



DUTCH-EMIRATI COOPERATION ON SEAWEED TO SUSTAINABLY IMPROVE FOOD SECURITY

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Preface and acknowledgement

This thesis has been written as part of my fourth year of studying European Food Business. This study program is based on agribusiness management, with a specific focus on the European Food market. I have done a small voluntary internship last summer where I was the host of the Dutch pavilion at the World Horti Expo in Beijing, which sparked my interest in international expo's. This internship was at the Ministry of Foreign Affairs, preparing the Dubai Expo, where I have learned so much from my colleagues. During the internship, the Expo got postponed with one year due to the COVID-19 crisis (WHO, 2020), which also meant that the internship would be held from home. Still, the digital contact was very good, and I had enough work for 40 hours a week, which I am very grateful for. The situation in the UAE changed as well, due to the pandemic the focus on self-sufficiency and food security increased. The theme of the Dutch Expo pavilion will be even more relevant; connecting water, energy and food for a sustainable food production. The pavilion is built up like a greenhouse and horticulture businesses are stimulated to join forces on the Dubai Expo. My mission with this thesis was to find out if, along with horticulture, seaweed could be a focus sector for the Netherlands as well. The idea came from brainstorm sessions with entrepreneurs at PLNT Leiden, a centre for entrepreneurship, and expert feedback on the UAE FoodTech Challenge.

The target group consists of the government: colleagues organizing the Expo, working at the Embassy in the UAE, Agricultural counsellors in the Gulf region and colleagues at the Dutch Consul General in Dubai. Businesses working on seaweed, all along the supply chain from breeding to distributing. Knowledge institutes like TNO or Wageningen University working hard to broaden the horizon of technical solutions with seaweed.

I would also like to thank my thesis coach, Dinand Ekkel for giving feedback and support in the thesis writing process. His feedback was appreciated in this explorