwegian salmon companies in 2017.

4.2 Part II

In this part the main findings from the interviews with the representatives from each country in addition to findings from the secondary research are presented. The aim was to answer research question two and three:

RQ 2: *What is the current situation in the aquaculture sector in the respective countries*

RQ 3: *What are the costs related to setting up a land- based salmon farming site in the different emerging countries?*

4.2.1 BULGARIA

The aquaculture sector in Bulgaria is known for being fragmented and small-scaled where access to natural- and human resources are low. These factors in addition to the lack of capital to scale production are the most significant barriers for growth (Taskov, 2018).

The most common farmed species in Bulgaria are carps, rainbow-trout and mussels where the majority is farmed by using semi-intensive systems (ponds) and intensive systems for trout farming (FAO, 2018). Mr. Taskov was also of the opinion that there are one salmon farm operative in Bulgaria which produces Coho salmon, a type of Pacific salmon. The farm is a highly automated farm using RAS technology and is supplying the high-end market in Sofia (See Appendix A).

In terms of education within aquaculture and fisheries, Bachelors, Masters and PhDs are offered at seven governmental aquaculture institutes in the country (FAO, 2018). However, the interest for the sector is generally low, and most people working in the sector obtains a degree in engineering and fish biology rather than aquaculture (Taskov, 2018). The low

interest has also made aquaculture enterprises to hire people from abroad countries (Taskov, 2018). To boost the interest and development of the sector, Bulgaria has stated through their Multiannual Strategic Plan to increase the production volume of aquaculture products from 14,000 mt to 20,000 mt annually by 2020 (European Commission, n.d.). They have also identified four best practices on how to accomplish that (See Appendix A).
Regarding support to the sector, financial support from the government is absent and subsidies to the sector has been terminated since the beginning of the 1990s (FAO, 2018).

Bulgaria is a water deficient country where groundwater represents around 30% of all water resources in the country (Galabov & Lichev, 2004). Bulgaria has also a long history with poor quality drinking water, where 18 of the 28 districts reported contaminated drinking water in 2012 (Axtman, 2017). However, the situation has improved over the last years due to several installments of wastewater treatment plants (European Environment Agency, 2015) and decline in industrial- and agriculture production (European Environment Agency, 2016).

In terms of other more cost-related parameters of nearshoring land-based salmon farming, Bulgara is one of the countries in Europe with lowest corporate tax rate, wages, prices of agricultural land and electricity prices. In terms of corporate taxes, only Hungary, Montenegro and Isle of Man are offering a lower one (Trading Economics, 2018) where the country offers a flat corporate income tax rate (See Appendix J) applicable to all types of income (Deloitte, 2018). Bulgaria is in possession of a double taxation treatment with Norway to avoid double taxation (Regjeringen, 2016). With regard to wages, the average annual wages of employees on national level were more than 1,000 EUR higher compared to the average annual wages for employees under labour contract in the agriculture, forestry and fishing sector in 2017 (See Appendix J). Moreover, according to Eurostat (2018), the average price of one hectar arable land in Bulgaria in 2016 were around 2,000 EUR. Compared to the Netherlands, which obtained the highest average price of one hectar arable land in EU, the price was 63,000 EUR. In terms of rental prices of arable land, Bulgaria obtained an average rental price that was four times as low as the average in the Netherlands in 2016, who also obtained the highest rental price for one hectare arable land in the whole EU (See Appendix J). Bulgaria is also one of the countries with lowest electricity prices for industrial users, with an average price of 0,0972 EUR per kWh.

Regarding logistics and transportation infrastructure, Bulgaria is ranked as number 52 on the Logistics Performance Index (LPI) Global Rankings in 2018 (The World Bank, 2018) with an average score of 3,03 (See Appendix A). Taking into consideration their geographical proximity to the ten largest importing countries of Norwegian salmon, Bulgaria is located within a range of 21,351 km, where the total costs of transportation from Sofia to all capitals in the countries is estimated to be 4,550 EUR (See Appendix J).

4.2.2 CZECH REPUBLIC

As mentioned by Mr. Linhart, the aquaculture sector in the Czech Republic is a small sector where the main challenges are related to lack of water, problems with bureaucracy and low consumption of fish. Another trend is that the 406 enterprises that are involved in aquaculture do not practice it as a main activity, but rather alongside with other activities (European Commission, n.d.). However, the Czech Republic is still the largest exporter of carp in Europe (Adamek et al., 2012), a species that is famous for its quality because of its strict certification schemes (European Commission, n.d.). In terms of farming systems, semi-intensive and extensive systems are the most common ones where pond farming represents around 95% of total aquaculture production in the country (European Commission, n.d.). According to Adamek et al. (2012), RAS is a relative new technology in the aquaculture sector in the Czech Republic and is therefore only practiced by four fish farms in the country, mainly for species such as catfish, eel, rainbow-trout, pikeperch and ornamental fish.

Several schools in the Czech Republic offer secondary education in studies related to water management practices, hydro-ecological issues, pond management, intensive aquaculture technologies, and fish breeding (FAO, 2018) where graduates usually are employed in fish farming enterprises or within authorities that are focusing on water protection and environmental conservation (Adamek et al., 2012). Vocational training with focus on fish farming and fish handling is also offered, while higher education within aquaculture studies (See Appendix B) is offered at two universities, one of them known for being the most complete educational institute for aquaculture studies in Central Europe.
According to Linhart (2018), the quality of employees in the sector is high with the majority having a background from university level and vocational training (FAO, 2018).
In terms of the development of the sector, the Czech Republic aims to increase the production of fish in recirculation systems with 300% until 2020 as a part of their Multiannual Strategic

Plan (See Appendix B). However, the financial support from the government to the sector is rather low where most of it originates from funds from the European Union (OECD, n.d.).

According to the Ministry of Agriculture of the Czech Republic (2016), the country has been suffering from drought over the last years which has resulted in a significant deficit of groundwater. The general quality of the groundwater sources in the country are also poor, where several sources having high values of nitrate, sulphate and ammonia (Czech Committee of the International Commission on Irrigation and Drainage, n.d.)

In terms of other more cost-related parameters of nearshoring land-based salmon farming, the Czech Republic has a flat corporate tax rate that is significant higher compared to several other emerging countries in Europe (See Appendix J). However, the Czech Republic is more competetive in terms of electicity prices for industrial users, being the cheapest emerging country in Europe besides Ukraine and Russia (See Appendix J).

According to the latest updates from the Czech Statistical Office (2018), the average gross wage in the Czech Republic is 31,851 CZK. Converted to euro that equals 1227 EUR (XE Currency Converter, 2018). However, as mentioned by Mr. Linhart, the level of wages in the aquaculture sector is lower than the average salary in the country (See Appendix J), where he estimated the monthly gross wage to be around 20,000 CZK / 771 EUR (XE Currency Converter, 2018).

The average price of agricultural land in the Czech Republic were at 5,170 EUR per hectare in 2014 (Businessinfo, 2016) and there are currently no limitations for foreign investors to buy land in the country (Emerging Europe, 2017). The country also has the lowest average rental prices for agricultural land among the emerging countries in Europe, with a price of 54-66 EUR anually (Czech Point 1010, 2014).

In terms of the quality of transportation infrastructure, the Czech Republic is ranked as number 22 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,68, significantly higher than Bulgaria (See Appendix B). By taking into consideration their geographical proximity to the ten largest importing countries of Norwegian salmon, the country is located within a range of 10,978 km, being the emerging country with the lowest distance to the largest consuming countries of Norwegian salmon

(Viamichelin, 2018). The total costs of transportation from Prague to all ten capitals is estimated to be 2,395 EUR (See Appendix J).

4.2.3 GREECE

According to FAO (2018), Greece has been a leading producer of fish since the economic crisis in 2008, and is mainly a export-oriented country (Huffingtonpost, 2015) where only one quarter of the fish that is consumed in the domestic market is being imported (FAO, 2018). Most of the fish in Greece originates from marine aquaculture (See Appendix C) where freshwater aquaculture is a small and fragmented sub-sector that is usually runned by family enterprises (FAO, 2018). Freshwater aquaculture is also limitied to a few areas where rivers are available and has a low potential of growth due to the lack of freshwater resources in the country (FAO, 2018). Another barrier for growth in the Greek aquaculture sector is the costly and time-consuming process of acquiring licenses. According to FAO (2018), it takes up to 25 months to acquire a license for aquaculture farming and the costs can be as much as 25,000 EUR. Moreover, only 25% if the applications are approved.
The most common farmed species in Greece are sea bass, sea bram and mussels (European Commission, n.d.) where the majority of fish is being farmed in cages, hanging parks and raceways (FAO, 2018). In terms of land-based farming in Greece, there are currently five sites for spirulina farming registrated with an annuall production of 12 mt (FAO, 2018).

In Greece there are several universities offering education within aquaculture, marine and veterinary sciences, mainly at MSc and PhD level (FAO, 2018). The employment in the sector has also increased over the last years (See Appendix C), but the people working in the sector is nevertheless characterized of being old and lacks training (European Commission, n.d.). Additionally, the sector is seen by many as a non-specialized industry where the education level among employees are low (FAO, 2018).

According to FAO (2018), no radical changes are expected in the freshwater aquaculture sector in Greece. However, as a part of the Common Fishery Policy reform, Greece aims to increase the production volume from 114,000 mt in 2012 to 170,000 mt in 2020 (European Commission, n.d.). In order to do so the country has identified three best practices (See Appendix C).

With regard to financial support, the Agricultural Bank in Greece offers a lower interest rate to people or companies that want to invest in the aquaculture sector compared to what the

Central Bank offers to other sectors (See Appendix C). The Greek government also aims to increase the attractiveness for new entrants in the sector by distributing grants with a high value (FAO, n.d.). However, the grant funding system is a relative new system in the sector, and has been difficult to implement because of administrational complexity which in turn has resulted into underutilization (FAO, n.d.).

The quality of groundwater in Greece is in general good, but several of the 300,000 wells and boreholes where groundwater can be extracted from underground layers of aquifers are intruded by seawater, especially in coastal areas (European Academies Science Advisory Council, n.d.). In addition, the groundwater is threatened by uncontrolled disposal of wastewater and nitrate pollution (European Academies Science Advisory Council, n.d.).

In terms of other more cost-related parameters of nearshoring land-based salmon farming, Greece is on average the costliest emerging country for nearshoring. It is the emerging country in Europe with the highest corporate taxes (See Appendix J) even higher than the CIT in Norway. Furthermore, according to Shafer (2018), the average price for one hectare of agriculture land in Greece was measured to be around 12,000 EUR in 2016, the highest of all emerging countries in Europe. Greece is also the emerging country in Europe with the highest price per kWh for industrial users (See Appendix J). In terms of wages, the average monthly gross wage in Greece was estimated to be 1,060 EUR in February 2018 (Trading Economics, 2018), being the emerging country in Europe with the third highest average wage.

Regarding logistics services and transportation infrastructure, Greece is relative underdeveloped ranking as number 42 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,20 (See Appendix C). By taking into consideration their geographical proximity to the ten largest importing countries of Norwegian salmon, Greece is located within a range of 26,825 km with a total transportation cost of 5,652 EUR to all ten capitals (Viamichelin, 2018).

4.2.4 HUNGARY

The aquaculture sector in Hungary has great traditions, but also great challenges in terms of low consumer demand, low level of processing, high price sensitivity among consumers, low cooperation within the sector and damage from fish-eating birds in pond farms (Lengyel, 2018). The industry is also characterized of being fragmented where the majority are small- and medium sized enterprises (European Commission, n.d.).

The most common farmed species in Hungary are carp, catfish, sturgeon and trout where semi-intensive fish farming in ponds is the most common fish farming technology (Lengyel, 2018). However, recirculation systems are becoming more and more popular (European Commission, n.d.)

According to Mr. Lengyel, aquaculture courses are usually offered as a part of agricultural studies in Hungary, while fish biology is a part of hydrobiology education. However, the Hungarian research on aquaculture have gained international reputation (FAO, 2018), where the country is in possession of high number of specialists (Lengyel, 2018). Nevertheless, one of the main challenges in the sector is the very low number of people with vocational training, which also affects the labor market which lacks a skilled workforce. The interest towards working in fish farms are also low because it is considered to be underpaid (Lengyel, 2018).

In terms of developing the Hungarian aquaculture sector in the future, Hungary have stated through their Multiannual Strategic Plan to increase the production volume 21,500 mt in 2014 to 27,000 mt annually in 2023 (European Commission, n.d.) where they have identified five best practices on how to accomplish that (See Appendix D). The financial support is mostly coming from different ministries directed to the leading research institutes of aquaculture in the country. However, most of it is financed through the European Maritime and Fisheries Fund (Lengyel, 2018).

Hungary is a country that are rich in freshwater resources, both in terms of groundwater and surface waters, having around 70,000 groundwater wells (MTA, 2017). In addition, the country is rich in geothermal resources (European Commission, n.d.) which increases the possibilities for development of intensive aquaculture (FAO, 2018). Most of the groundwater sources in Hungary are also classified as having “good status” (See Appendix D).

In terms of other more cost-related parameters of nearshoring land-based salmon farming, Hungary offers the lowest corporate tax rates of all emerging countries in Europe (See Appendix J) where the country also has a double tax treaty agreement with Norway that dates back to 1981 (Regjeringen, 2016). According to Trading Economics (2018), the average monthly gross wage in Hungary in August 2018 were measured to be 321,172 HUF. Converted to euro that equals 995,386 EUR (XE Currency Converter, 2018). No official information was found about wages in the aquaculture sector, but as explained by Mr. Lengyel the wages are considered to be low even though the sector have been experiencing a substantial growth of 30,6% in the period from 2010 to 2015 (Ministry for National Economy,

n.d). Hungary is also a country that offers competitive prices on purchasing and renting arable land (See Appendix J). However, according to Thomson Reuters Practical Law (2015) acquisition of agricultural land by any foreign business is currently illegal, even by using a domestic legal person. The average price per kWh for industrial users in Hungary was measured to be 0,1042 EUR in 2018 (Pordata, 2018).

In terms of quality of transportation and logistics, Hungary is ranked as number 31 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,42. By taking into consideration their proximity to the ten largest importing countries of Norwegian salmon, Hungary is located within a range of 14,330 km with a total transportation cost of 3,119 EUR to all ten capitals (Viamichelin, 2018).

4.2.5 POLAND

The aquaculture sector in Poland is most known for the high quality of the people working in the industry (FAO, 2018) in addition to having a strong processing industry (European Commission, n.d.).

The most common farmed species in the Polish aquaculture sector are carp and trout (European Commission, n.d.) and in 2016 Poland exported as much 462,460 mt of fisheries and aquaculture products (Eurofish, n.d.) where most aquaculture products originates from extensive and intensive methods (Buczkowska, 2017). However, RAS are becoming more popular (European Commission, n.d.) with several investors launching new businesses in indoor RAS technology (Towers, 2015). One of them is the land-based salmon farming company Jurassic Salmon which is using 150-million-year-old thermal water (Jurassic Salmon, 2018). Poland is also one of the worlds` largest importers of salmon (Eurofish, n.d.).

In terms of education with fisheries and aquaculture, Poland has a well-developed system where education is offered at vocational and technical schools in addition to Master of Science and doctoral programs (FAO, 2018). The leading university within inland fishery and aquaculture is also actively involved in different advisory services related to the sector (See Appendix E). According to the European Commission (n.d.) 4,400 full-time workers are employed in the sector where over 70% of trout producers have completed higher education (FAO, 2018).

As a part of the Common Fishery Policy, Poland aims to achieve over 100% growth in intensive farming systems in the period 2014-2020 and to increase overall production of seafood products with 53% in the same period (European Commission, n.d.). In terms of financial support to the sector, the Stanislaw Sakowicz Inland Fisheries Institute (IFI) receives funding from the state for research and development projects. However, the financial support to private entrepreneurs are rather modest, which can make it difficult to cover the costs that comes with research and development (FAO, 2018).

In terms of other more cost-related parameters of nearshoring land-based salmon farming, Poland`s corporate tax rate is lower than the Norwegian one, but far by the lowest among emerging countries in Europe (See Appendix J). Poland has also the second highest average wages among the emerging countries in Europe, with an average monthly gross wage of 1,066 EUR in the third quarter of 2018 (Trading Economics, 2018). However, the average gross wage in the aquaculture sector is almost half of the average national wages (Salary Expert, n.d.). In terms of land ownership, foreigners are banned from purchasing agricultural land until 2021 (European Parliament, 2018). However, if the ban opens in the future, foreigners can expect a price around 8,000 EUR per hectare of arable land (Eurostat, 2018). Foreigners are still allowed to rent agricultural land to a monthly price of around 200 EUR per hectare (Eurostat, 2018). The average electricicty price per kWh for industrial users in Poland in 2018 is 0,1078 EUR (Pordata, 2018).

According to The World Bank (2018), Poland is ranked as number 28 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,54. Poland has also the second highest geographical proximity to the ten largest importing markets of Norwegian salmon after the Czech Republic, where the country is located within a range of 12,007 km with a total transportation cost of 2,353 EUR to all ten capitals (Viamichelin, 2018).

4.2.6 ROMANIA

The Romanian aquaculture sector is characterized of being fragmented and dependent on imports, where local fish producers only covers 20% of the domestic consumption (FAO, 2018). The sector is also affected by having old fishing facilities, which is a great barrier of growth (FAO, 2018). The most common farmed species in Romania are carp, goldfish and trout (FAO, 2018), where extensive and semi-extensive farming methods are most popular.

Some RAS technology is also practiced for farming of turbot with financial support from European funding (FAO, 2018).

A common practice in the educational system in Romania is to offer aquaculture courses as a part of the curricula in agriculture studies (See Appendix F). Additionally, several schools on high school level offers vocational training in fish farming and a few training centers are authorized to offer vocational training courses for workers in fish culture (FAO, 2018).
In terms of employment in the aquaculture sector, over 90% are men where 15% are in possession of higher education (FAO, 2018).
Romania have stated in the Multiannual Strategic Plan that it aims to increase production of aquaculture products with 255% from 2013-2020 (European Commission, n.d.). In order to do so the country has identified four best practices (See Appendix F). However, the financial support to the sector is non-existing where subsidies and grants in forms of capital aid never have been provided (FAO, 2018).

According to the Ministry of Environment and Sustainable Development (n.d.), Romania is a country poor in water resources where only 3,7% of the surface is water. With regard to groundwater, most of the sources in Romania still contains a high level of nitrates, leaving 35% of the population without consistent access to public clean water (Palzkill, 2017).

In terms of other more cost-related parameters of nearshoring land-based salmon farming, Romania is one of the emerging countries in Europe with lowest corporate taxes, having a flat CIT of 16% (Trading Economics, 2018). With regard to wages, the average gross wages in June 2018 was estimated to be 4,449 RON (National Institute of Statistics of Romania, 2018). Converted to euro that equals 958 EUR (XE Currency Converter, 2018). In comparison, the average net wages in the Romanian fish farming sector in 2016 were measured to be 1,621 RON (Pana, 2017), which equals around 350 EUR (XE Currency Converter, 2018). At that time, the average gross salary in Romania were around 2,800 RON (Trading Economics, 2018) significant higher than the average salary in the aquaculture sector at that time.
The variable where Romania is the most competitive is within purchase price of arable land. According to Eurostat (2018), Romania is the country in EU with the cheapest average price of one hectare arable land, and the second cheapest emerging country in Europe in terms of rental price of one hectare arable land (See Appendix J). The average price per kWh for industrial users in Romania was measured to be 0,0989 EUR in 2018 (Pordata, 2018).

With regard to transportation infrastructure, Romania is ranked as number 48 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,12. Taking into consideration their proximity to the ten largest importing countries of Norwegian salmon, Romania is located within a range of 21,369 km where the country is located within a range of 12,007 km with a total transportation cost of 4,246 EUR to all ten capitals (Viamichelin, 2018).

4.2.7 RUSSIA

Because of the size of the country, the aquaculture sector in Russia differs in each geographical area (Korolkova, 2018). However, the sector is in general characterized of having minimal influence on the environment and being rich in water- and ground areas (FAO, 2018). Freshwater aquaculture is the most dominant sub-sector in the Russian aquaculture industry (USDA Foreign Agricultural Service, 2017) and according to Worldfishing & Aquaculture (2018) the country is currently experiencing a boom in the aquaculture sector and have in the recent years implemented several initiatives for growth after banning all import of seafood from several countries (See Appendix G).

The most common farmed species in the Russian freshwater aquaculture sector is carp, salmon and sturgeon (USDA Foreign Agricultural Service, 2017). According to Worldfishing & Aquaculture (2018), salmon represent around 25% of all fish produced in Russia in 2017, where most farming of Atlantic salmon is practiced in the Murmansk area in the north-western part of the country.

Regarding farming methods, pond aquaculture is the most practiced one. However, several fish breeding farms have started to experiment with the RAS technology, but because of the high construction- and maintenance costs it is not so developed (FAO, 2018).

According to Mrs. Korolkova, the educational system within aquaculture in Russia is well developed up to the level of MSc. The number of institutions offering education on PhD level are rather low because of the lack of professors with doctor degree in fish farming. However, these professors are usually specialists in biology, hydrobiology, oceanology and environment protection (Korolkova, 2018). On bachelor level, 30 state universities spread over the whole country offers BSc in water bioresources and aquaculture where it is possible to specialize in several aquaculture related topics (See Appendix G). These programs also require short-term work in fish farming enterprises (Korolkova, 2018). Aquaculture studies on MSc level can be studied in a few universities, but not as many as on bachelor level (Korolkova, 2018).

According to FAO (2018), 22,000 people were working in the Russian aquaculture sector in 2004, where the quality differs in terms of where the farm is located (Korolkova, 2018). A common trend is that farms that are located in rural areas usually employs people without educational background in aquaculture, people who must receive training from scratch (Korolkova, 2018).

Since Russia is not a part of the European Union, it is neither a part of the Common Fishery Policy reform. Nevertheless, Russia aims to reach an annual production of 700,000 mt of seafood products before 2030 (Adamowski, 2013) and the country have created a long-term development strategy that will focus on five points to achieve that goal (See Appendix G). Because of the national importance of developing the aquaculture sector in Russia, the Russian government has done several things, among them improved the investment environment, reduced interest on loans from state-owned banks, distribution of subsidies etc. (See Appendix G).

Russia is a water rich country and is in possession of one fifth of the world`s fresh water reserves (Climate Change Post, 2018). However, the quality of the Russian groundwater is in general poor, with over 30% of all groundwater sources being polluted (Facts and Details, 2016). According to IOP (2018), polluted groundwater is one of the main concerns in the Russian water industry.

In terms of other more cost-related parameters of nearshoring land-based salmon farming, the corporate tax rate in Russia is relatively high compared to other emerging countries in Europe (See Appendix J). However, the average gross wages are one of the lowest, averaging around 489 EUR per month in 2016 (Federal State Statistics Service, 2017). In comparison, the average monthly gross wages in the fishing industry the same year was higher than the average for the whole economy, measured at 724 EUR in 2016 (Federal State Statistics Service, 2017; XE Currency Converter, 2018). The wages are also dependent on where the farms are located. As mentioned by Korolkova (2018), the wages in private enterprises in central regions are similar to the regional average wages while the wages in farming companies owned by the state are usually lower than the regional wages. However, these farms usually supply their workers with additional social benefits including accommodation (Korolkova, 2018).

According to Zimmer (2014), the average price for arable land in Russia in 2011 were around 1,000 USD per hectare, which equals around 879 EUR (XE Currency Converter, 2018). No

more recent information on purchase price or official information on rental prices of arable land in Russia were possible to obtain. By considering a low appreciation, Russia is the emerging country in Europe with the lowest price per hectare of arable land. The same can be said about electricity prices, where Global Petrol Prices (2018) estimated the average prices to be around 0,050 EUR in 2018, being the emerging country in Europe with second lowest prices per kWh for industrial users. However, this price is for non-industrial users, and can be different compared to the kWh price for industrial users.

In terms of the quality of the transportation infrastructure and logistics system, Russia is ranked as number 75 on the Logistics Performance Index (The World Bank, 2018). However, the country has created its own strategy plan for improving the transportation infrastructure and is planning to invest an enormous amount of money for development (See Appendix G). By taking into consideration their proximity to the ten largest importing countries of Norwegian salmon, Russia is located within a range of 23,132 km with a total transportation cost of 4,415 EUR to all ten capitals (Viamichelin, 2018).

4.2.8 TURKEY

Turkey has one of the fastest growing aquaculture sectors in the world (Worldfishing, 2013) with a growth of nearly 20% in production volume over the last ten years (FAO, 2018). According to FAO (2018), the aquaculture sector in Turkey has several strengths that will contribute to a growth in the future, but it is also facing some challenges that will be important to overcome (See Appendix H).
The most common farmed species in the Turkish aquaculture sector are rainbow-trout, sea bass and sea bream where intensive farming is the most common farming method (FAO, 2018). There are also one land-based farm with RAS techonology operative in Turkey (FAO, 2018).

The country is in possession of a high quality labor force with extensive know-how in the aquaculture sector (FAO, 2018; Akbulut, 2018). In addition to vocational training, education in aquaculture, fisheries and aquatic sciences at undergraduate and graduate level is offered by 17 faculties where most of the students enters the marine aquaculture sector when graduating (FAO, 2018). The country is also in possession of a high bulk of people working in the aquaculture sector with nearly 25,000 people employed in Turkish fish farms in 2013 (Worldfishing & Aquaculture, 2013).

Since Turkey is not a member of the European Union, the country has developed its own strategy for growing the aquaculture sector, where according to Worldfishing & Aquaculture (2013) Turkey aims to become EU`s largest producer of fishery products within 2023. Hence, the Turkish government has supported the aquaculture sector financially over the last years by allocating regional subsidies, in addition to banks offering credit loans with low interest rates (Giannetto, et al., 2014). However, the Turkish government is of the opinion that the sector is able to stand on its own feets now, and it is therefore more difficult to get financial support compared to earlier (Worldfishing & Aquaculture, 2012). Nevertheless, farms that are cultivating new species are more attractive to get support from the government (Worldfishing & Aquaculture, 2012).

Regarding the water quality in Turkey, groundwater sources have been heavily polluted over the last years because of increased urbanization, industrialization and application of fertilizers and pesticides in agricultural farming (Cekmak, 2005).

In terms of other more cost related parameters that are important to consider when nearshoring land-based salmon farming, Turkey`s corporate tax rate is almost the same as in Norway (See Appendix J) and will not contribute in any cost savings by nearshoring. However, according to the Turkish Statistical Institute (2016), the average monthly wage for agriculture workers was 1,677 Turkish Lira in 2016. Converted to euro that equals 286 EUR (XE Currency Converter, 2018) which is around 3,350 EUR less than the average monthly gross wages in the Norwegian aquaculture sector (See Appendix J). With regard to prices of arable land, Turkey is together with Greece the most expensive emerging country in Europe. According to Bojnec (2011), the prices of one hectare arable land in Turkey varies between 50,000 – 80,000 Turkish Lira, which equals between 8,500 – 13,600 EUR (XE Currency Converter, 2018). However, there are considerable regional differences in terms of quality, which also affects the price (Bojnec, 2011). In terms of rental prices of arable land, no statistics were possible to obtain. The same accounts for electricity prices for industrial users.

With regard to transportation infrastructure and logistics, the country is ranked as number 47 on the Logistics Performance Index (The World Bank, 2018) By taking into consideration their geographical proximity to the ten largest importing countries of Norwegian salmon, Turkey is located within a range of 30,431 km, being the country with the lowest geographical proximity of the countries that are analyzed. The total transportation cost is calculated to be

6,244 EUR to all ten capitals, by far the most of all emerging countries in Europe (Viamichelin, 2018).

4.2.9 UKRAINE

The Ukrainian aquaculture industry is characterized of being a small-scaled industry (Fao Reu, 2016) that is heavily regulated (Pedersen et al., 2017). The country is also highly dependent on import of seafood where it imports almost 80% of all seafood that is consumed in Ukraine (Fao Reu, 2016). One of the main reasons for the low amount of export of seafood from Ukraine is that the Ukrainian standards for inspection and fish safety are not harmonized with the ones of EU (Food Safety News, 2018).
The most common farmed species in the Ukrainian aquaculture sector are carp, rainbow-trout and sturgeon where semi-intensive farming in ponds are most practiced (FAO, 2018). Land-based farming with RAS technology has an insignificant share of aquaculture output in Ukraine (Pedersen et al., 2017) and according to Bekh (2018) there are no farming activities of salmon in the country.

The overall educational system within aquaculture in Ukraine is poor (See Appendix I) and is mostly directed towards small-scaled aquaculture production (Bekh, 2018). The proportion of students with aquacultural background entering the sector when graduating is relatively small (Fao Reu, 2016) and consequently this trend has also affected the quality of labor in the sector. Another characteristic of the labor force in the Ukrainian aquaculture industry is the high average age and that people often enters the sector randomly which in most cases leads to the need of receiving training (Bekh, 2018).

Since Ukraine is not a member of the European Union, it has created a strategy for agriculture and rural development which is due to 2020 (FAO, 2015). This strategy also includes developing the aquaculture sector, but the emphasis on aquaculture development is rather scarce (See Appendix I). There are neither any governmental programs supporting the sector financially (Fao Reu, 2016).

With regard to water sources, Ukraine is the country with the largest inner water surface in Europe (Pedersen et al., 2017). However, almost all groundwater sources in Ukraine is

contaminated and it often fails to meet regulatory requirements (Ministry of Ecology and Natural Resources of Ukraine, 2012).

In terms of other more cost related parameters that are important to consider when nearshoring land-based salmon farming, Ukraine has a relative high corporate tax rate compared to other emerging countries in Europe (See Appendix J). However, the country has the lowest average wages of the emerging countries in Europe with an average wage of 222 EUR (State Statistics Service of Ukraine, 2017). Nevertheless, it is difficult to estimate the exact average wage in the country since receiving salary in form of cash for avoidance of taxation is a widespread activity (Contact Ukraine, 2016).

According to Kyivpost (2018) Ukraine currently obtains a moratorium which permits Ukrainian people to sell land to investors, only allowing them to rent it out. The moratorium will last at least until January 1. 2019, and the prices will most likely increase to a place between 2,000 – 5,000 EUR per hectar when the moratorium is removed, depending on the condition of the land (Kyivpost, 2018). According to Ukraine`s former Agriculture Minister Oleksiy Pavlenko, the price of renting one hectare of land in Ukraine ranges from 400 USD to 1,300 USD depending on length of contract and quality of land (Kyivpost, 2018), while Pedersen et al. (2017) claims that the fee of land rates ranges from 70-120 USD/ha annually.

The average electricity prices in Ukraine is estimated to be around 0,040 EUR in 2018 (Global Petrol Prices, 2018), being the emerging country with the lowest price per kWh in Europe. However, this price is for non-industrial users, a price that can be different from the kWh price for industrial users.

The quality of transportation infrastructure and logistical systems are poor in Ukraine where the country is ranked as number 66 on the Logistics Performance Index (The World Bank, 2018). By taking into consideration their proximity to the ten largest importing countries of Norwegian salmon, Ukraine is located within a range of 19,111 km where the total transportation cost is calculated to be 3,867 EUR to all ten capitals (Viamichelin, 2018)

5. Analysis

As previously mentioned, the simple multi attribute rating technique SMART is used to evaluate the most optimal emerging country to nearshore land-based salmon farming.
The weights that is put together with each attribute are calculated differently in terms of their importance. The attributes that have been given the highest weight (0,15) are those who have been labelled the most important by the industry experts. The other attributes have been given a weight based on the authors subjective opinion about their importance. Regarding the values, the following scheme is showing the range of scores for each attribute, which ranges from 1-5. The remaining attributes (education and labor, industrial policies, groundwater quality and financial support) are given a score based on subjective opinions.

CIT (%)	**Wages (EUR)**	**Prices of land (EUR)**
9-12% = 5	0-199 = 5	0-2,800 = 5
13-16% = 4	200-399 = 4	2,900-5,700 = 4
17-20% = 3	400-599 = 3	5,800-8,600 = 3
21-24% = 2	600-799 = 2	8,700-11,500 = 2
25-28% = 1	800-999 = 1	11,600-14,400 = 1
Electricity prices (EUR)	**Transportation and Logistics (Index)**	**Geographical Proximity (Km)**
0-0,0250 = 5	< 1 = 1	10,000-15,000 = 5
0,0251-0,0501 = 4	< 2 = 2	15,100-20,100 = 4
0,0502-0,0752 = 3	< 3 = 3	20,200-25,200 = 3
0,0753-0,1003 = 2	< 4 = 4	25,300-30,300 = 2
0,1004-0,1254 = 1	< 5 = 5	30,400-35,400 = 1

Table 4: Overview of range of scores for attributes

In the analysis below, some of the values are marked in red, such as groundwater quality in Bulgaria and Poland and the prices of land in Ukraine. Because the information about these attributes are non-existent, the average value is used. The attribute "prices of land" is given a score based on the total of purchase price and rental price while the wages is calculated using th average wage of the national wage and the aquaculture wage.

SMART

Attributes/ Countries	**Education and Labor** Weight: 0,15	**Industrial Policies** Weight: 0,05	**Groundwater Quality** Weight: 0,15	**Financial Support** Weight: 0.05	**Corporate Taxes** Weight: 0,05
Bulgaria	2 (30)	2 (10)	2* (30)	2 (10)	5 (25)
Czech Republic	5 (75)	3 (15)	2 (30)	2 (10)	3 (15)
Greece	2 (30)	2 (10)	3 (45)	3 (15)	1 (5)
Hungary	3 (45)	2 (10)	5 (75)	2 (10)	5 (25)
Poland	4 (60)	3 (15)	2 * (30)	2 (10)	3 (15)
Romania	3 (45)	2 (10)	2 (30)	1 (5)	4 (20)
Russia	4 (60)	4 (25)	2 (30)	5 (25)	3 (15)
Turkey	4 (60)	4 (25)	2 (30)	3 (15)	2 (10)
Ukraine	1 (15)	1 (5)	1 (15)	1 (5)	3 (15)

Attributes/ Countries	**Wages** Weight: 0,10	**Prices of Land** Weight: 0,05	**Electricity Prices** Weight: 0,15	**Transportation Infrastructure** Weight: 0,10	**Geographical Proximity** Weight: 0,15	**TOTAL**
Bulgaria	**3 (30)**	**5 (25)**	**2 (30)**	**3 (30)**	**3 (45)**	**0,265**
Czech Republic	**1 (10)**	**4 (20)**	**2 (30)**	**4 (40)**	**5 (75)**	**0,320**
Greece	**2 (20)**	**1 (5)**	**1 (15)**	**3 (30)**	**2 (30)**	**0,265**
Hungary	**2 (20)**	**4 (20)**	**1 (15)**	**3 (30)**	**5 (75)**	**0,325**
Poland	**1 (10)**	**3 (15)**	**1 (15)**	**4 (40)**	**5 (75)**	**0,285**
Romania	**2 (20)**	**5 (25)**	**2 (30)**	**3 (30)**	**3 (45)**	**0,260**
Russia	**2 (20)**	**5 (25)**	**4 (60)**	**3 (30)**	**3 (45)**	**0,335**
Turkey	**3 (30)**	**2 (10)**	**2 (30)**	**3 (20)**	**1 (15)**	**0,245**
Ukraine	**4 (40)**	**4*(20)**	**4 (60)**	**3 (20)**	**4 (60)**	**0,255**

6. Conclusion

According to the findings and the SMART analysis, Russia is the most optimal emerging country in Europe for Norwegian salmon farmers to nearshore land-based salmon farming. The findings show that the development of the sector is of national importance where the country is currently laying down a great effort in strengthening the aquaculture sector after the import ban of seafood were initiated in 2014. In the SMART analysis, Russia is assigned a high-performance score on several attributes, scoring four or higher on five out of ten attributes.

6.1.1 Education and labor

According to Gievær (2018) and Bjørndal & Tusvik (2016), the right human competencies are one of the most important factors for succeeding with land-based salmon farming with RAS technology. With its 30 State Universities offering higher education within water bioresources and aquaculture, mandatory work in fish farming enterprises during the education and a large bulk of specialists within hydrobiology in the country, Russia was one of four countries who received a score higher than 4 in this field of area. Only the Czech Republic received a higher score by being in possession of the best scientific research center in Central Europe in terms of aquaculture and protection of waters, in addition to offering a higher number of courses that are related to fish farming and fish welfare than Russia.

6.1.2 Industrial Policies and Financial Support to the sector

Based on the interviews with the industry experts, only two countries emerge as genuinely interested in strengthening their domestic aquaculture sector. Turkey with its plan of becoming EU`s largest producer of fishery products in 2023 with aquaculture products contributing with 600,000 mt were together with Russia assigned the maximum score on "industrial policies". Russia also has great plans for their domestic aquaculture sector, aiming to reach an annual production of 700,000 mt of seafood products before 2030. In terms of supporting the sector financially, the research revealed that Russia has a budget of USD 1,21 billion for aquaculture development at disposal. Additionally, discounts on interest rate on soft loans to people involved in the sector, continuous distribution of subsidies for aquaculture development and refunds of up to 40% of investment costs related to new projects in the sector is making Russia to the only country in the SMART analysis receiving a higher score than four on this attribute. In contrast, countries such as Ukraine and Romania who have

governments where subsidies to the sector are non-existent receives a value of one on this attribute.

6.1.3 Groundwater Quality

During the period of data collection it became clear that most of the emerging countries in Europe are in possession of groundwater sources with poor quality. Russia were no exception, where one of the main problems in the Russian water industry are groundwater pollution. According to both Bjørndal & Tusvik (2016) and Gievær (2018), the importance of good quality raw water without bacteria are one of the most important factors for succeeding with land-based salmon farming. Hungary seems to be the only emerging country in Europe being in possession of groundwater with good quality, where almost 79% of all groundwater sources are free for chemicals. The country is also rich in geothermal sources which are positive for intensive aquaculture.

6.1.4 Corporate Taxes, Wages, Prices of land and Electricity Prices

There is no doubt that most of the cost-related attributes mentioned above offer more benefits in an emerging country compared to what they do in Norway. In total, by considering corporate taxes, wages, prices of land and electricity prices, Bulgaria and Ukraine are the two most low-cost countries with a total score of 15, without considering the weights. Russia and the Czech Republic comes three with a total score of 14, while Greece is the costliest country having the highest CIT, electricity prices and prices of land of all countries. In terms of electricity prices, the average price per kWh in Ukraine and Russia is almost half as much as the rest of the countries that are analyzed which can incur into large cost savings. Russia also has the lowest price for arable land with an average price around 880 EUR for one hectare. In comparison, Bulgaria who has the second lowest average price for a hectare of arable land is twice as expensive as Russia.

6.1.5 Transportation Infrastructure and Geographical Proximity

Atlantic salmon is valued by many as a high-quality product because of its freshness. For it to maintain its reputation, moving the fish from where it is packed to the customer requires efficient handling and distribution. By using the Logistics Performance Index of the World Bank, it was possible to assess the quality of the transportation- and logistics system of all the emerging countries. According to the index, all countries have an average value of three beside the Czech Republic and Poland who were assigned an average value of 4. EU countries will also benefit from the TEN-T Core Network, however, Russia will most likely experience

a lift itself where USD 969 billion is estimated to be used on development of transportation infrastructure. A developed transportation network will also increase the geographical proximity, where the potential of Atlantic salmon depends on selecting sites close to major markets (Summerfelt et al., 2012). The route-planner "Viamichelin" revealed that the emerging countries in Central Europe (Hungary, Poland and the Czech Republic) were closest to the ten largest markets of Norwegian salmon, both in terms of distance and costs of freight.

6.2 Limitations

The readers should be aware of some limitations in the thesis, especially in terms of the values of the attributes in the SMART analysis. The SMART model is based on subjective opinions, and the outcome might be different in terms of who's evaluating the attributes and their respective weights. For the sake of that, the results are based on the author`s evaluation and can be different to others doing the same analysis. Moreover, because of the difficulties in finding information about some of the attributes such as groundwater quality in Bulgaria and Poland and prices of land in Ukraine, an average sum was allocated to the attributes. The same were done for certain countries where wages in the aquaculture sector and prices related to purchase and rental of arable/aquaculture land were missing. Moreover, the route-planner does not consider time, toll and road taxes for a semi-trailer that is the most common vehicle for freight of salmon, but rather a normal car.

The attributes would also benefit from a more comprehensive analysis on some of the topics, e.g. the legal framework around purchase/rent of arable land and taxing system, in addition to more info on the distribution of labor costs in the aquaculture sector. However, by doing so, the page limit would have been exceeded.

6.3 Future Research

Future research should dig deeper into the groundwater quality in topical countries for land-based salmon farming and try to discover specific locations with access to clean and bacteria free water. The same accounts for labor costs and the legal framework around the taxing system and ownership/rent of arable land. Moreover, since the thesis have been focusing more on country specific variables that should be considered when considering to nearshore land-based salmon farming, it would be interesting to know more about what fish farming enterprises that would be interested in being a nearshoring partner.

6.4 Possible Entry Mode

If a Norwegian salmon farming company is considering to nearshore land-based salmon farming to Russia, a joint venture is recommended as a partnership model for foreign entry. Since land-based salmon farming with RAS technology is a relative new farming method, a high degree of involvement from the Norwegian part will be crucial, and in that case other foreign entry modes with lower involvement will impose higher risks.

A joint venture with a large salmon farmer in Russia would most likely be welcomed, due to the fact that the Russian government is putting a lot of effort in strengthening the sector to reach their production target of 700,000 mt of seafood by 2030. Another incentive for a JV is that a Norwegian salmon farming company can exploit the advantages of a highly educated labor force which can incur into less resources used for training. Even though cultural differences can occur, Norway has several years of experience in doing business with players in the Russian aquaculture sector. A Norwegian salmon farming company could also take advantage of the financial support that is available in sector which could make it more economically feasible compared to nearshoring to other countries. Nevertheless, it will be important to get familiar with the legal framework of ownership before considering a JV with a Russian company.

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8. Appendices

Appendix A

BULGARIA

Interview Dimitar Taskov – PhD student at the Institute of Aquaculture, Stirling University

Background: *Bachelor in sustainable aquaculture with focus on small aquaculture integration in Bangladesh. MSc in aquaculture and development with focus on the environmental aspects of aquaculture in Indonesia, Java and Sumatra.*

Main farmed species: Carps, rainbow-trout and mussels (FAO, 2018)
Main aquaculture systems: Semi-intensive and intensive (FAO, 2018)

As mentioned by Mr. Taskov, the aquaculture sector in Bulgaria is fragmented and small-scaled where production is affected by low consumption (five kg per capita) and low access to natural and human resources. These parameters, especially the fragmentation of the industry makes it difficult to grow because most farming companies are owned by families who not have enough money to invest or willing to take the risk of scaling production. Additionally, low access to water makes it challenging to establish open farm systems such as ponds, cages or raceway intensives.

The total output of freshwater and marine aquaculture products in Bulgaria were 3,300 mt in 2004 where the majority of the fish is farmed in semi-intensive production systems (ponds) and some through intensive systems for trout farming (FAO 2018). Bulgaria is also a country that relies more on import than export of seafood because of the limited range of domestic products. Total import of fish products was 37,700 mt in 2016 while total export reached 12,100 mt the same year. In 2011, only four Bulgarian companies were licensed to export fish to EU countries (European Parliament, 2011).

Mr. Taskov was of the opinion that there is only one operative salmon farm in Bulgaria (Coho Farm Ltd) where Coho salmon, a type of Pacific salmon is being farmed. The farm uses RAS technology from the United States where salt minerals are added to the fresh water to secure optimal production. The farm is also a relatively automated farm with only one employee that produces around 200 mt with salmon anually, and supplies the high-end market in Sofia**.** The total investment of the plant were 4 million USD where 1,42 million USD came from EU

financial support (U.S. Embassy Sofia, 2016). According to Mr. Taskov, 15% of the investment also came from the Bulgarian government and a recent interview made with the founding partner of Coho Farm Ltd revealed that they are now looking to expand their business outside Bulgaria (Salmon Business, 2018).

Education and labor in the Bulgarian Aquaculture Industry

According to the Human Development Indices and Indicators of the United Nations (2018) the average years of education in Bulgaria were 11,8 in 2017. In terms of education within aquaculture and fisheries, general training, Bachelors, Masters and PhD degrees are all offered in the seven major governmental aquaculture research institutes and universities in Bulgaria (FAO, 2018). However, as emphasized by Mr. Taskov, most people working in the sector do not necessarily obtain a degree in aquaculture, but rather within fish biology or engineering. Mr. Taskov was also of the opinion that most Bulgarian people do not know what aquaculture is, and that the interest for the sector is low. This makes it difficult to find skilled and motivated people, and in most cases training from scratch is necessary (Taskov, 2018). The low interest for the sector have also made it necessary to hire employees from abroad countries such as Serbia, where several people have gained experience from the Norwegian aquaculture sector (Taskov, 2018). According to the European Parliament (2011) only 5,000 people were employed in the Bulgarian aquaculture sector in 2011.

Industrial Policies in the Bulgarian Aquaculture Industry

According to Bulgarias Multiannual Strategic Plan for promotion of sustainable development of aquaculture, the country aims to increase the overall production volume of aquaculture species from 14,000 mt to 20,000 mt by 2020 and to increase the volume of freshwater fish farming by 34,5% in 2020 (European Commission, n.d.)

In order to do so the country have identified four best practices:

- **Governance**: To have regulations related to human health, environmental protection, food safety, animal welfare and traceability of food protection
- **Science and innovation**: To stimulate innovation and scientific research in aquaculture, to transfer innovation into aquacultural acitivity and to facilitate best available practices and knowledge transfer, including results and scientific projects from the rest of the EU
- **Innovative techniques**: Encouraging biotechnological, full cycle technology and resirculation fish farming for cultivating black mussels and sturgeon farms

- **Marketing:** To build mechanisms for market research, hereby using information regarding changes and trends at EU and national levels.

Financial support to the sector

According to Mr. Taskov, the Bulgarian government usually does not support the aquaculture sector financially, but rather in terms of licenseeing and policy. According to FAO (2018), the Bulgarian government terminated their subsidies to aquaculture and fishery enterprises in the beginning of the 1990s. However, new companies that want to invest in sustainable aquaculture can now apply for 16,6 million Levs (8,5 million euro) from the EU Fisheries Program to build up their business (Ministerie van Landbouw, Natuur en Voedselkwaliteit, 2018).

Groundwater quality

Bulgaria is a water deficient country with only 36,000 hectares of inland water surface that covers 0,32 % of the country`s total area (FAO n.d.). Compared to Central European levels, the country has two times less water resources where most of the water resources aggregates from the internal rivers in the country (Paskalev, n.d.). In terms of groundwater, it was not possible to obtain any recent statistical information. However, according to Galabov & Lichev (2004), groundwater represents around 30,6% of all water resources in Bulgaria and with regard to water quality, Bulgaria has a long history with poor quality drinking water, where 18 of the 28 districts reported contaminated drinking water in 2012 (Axtman, 2017). However, the situation has improved over the last years due to several installments of wastewater treatment plants (European Environment Agency, 2015) and decline in industrial- agriculture production (European Environment Agency, 2016).

Transportation Infrastructure

According to The World Bank (2018), Bulgaria is ranked as number 52 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,03 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	2,94
Infrastructure (2)	2,76
International shipments (3)	3,23
Logistics competence (4)	2,88
Tracking and tracing (5)	3,02
Timeliness (6)	3,31

LPI Global Rankings 2018 (The World Bank, 2018)

(1) = Efficiency of the clearance process (i.e. speed, simplicity and predictability of formalities) by border control agencies, including customs

(2) = Quality of trade and transport related infrastructure (e.g. ports, railroads, roads, information technology)

(3) = Ease of arranging competetively priced shipments

(4) = Competence and quality of logistics services (e.g. transport operators, customs brokers)

(5) = Ability to track and trace consignments

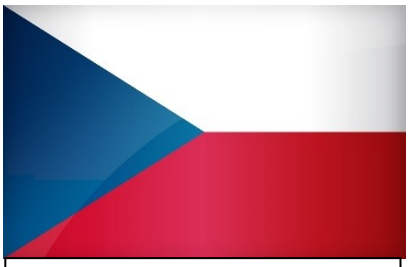
(6) = Timeliness of shipments in reaching destination within the scheduled or expected delivery time

Appendix B

CZECH REPUBLIC

Interview Otomar Linhart – Director of CENAKVA, Faculty of Fisheries and Protection of Water, University of South Bohemia

Background: *MSc with specialization in fishery, Doctor of philosophy with specialization in animal breeding, Doctor of science with specialization in animal breeding*



Main farmed species: Carp, trout, pike, amur and trench (Adamek et al. 2012)
Main aquaculture systems: Semi-intensive and intensive (Adamek et al, 2012)

According to Mr. Linhart, the aquaculture sector in the Czech Republic is a small sector, where the main challenges are related to lack of water, bureaucracy and low fish consumption per capita (5,5 kg). There are around 406 businesses registered in the aquaculture industry in the Czech Republic, most of them small and medium enterprises. A common trend for these enterprises and the sector in general is that aquaculture is usually not the main activity, but an activity alongside with other activities (European Commission, n.d.).

The total output of aquaculture products is around 20,000 mt annually (European Commission, n.d.), most of it coming from semi-intensive and extensive fish farming systems where pond farming represents around 95% percent of total aquaculture production. The aquaculture sector in the Czech Republic is also suffering from imports of cheaper products, both from other European countries and South East Asia. Nevertheless, the country is the largest exporter of carp in Europe where Germany, Poland and Slovakia are the largest markets (Adamek et al. 2012). The quality of carp is also known to be high, and is often trademarked or carries geographical indications or certificates of origin (European Commission, n.d.).

According to Adamek et al (2012) RAS is a relative new technology in the aquaculture industry in the Czech Republic, and it is therefore only four large fish farms using the technology when farming fish, mainly for species such as catfish, eel, rainbow-trout, pikeperch and ornamental fish.

Education and labor in the Czech Republic Aquaculture Industry

As mentioned by Mr. Linhart, the country offers vocational training, secondary- and higher education in addition to research within aquaculture. The vocational training offers training in

basic fish farming and fish handling skills while secondary education is focused on studies related to water management practices, hydro-ecological issues, pond management, intensive aquaculture technologies and fish breeding (FAO 2018). Graduates are usually employed in fish farming enterprises or within authorities that are focusing on water protection and environmental conservation (Adamek et al. 2012). Higher education at university level is offered at two universities where one of the universities is known for being the most complete educational institute for aquaculture in Central Europe offering bachelor, master and postgraduate studies in protection of waters, aquaculture and fisheries. The faculty also has experimental competencies within hydrobiology, aquaculture and fish diseases. Some doctoral- and master courses are offered in English, while bachelor studies are offered in Czech. The university is also known for attracting foreign students and has been investing in R&D centers to become the best scientific research center in Central Europe in terms of aquaculture and protection of waters.

In terms of labor in the Czech Republic aquaculture sector, there are currently 1,520 full time workers (European Commission, n.d.) where the majority have an educational background at university and/or college level in addition to vocational training (FAO, 2018). According to Mr. Linhart, the general quality of the people working in the sector is high.

Industrial Policies in the Czech Republic Aquaculture Industry

As a part of the Common Fishery Policy reform (CFP) in EU, the Czech Republic`s Multiannual Strategic Plan for promotion of sustainable development of aquaculture addresses the following growth objectives from 2014-2020 (European Commission, n.d.):

- Remain production volume at around 20,000 mt and production value at around 42,5 million euro
- Increase production in resirculation systems with 300%
- Increase processing with 30%

In order to do so the country have identified two best practices:

- Practicing intensive farming of trout in recirculation systems
- Increased omega 3 content in carps

The country will also work to digitalize administrative procedures and creating a “farmers portal”. Moreover, it will enhance competetiveness by investing in recirculation systems,

developing innovative technologies and products, and to further develop czech national and regional labels (European Commission, n.d.).

Financial support to the sector

There are three types of subsidies in the aquaculture/fishery sector in the Czech Republic, namely structural subsidies through the SAPARD programme, government subsidies and subsidies through the operational programme "Rural Development and Multifunctional Agriculture" OECD (n.d.). However, the amount and value of subsidies in the sector are in general low, where most of if comes from funds from the European Union (OECD, n.d.)

Groundwater quality

According to the Ministry of Agriculture of the Czech Republic (2016), the drought has become more severe in the country which has resulted in a siginificant deficit of groundwater sources over the last years. The quality of the groundwater from shallow aquifers is also poor because of high values of nitrate, sulphate and ammonia (Czech Committee of the International Commission on Irrigation and Drainage, n.d.). In 2016 a total of 675 groundwater sources were monitored where 86,8% exceeded the limit values for groundwater (Ministry of Agriculture of the Czech Republic, 2016).

Transportation Infrastructure

According to The World Bank (2018), the Czech Republic is ranked as number 22 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,68 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	3,29
Infrastructure (2)	3,46
International shipments (3)	3,75
Logistics competence (4)	3,72
Tracking and tracing (5)	3,70
Timeliness (6)	4,13

Appendix C

GREECE

Main farmed species: Sea bass, sea bram and mussels (European Commission, n.d.)
Main aquaculture systems:
- Marine aquaculture: cages
- Mussel aquaculture: hanging parks
- Freshwater aquaculture: raceways (FAO, 2018)

Greece has been a leading producer of fish with an annual production of around 110,000 mt since the economic crisis in 2008 (FAO, 2018). In total there were registered around 1,050 aquaculture enterprises businesses in 2012 where the total production reached a volume of 114,000 mt with a value of 545 million EUR the same year (European Commission, n.d.). The aquaculture industry in Greece is also divided into different sub-sectors, namely marine aquaculture, freshwater aquaculture and mussel's aquaculture where the marine aquaculture is the largest and most important one in terms of value and production volume. In terms of freshwater aquaculture, it is a fragmented sub-sector that consists of small family enterprises that are farming trout in tanks and small amounts of carp (FAO, 2018). In 2012-2013 there were 72 farms focusing on freshwater aquaculture in the Greek mainland (FAO, 2018) mainly in areas where rivers are available. Freshwater aquaculture does also have a low potential of growth because of lack of natural freshwater sources (FAO, 2018). Another barrier for growth is the high costs and time-consuming process of acquiring licenses for aquaculture farming. According to FAO (2018) it takes up to 25 months to acquire a license for aquaculture farming and the costs are up to 25,000 EUR. Moreover, only 25% of the applications are approved.

The main farming systems used in the Greek aquaculture sector are cages, hanging parks and raceways (FAO, 2018). In terms of land-based farming in Greece, five sites for spirulina farming with an annuall production of 12 mt is currently registrated (FAO, 2018). In terms of international trade, Greece is mainly an export-oriented country (Huffingtonpost, 2015) where only one quarter of the fish that is consumed in the domestic market is being imported (FAO, 2018).

Education and labor in the Greek Aquaculture Industry

There are several universities offering education within aquaculture, marine and veterinary sciences, mainly at MSc and PhD level (FAO, 2018). The employment in the aquaculture

sector has been increasing with 4,5% since 1997 and provides close to 10,000 direct jobs in regular or seasonal employment (European Commission, n.d.) where 7% is employed in the freshwater aquaculture sector (FAO, 2018). However, people working in the fishery sector is characterized of being old and lacks training (European Commission, n.d.) and the education level among the employees in the industry is poor and is seen by many as a non-specialized industry (FAO, 2018).

Industrial Policies in the Greek Aquaculture Industry

According to FAO (2018) no radical changes are expected in the Greek freshwater aquaculture sector in the nearest future. However, as a part of the Common Fishery Policy reform (CFP) in EU, Greece have also created their Multiannual Strategy Plan for sustainable development of their domestic aquaculture industry. The objective for growth in the period 2012-2020 is to increase production volume from 114,000 mt in 2012 to 170,000 mt in 2020 (European Commission, n.d.)

In order to do so the country has identified three best practices:

- Implementing a national framework for sustainable aquaculture and spatial planning
- Focus on protection of sensitive areas and environmental licensing
- Standardizing the calculation for estimating the carrying capacity of marine aquaculture production sites.

Financial support to the sector

Grants in form of capital aid for productive investments in the aquaculture sector are available from the state, where the level of granting varies according to the location and the nature of the investment (FAO, n.d.). All investments in the aquaculture sector are likely to get the highest level of granting because of the difficulties and low interest in developing the sector, usually a 20-50% grant depending on the investors own participation (FAO, n.d.). The Agriculture Bank also provides the aquaculture sector with a interest rate of 18,5% which is four percent lower than what the Central Bank of Greece is offering other sectors (FAO, n.d.). However, the bank only considers applications for loans after grants from the state have been approved or not.

The grant funding system for aquaculture projects is a relative new system in Greece and it has been difficult to implement due to administrative complexity which have culminated into discouragement among investors. As a result, the investment grants are underutilised (FAO, n.d.).

Groundwater quality

In Greece there are around 300,000 wells and boreholes where groundwater can be extracted from underground layers of aquifers, most of them in coastal areas where the intrusion of seawater is high (European Academies Science Advisory Council, n.d.). The quality of the groundwater is generally good, however it is threatened by uncontrolled disposal of wastewater, nitrate pollution and seawater intrusion in coastal aquifers (European Academies Science Advisory Council, n.d.)

Transportation Infrastructure

According to The World Bank (2018), Greece is ranked as number 42 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,20 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	2,84
Infrastructure (2)	3,17
International shipments (3)	3,30
Logistics competence (4)	3,06
Tracking and tracing (5)	3,18
Timeliness (6)	3,66

Appendix D

HUNGARY

Interview Peter Lengyel – Head of the Aquaculture Development Unit at the Ministry of Agriculture and deputized Head of the Department of Fisheries Management

Background: *Degree as biologist/ecologist from the University of Debrecen where he conducted his thesis on fish nutrition at the University of Parma*

Main farmed species: Carp, catfish, sturgeon and trout (Lengyel, 2018)
Main aquaculture systems: Semi-intensive and intensive (FAO 2018)

According to Mr. Lengyel, aquaculture in Hungary has great traditions, but also great challenges in terms of low consumer demand, low level of processing, high price sensitivity among consumers, low level of cooperation within the sector and damage from fish-eating birds in pond farms. The industry is also characterized of being fragmented where most of the farms are small and medium enterprises (European Commission, n.d.). The total output from both aquaculture and capture fisheries were at 18,324 mt in 2002, where 11,574 mt came from aquaculture (FAO, 2018). As mentioned by Mr. Lengyel, the dominant subsector of aquaculture is semi-intensive fish farming in ponds, but intensive aquaculture has been coming up recently. While the general willingness to innovate is low among farmers, there are several innovative farmers experimenting with new species and new technological solutions for farming (Lengyel, 2018) where recirculation and flow through systems are becoming more popular in the Hungarian aquaculture industry (European Commission, n.d.). In terms of salmon farming, Mr. Lengyel was not aware of any related activities in Hungary.

Education and labor in the Hungarian Aquaculture Industry

In 2017 the average years of education in Hungary were 11,9 (United Nations, 2018). According to FAO (2018) Hungarian aquaculture and fisheries research have long traditions and have gained an international reputation. The country`s core research program is supervised by the Ministry of Agriculture and Regional Development which also provide financial support in forms of projects, salaries, direct operational costs etc through fonds. As described by Mr. Lengyel, several agricultural universities offers postgraduate courses in fisheries and aquaculture, courses that usually last for three years and are open for people with an agricultural degree. However, aquaculture courses are usually a part of different

agricultural curriculums, while fish biology is generally a part of hydrobiology education (Lengyel, 2018)

Even though the number of specialists with an university degree in agricultural are high, one of the main challenges in the Hungarian aquaculture sector is the very low number of people with vocational training in the industry. There is a vocational school in Hungary offering fisheries and aquaculture courses, but the interest towards attending this is very low (Lengyel, 2018). This also affect the labor market in a sector that lacks a skilled workforce. The interest towards working on fish farms is also low because it is considered to be hard and underpaid and many farms works with low profit margins which makes it difficult to offer higher wages (Lengyel, 2018).

Industrial Policies in the Hungarian Aquaculture Industry

As a part of the Common Fishery Policy reform (CFP) in EU, Hungary`s Multiannual Strategic Plan for promoting a sustainable development of aquaculture is stating that the country aims to increase the production volume of aquaculture products from 21,500 mt in 2014 to 27,000 mt in 2023 (European Commission, n.d.).

In order to do so the country have identified five best practices:

- No increase in environmental pressure from aquaculture while achieving production growth
- Improved quality of water in intensive systems
- Modernisation of infrastructure and equipment to improve efficiency and product quality, including transporting trucks, pumps, fish loaders and harvesting gears
- Establishing intensive fish production. Examples are high-technology market-size fish rearing and postrearing tanks with oxygen supply that are automated, climate control, lightning and power supply back-up
- Providing water supply in an sufficient and continous manner to increase efficiency and profitability of farming activites

Financial support to the sector

According to Lengyel (2018), the aquaculture sector in Hungary is mostly financed through the European Maritime and Fisheries Fund which rules strongly and limits the provision of other state funding. However, the Ministry of Agriculture and Regional Development provides funds to support the lead research institute in aquaculture in forms of projects,

salaries and operational costs while other ministries are financing projects related to aquaculture through R&D funds (FAO 2018). As mentioned by Mr. Lengyel, fish farmers also receive a de minimis support for participating in the "Quality Carp Breeding Programme" (i.e. using approved breeds and landraces for propagation).

Groundwater quality

Since the country is landlocked, Hungary does not have access to saltwater. However, it is rich in freshwater resources, both in terms of groundwater sources and surface waters where the total number of groundwater wells are around 70,000 (MTA, 2017). The country is also rich in geothermal resources (European Commission, n.d.) that increases the possibilities for development of intensive aquaculture (FAO, 2018). According to Budapest Water Summit (2016) there are around 1,400 thermal water wells in the country and in terms of the quality of the groundwaters in Hungary, a report by Unece (n.d.) revealed that 79,5% of all groundwater sources in Hungary is classified as of "good status" in terms of chemical values.

Transportation Infrastructure

According to The World Bank (2018), Hungary is ranked as number 31 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,42 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	3,35
Infrastructure (2)	3,27
International shipments (3)	3,22
Logistics competence (4)	3,21
Tracking and tracing (5)	3,67
Timeliness (6)	3,79

Appendix E

POLAND

Main farmed species: Carp and trout (European Commission, n.d.)
Main aquaculture systems: Extensive and intensive (Buczkowska, 2017)

The aquaculture sector in Poland is most known for the high quality of the people working in the industry (FAO, 2018).
The most common farmed species in Poland are carp and trout (European Commission, n.d.) where carp represented about 50% of the total production in 2014 (Towers, 2015). Even though most farming of aquaculture species is based on extensive and intensive methods (Buczkowska, 2017), new techniques such as RAS are becoming more popular (European Commission, n.d.) with several investors launching new businesses in indoor RAS technology (Towers, 2015). One of them are the salmon farming company Jurassic Salmon who is the first land-based salmon company of Atlantic Salmon using 150 million years old thermal water (Jurassic Salmon, 2018).
Salmon is also a popular fish among the Polish consumers, where Poland is one of the worlds' largest importers of salmon (Eurofish, n.d.).
In terms of international trade, Poland exported 462,460 mt of fisheries and aquaculture products in 2016 where European countries such as Germany, France, United Kingdom and Denmark were the main markets (Eurofish, n.d.). Poland is also known for having a strong processing industry (European Commission, n.d.) were salmon usually are imported and re-exported after being processed (Eurofish, n.d.).

Education and labor in the Polish Aquaculture Industry

According to FAO (2018), the Polish aquaculture sector is known for being operated by professional trained people, having an educational system that is highly developed. Education is offered at vocational schools, technical schools for secondary education and Master of Science or Engineering degrees through higher education (FAO, 2018). Doctoral programs are also offered at the universities (FAO, 2018).

The leading research and development facility within fisheries in Poland are the Stanislaw Sakowicz Inland Fisheries Institute (IFI), an institute that are involved in research and development projects, in addition to advising on design of pond facilities, rearing programs, solutions for hatchery and farm facilities, treatment of post-production waters and diagnosis of fish diseases (FAO, 2018).

According to the European Commission (n.d.) 4,400 full-time workers were employed in the Polish aquaculture sector in 2013, where trout producers are the most educated group with over 70% completed higher education (FAO, 2018).

Industrial Policies in the Polish Aquaculture Industry

Through their Multiannual Strategic Plan, Poland aims to produce 61,000 mt of seafood in 2020 (53% increase from 2014) and reaching over 100% growth in intensive production by 2020. According to the plan, the growth objectives for marine fish farming and mollusk farming will be initiated by 2020 (European Commission, n.d.). Poland has not identified any best practices on how to reach their objectives.

Financial support to the sector

According to FAO (2018) the financial support to the sector is modest, and in most cases a private entrepreneur cannot afford the costs that comes with development and research. However, the Stanislaw Sakowicz Inland Fisheries Institute (IFI) receives funding from the state for research and development projects (FAO, 2018).

Transportation Infrastructure

According to The World Bank (2018), Poland is ranked as number 28 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,54 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	3,25
Infrastructure (2)	3,21
International shipments (3)	3,68
Logistics competence (4)	3,58
Tracking and tracing (5)	3,51
Timeliness (6)	3,95

Appendix F

ROMANIA

Main farmed species: Carp, goldfish and trout (FAO, 2018)
Main aquaculture systems: Extensive and semi-extensive (FAO 2018)

According to FAO (2018), the fisheries sector in Romania is divided into inland fishing, aquaculture, processing and marine aquaculture, where the largest subsector is aquaculture. The sector is known for being fragmented and dependent on imports, with local fish producers only covering 20% of the domestic consumption. The 857 fish farming companies that were registered in 2008 are also affected by having old fishing facilities, which are a barrier for growth in the sector (FAO, 2018).

The most ommon farming systems in the Romanian aquaculture sector are extensive or semi-extensive systems where farming of carp in ponds is most popular. Cages in lakes are also used when farming sturgeuon, while the development of RAS technology have started to shine for turbot farming with help from European funding (FAO, 2018).

Education and labor in the Romanian Aquaculture Industry

According to FAO (2018) the most important provider of higher education and training in aquaculture and fisheries in Romania is the "Dunarea de Jos" University. Additionally, five agricultural universities offer training in fish breeding as a part of their curricula (FAO, 2018). Training in aquaculture at undergraduate level is offered by the National Agency for Agriculture Consultancy while a few training centers in the country are authorized to offer training courses for workers in fish culture (FAO, 2018). In terms of education at high school level, several schools are offering vocational training within fish farming (FAO, 2018). According to FAO (2018), around 2,800 were working in the sector in 2005, 90% of them men where 15% were in possession of higher education, while 41% obtained high school education.

Industrial Policies in the Romanian Aquaculture Industry

As a part of the Common Fishery Policy reform, Romania aims to increase the production volume of aquaculture products with 255% from 2013 to 2020 (European Commission, n.d.). In order to do so, they have identified four best practices:

- **Social responsibility:** labour relations and safety, interaction with the local community, property rights and respect for legality

- **Environmental protection responsibility:** Management of waste and wastewater, protection of nature, biodiversity and ecosystems, sustainable and efficient use of nutrients and control of escapes
- **Animal health and welfare responsibility:** Welfare and health of animals
- **Food safety responsibility:** safety of food, harvesting, transport of fish and conditioning.

Financial support to the sector

Fish farming have still not been subsidized in Romania where grants in forms of financial support only have been provided of preservation and improvement of fish genetic heritage (FAO, 2018).

Groundwater quality

According to the Ministry of Environment and Sustainable Development (n.d.) Romania is a country poor in water resources. Only 3.7% of the surface is water where 10% of all water resources in Romania is groundwater (International Commission for the Protection of the Danube River, n.d.). Many groundwater sources in Romania also contains nitrates, leaving 35% of the Romanian population without access to public clean water Palzkill (2017). That is why most of the drinking water in Romania is extracted from surface waters (Vartolomei & Andre, 2010).

Transportation Infrastructure

According to The World Bank (2018), Romania is ranked as number 48 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,12 on a range from 1 (low) to 5 (high).

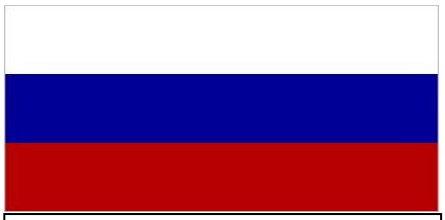
Indicators	Value
Customs (1)	2,58
Infrastructure (2)	2,91
International shipments (3)	3,18
Logistics competence (4)	3,07
Tracking and tracing (5)	3,26
Timeliness (6)	3,68

Appendix G

RUSSIA

Interview Svetlana V. Korolkova – Doctor of Science and the Head of Chair of Water Bioresource, Aquaculture and Hydrochemistry in the Russian State Hydrometeorological University.

Background: *Doctor of Science*



Main farmed species: Carp, salmon and sturgeon (USDA Foreign Agricultural Service, 2017)
Main aquaculture systems: Semi-intensive and intensive (FAO, 2018)

As mentioned by Mrs. Korolkova, the aquaculture sector in Russia differs in each geographical area. However, the Russian aquaculture sector is in general being characterized as having minimal influence on the environment and rich in water and ground areas (FAO, 2018). According to USDA Foreign Agricultural Service (2017) marine aquaculture accounts for 15% of total output while freshwater aquaculture accounts for 85% where the main type of aquaculture farming is pond aquaculture. Nevertheless, the sector is currently seeing a trend of shifting to more semi-intensive methods (FAO, 2018). There are several fish breeding farms using RAS technology as well, but because of high costs due to construction and maintenance it is not so developed (FAO, 2018).

In terms of output of aquaculture products, Russia has experienced an increase from 105,000 mt in 2007 to 219,000 mt in 2017 (Worldfishing & Aquaculture, 2018) where the Russian ban on imports of seafood in 2014 from EU, Norway, Australia, Canada and the United States have created a boom in the domestic production of aquaculture products. The development of fish farming is of national importance and in 2014 a federal law on aquaculture was signed in order to accelerate the industry (Worldfishing & Aquaculture, 2018). In the time after, locations for growing fish were prepared and sold on auctions by The Federal Agency for Fisheries. According to the deputy head of the agency, Mr. Vasily Sokolov, the number of aquaculture sites ready-to-use have grown from 1,900 to 4,500 since 2015 (Stupachenko, 2018) where the majority have a production capacity below 100 mt annually (Worldfishing & Aquaculture, 2018).

In terms of Russian export of aquaculture products, trout eggs and sturgeon are the only products that are exported (FAO, 2018). With regard to salmon farming, the species accounted for 25% of all fish produced in Russia in 2017 where most farming of Atlantic

salmon is practiced in the Murmansk region in the north-western part of Russia (Worldfishing & Aquaculture, 2018).

Education and labor in the Russian Aquaculture Industry

The average years of education in Russia were 12 years in 2017 (United Nations, 2018). In 2003, 15,5% of those working in the aquaculture sector had primary vocational training, 24,8% secondary vocational training, 30,5% completed secondary education and 12,23% had higher professional education (FAO, 2018). In terms of research within aquaculture, most is conducted through industry approved sectoral programs that are offered by twelve organizations of the Russian Academy of Agricultural Sciences and the Ministry of agriculture in addition to six institutes of higher education (FAO, 2018). In terms of higher education, about 30 State Universities distributed over the whole country offers BSc in water bioresources and aquaculture, a program that obtains a Federal State Educational Standard (Korolkova, 2018). This standard includes four years of training before graduation and requires short term mandatory work in fish farming enterprises during the training program (Korolkova, 2018). When you graduate you will be specialized in fish farming, ichtiopathalogy, hydrobiology or water bioresources protection (Korolkova, 2018). In terms of MSc programs, Mrs. Korolokova explained that only a few universities offer education within aquaculture, whereas a few institutions offer PhD education for people with a MSc degree. The reason for the low number of institutions offering education on PhD level is according to Mrs. Korolkova the lack of professors with doctor degree in fish farming, where the majority of the professors are specialists in general biology, hydrobiology, oceanology or environment protection having low experience with fish farming.

According to FAO (2018) there were 22,000 people working in the Russian aquaculture sector in 2004, most of them women. As mentioned by Korolkova (2018) the quality of labor differs depending on where the farms are located. The need of specialists with education are very high, especially in rural areas. However, farms located in those areas mainly employs people without educational background in aquaculture, people who must receive training (Korolkova, 2018).

Industrial Policies in the Russian Aquaculture Industry

Since Russia is not part of the European Union, it is neither a part of the Common Fishery Policy reform (CFP). Nevertheless, according to Adamowski (2013) the Russian government has announced that they aim to reach an annual production of 700,000 mt of seafood products before 2030. Russia has also created a long-term development strategy for its fishing industry,

a strategy that will be supported by a federal budget of $1,21 billion over seven years (Mereghetti, 2017). The strategy includes the following five points:

- Aquaculture development
- Biotechnology progress
- Expansion in Antarctic waters
- Fleet renewal
- Development of aquatic biological resources

Financial support to the sector

According to Worldfishing and Aquaculture (2018) the Russian government has worked in several years to improve the investment environment in the sector. The government has also given fish farmers access to soft loans by reducing the interest rate on loans from state-owned banks, occasionally from the usual 18% to 5% (Worldfishing and Aquaculture, 2018). Additionally, the Russian government distributes subsidies to the regions for aquaculture development and refunds up to 40% of investment costs related to new projects and up to 20% for feed costs. For this matter, over the last three years an average of $18 million has been available from the federal budget (Worldfishing and Aquaculture, 2018). However, the need for additional support from the government is necessary in order maintain sustainable growth in the aquaculture sector.

Groundwater quality

According to Climate Change Post (2018) Russia is in possession of one fifth of the world`s fresh water reserves. Regarding water surfaces applicable for aquaculture purposes, over one million hectares of water resources are available (Stupachenko, 2018). However, only a small part is currently utilized (USDA Foreign Agricultural Service, 2017). In terms of groundwater, 30% of all groundwater sources available for use in Russia are polluted (Facts and Details, 2016).

According to IOP (2018) one of the most important problems in the Russian water industry is “unsatisfactory condition of utility and driking water supply systems, low quality of water supplied to the population because of surface water and groundwater pollution”.

Transportation Infrastructure

According to The World Bank (2018) Russia is ranked as number 75 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 2,76 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	2,42
Infrastructure (2)	2,78
International shipments (3)	2,64
Logistics competence (4)	2,75
Tracking and tracing (5)	2,65
Timeliness (6)	3,31

Since Russia is not part of the European Union, it is neither participating in the TEN-T programme. However, according to The Russian Government (2014) Russia has elaborated its own strategy plan for improving transportation infrastructure (Transport Strategy of the Russian Federation until 2030). One of the key goals are integration into the global transport system and to provide high quality and affordable transport logistics services for freight. It is estimated that the country will invest over $969 billion on transportation infrastructure in the next few years, most of if into railways and roads (ITE Transport & Logistics, 2017).

Appendix H

TURKEY

Interview Bilal Akbulut and Recayi Cimagil – Researcher at the Central Fisheries Research Institute, Trabzon

Background: *Bachelor, Master and PhD in Fisheries Technology Engineering, Karadeniz Technical University*

Interview Recayi Cimagil – Researcher at the Central Fisheries Research Institute,Trabzon

Background: *Bachelor, Master and PhD in Aquaculture Engineering*

Main farmed species: Rainbow - trout, sea bass and sea bream (FAO, 2018)
Main aquaculture systems: Intensive (FAO, 2018)

The Aquaculture sector in Turkey is growing and developing (Akbulut, 2018) and is the world`s third fastest growing aquaculture sector (Worldfishing, 2013) with a growth of nearly 20% in production volume over the last ten years (FAO, 2018). The development of the sector is expected to continue in the future, where the major strengths lays within cheap labor, high fish demand and public support (FAO, 2018). However, the sector is also facing some challenges in terms of low product diversification, low access to water and increased focus on environmental- and animal welfare (FAO, 2018). Mr. Cimagil also added high feed costs, bad water quality and lack of RAS systems as the main challenges in the sector.

In terms of production volume, aquaculture contributes with 13,5% of the total production of fish in Turkey and represents around 25% in value (FAO, 2018). Most of the farms are owned by families, and in total it exists around 1,500 inland aquaculture farms in the country (FAO, 2018). Most of the aquaculture production (98%) comes from intensive farming, and currently there are one high-tech land-based farm with RAS technology operative in the country (FAO, 2018). According to Worldfishing & Aquaculture (2017), inland aquaculture production had a total output of 78,000 mt in 2010, where trout accounted for about 98% of it. There are also several land-based trout farms in Turkey, where some of them are using RAS technology with freshwater (Cimagil, 2018). In terms of salmon farming, Turkey experimented with farming of Atlantic salmon in the Black Sea during the 1990s, but the initiative failed (FAO, 2018). However, Turkey are still in possession of several salmon farms in the Black Sea. but these

farms are used for faming of rainbow trout (Cimagil, 2018), a species that is related to the salmon.

Education and labor in the Turkish Aquaculture Industry

According to FAO (2018), Turkey is in possession of a high-quality labor force with extensive know-how in the aquaculture sector. There are currently 17 faculties within fisheries and five departments in the agriculture faculties offering education in aquaculture, fisheries and aquatic sciences on undergraduate and graduate level (FAO, 2018). The number of students graduating from these faculties are around 300 annually where most of them enter the marine aquaculture sector (FAO, 2018). In terms of research institutes, there are currently four institutes associated with the Ministry in Turkey that are mainly focusing on aquaculture, fishery and other aquatic research. Additionally, there are several programs within fishery offered as vocational training, based both in coastal areas and inland (FAO, 2018).

According to Worldfishing & Aquaculture (2013), there were around 25,000 workers employed in Turkish fish farms in 2013. The labor quality is high (FAO, 2018; Akbulut, 2018), however, the interest among young people entering the aquaculture sector is rather low (Akbulut, 2018; Cimagil, 2018).

Industrial Policies in the Turkish Aquaculture Industry

Since Turkey only is a candidate for EU membership, the country has developed its own strategy for growth in the fishery and aquaculture sector. According to Worldfishing & Aquaculture (2013), the Turkish Government is aiming for Turkey to become the largest producer of fishery products in EU within 2023 with a total production of one million mt annually where the aquaculture will contribute with around 600,000 mt annually. In terms of export, the total annual value is expected to reach $1 billion in 2023 (Worldfishing & Aquaculture, 2013).

Financial support to the sector

In 2005, the Turkish Government started to support the aquaculture sector financially by allocating regional subsidies to the Turkish regions in addition to credits with low interest rates (Giannetto, et al, 2014). Moreover, the government has been preparing allocation plans and sites along the Aegean and Mediterranean coasts in order to increase production, develop production that is environmentally friendly, avoiding production of unlicensed or unregistered products and promoting domestic consumption (Giannetto, et al, 2014). However, according

to the Deputy Director General for Fisheries and Aquaculture at MoFAL (World Fishing & Aquaculture, 2012), it is currently more difficult to get subsidies from the Turkish Government, because it is now of the opinion that the sector is currently strong enough to stand on its own feet's. However, there are still credit available for establishment of new farms, and as mentioned by Cimagil (2018), grants are usually awarded based on the amount of fish that is produced. The government is also more open to support farms that are producing fries and cultivating new species (Worldfishing & Aquaculture, 2012).

Groundwater quality

According to Cakmak (2005) the amount of pollution in water resources in Turkey have increased drastically over the last years. The increasing urbanization, industrialization, fertilizer and pesticide applications in agricultural farming in addition to lack of water treatment plants have caused rapid pollution on both water surface and groundwater resources in Turkey (Cakmak, 2005).

Transportation Infrastructure

According to The World Bank (2018), Turkey is ranked as number 47 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 3,15 on a range from 1 (low) to 5 (high).

Indicators	Value
Customs (1)	2,71
Infrastructure (2)	3,21
International shipments (3)	3,06
Logistics competence (4)	3,05
Tracking and tracing (5)	3,23
Timeliness (6)	3,63

Appendix I

UKRAINE

Interview Vitaliy Bekh – Doctor of Agricultural Sciences, Senior Research Scientist, Head of the Fish Selection Department, Institute of Fisheries of NAAS, Ukraine

Background: *Educational bakcground within aquaculture*

Main farmed species: Carp, rainbow-trout and sturgeon (FAO, 2018)
Main aquaculture systems: Semi-intensive (FAO, 2018)

The Ukrainian aquaculture industry is characterized of being a small-scaled industry (Fao Reu, 2016) that is heavily regulated (Pedersen et al. 2017) where the main challenge is the high demand for foreign species, a trend that is stagnating the domestic growth of aquaculture output (Bekh, 2018). According to Fao Reu (2016), almost 80% of all seafood in Ukraine is imported and in 2015 the total amount of fishery and aquaculture products that were exported were 8,600 mt with a value of 17,7 million USD. One of the main reasons for the low number of exports of seafood products to the European market is that Ukrainian and European Union standards for inspections and fish safety is not harmonized (Food Safety News, 2018). Moreover, the high customs duties on export and import (European Commission, n.d.) have been a major cost for the sector, especially in terms of the 10% tax on fish feed (Pedersen et al. 2017). However, an association agreement between EU and Ukraine that came into force in 2017 (European Union, 2017) have removed the customs duties on export and import (European Commission, n.d.).

The total output of freshwater and marine aquaculture products in Ukraine were 21,425 mt in 2016 (FAO, 2018) where most of it were farmed in semi-intensive systems (ponds). Intensive farming systems are a less common farming technology in Ukraine (FAO, 2018) where land-based farming with RAS only have a share of 0,005% in terms of aquaculture area (Pedersen et al. 2017). According to Mr. Bekh, there are no farming activities of salmon in Ukraine.

Education and labor in the Ukrainian Aquaculture Industry

According to FAO (2018) research within aquaculture is only carried out by three institutes while education on bachelor- and master's level is lectured in eight different universites. PhDs and courses for aquaculture specialists are offered at the Institute of Fishery in Ukraine (FAO,

2018). However, the educational system is mostly directed for entry in small scaled aquaculture production (Bekh, 2018). In terms of the quality of the educational system, it is known for having low quality on professors, lack of access to international scientific literature, poor knowledge of English, outdated facilities and equipment, and a gap between theoretical knowledge and practical training (Fao Reu, 2016). These barriers among others have resulted in a small proportion (1/3) of students with aquaculture background entering the sector when graduating (Fao Reu, 2016). The low quality in the educational system of aquaculture studies have naturally affected the quality of the labor force as well. As mentioned by Bekh (2018), the general quality of the labor in the sector is low and the industry is affected by a high average age of the employees. Since most of the aquaculture farming takes place in rural areas, young people with an educational background related to aquaculture usually leaves the industry and moves to urban areas that offers higher salaries and increased standard of living (Bekh, 2018). One other trend is that people often enters the sector randomly, and the lack of experience usually leads to the need of receiving training (Bekh, 2018).

Industrial Policies in the Ukrainian Aquaculture Industry

Since Ukraine is not part of the European Union, the country is neither a part of the Common Fishery Policy reform (CFP). However, the Ministry of Agrarian Policy and Food of Ukraine has created a strategy called “Strategy for Agriculture and Rural Development 2015-2020” where the overall objective is to increase the competitiveness of the agricultural industry and to promote rural development in accordance with international and EU standards (FAO, 2015). The strategy plan also considers the development of the aquaculture sector where FAO will support the sector in an environmentally and regulated way by assessing the industry, strengthening governance and cooperation with other countries, and developing technical capacities (FAO, 2016).

Financial support to the sector

According to Fao Reu (2016) there are currently no government programs supporting the sector financially.

Groundwater quality

Ukraine has the largest inner water surface in Europe (Pedersen et al. 2017) occupying 4% of the country with an area of 2,422,000 hectares (Pedersen et al. 2017). According to the

Ministry of Ecology and Natural Resources of Ukraine (2012) almost all groundwater sources in Ukraine is contaminated and it often fails to meet regulatory requirements.

Transportation Infrastructure

According to The World Bank (2018) Ukraine is ranked as number 66 on the Logistics Performance Index (LPI) Global Rankings in 2018 with an average score of 2,83 on a range from 1 (low) to 5 (high). In comparison, Germany, which is ranked as number one obtained a LPI score of 4,20 (The World Bank, 2018).

Indicators	Value
Customs (1)	2,49
Infrastructure (2)	2,22
International shipments (3)	2,83
Logistics competence (4)	2,84
Tracking and tracing (5)	3,11
Timeliness (6)	3,42

Appendix J

Country	CIT	Highest	Lowest
Greece	*26%*	*49%*	*20%*
Norway	*24%*	*50,8%*	*24%*
Turkey	*22%*	*33%*	*20%*
Russia	*20%*	*43%*	*20%*
Poland	*19%*	*40%*	*19%*
Czech Republic	*19%*	*45%*	*19%*
Ukraine	*18%*	*30%*	*18%*
Romania	*16%*	*38%*	*16%*
Bulgaria	*10%*	*40,2%*	*10%*
Hungary	*9%*	*50%*	*9%*

List of countries by Corporate Tax Rate – Europe (Trading Economics, 2018)

Country	***Price per kWh for industrial users***
Bulgaria	*0,0972 EUR*
Czech Republic	*0,0887 EUR*
Greece	*0,1157 EUR*
Hungary	*0,1042 EUR*
Poland	*0,1078 EUR*
Norway	*0,0973 EUR*
Romania	*0,0989 EUR*
Russia	*0,0500 EUR (non-industrial users)*
Turkey	*0,0904 EUR*
Ukraine	*0,0400 EUR (non-industrial users)*

Electricity prices for industrial users in emerging countries in Europe (Eurostat, 2018; Pordata, 2018)

Country	Average wages national level	Average wages aquacultural sector
Bulgaria	*542 EUR*	*438 EUR*
Czech Republic	*1227 EUR*	*771 EUR*
Greece	*1060 EUR*	*Not applicable (473 average)*
Hungary	*995 EUR*	*Not applicable (473 average)*
Norway	*4,472 EUR*	*3,654 EUR*
Poland	*1,066 EUR*	*553 EUR*
Romania	*958 EUR*	*350 EUR*
Russia	*489 EUR*	*724 EUR*
Turkey	*Not applicable (820 average)*	*286 EUR*
Ukraine	*222 EUR*	*189 EUR*

Average wages on national and aquaculture level (Republic of Bulgaria National Statistical Institute, 2018; Republic of Bulgaria National Statistical Institute, 2017; Czech Statistical Office , 2018; Trading Economics, 2018; Salary Expert, n.d; National Institute of Statistics of Romania, 2018; Pana, 2017; Federal State Statistics Service, 2017; Turkish Statistical Institute, 2016; State Statistics Service of Ukraine, 2017; Contact Ukraine, 2016; SSB, 2018)

COUNTRY	**Purchase price per hectare**	**Rental price per hectare**
Bulgaria	2,000 EUR	200 EUR
Czech Republic	5,170 EUR	54-66 EUR
Greece	12,000 EUR	Not applicable (145 average)
Hungary	4,183 EUR	162 EUR
Norway	Not applicable (5,655 average)	Not applicable (145 average)
Poland	8,000 EUR	200 EUR
Romania	1958 EUR	105 EUR (2012)
Russia	879 EUR	Not applicable (145 average)
Turkey	8,500 – 13,600 EUR	Not applicable (145 average)
Ukraine	Not Applicable (5,655 average)	Not Applicable (145 average)

Purchase and rental prices for one hectare arable/agriculture land (Eurostat, 2018; Businessinfo, 2016; Czech Point 101, 2014; Schafer, 2018; Hungarian Central Statistical Office, 2018; European Commission, 2016, Zimmer, 2014; Bojnec, 2011)

Country	**Km**	**Effective time**	**Time with break**	**Costs exc road taxes and toll**	**Costs incl road taxes and toll**
Bulgaria	21,351	218h	382h	3,873 EUR	4,550 EUR
Hungary	14,330	149h	223h	2,605 EUR	3,119 EUR
Romania	21,369	240h	420h	3,723 EUR	4,246 EUR
The Czech Republic	10,978	116h	163h	2,007 EUR	2,395 EUR
Greece	26,825	280h	505h	4,830 EUR	5,652 EUR
Poland	12,007	127h	214h	2,020 EUR	2,353 EUR
Turkey	30,431	325h	600h	5,594 EUR	6,244 EUR
Ukraine	19,111	233h	398h	3,551 EUR	3,867 EUR
Russia	23,132	259h	450h	4,081 EUR	4,415 EUR

Geographical proximity from emerging countries capitals to the largest consuming countries of Norwegian salmon (Viamichelin, 2018) Note: Car type: Sedan, Fuel type: Petrol with price 1,477 per liter, Departure: 07:00 AM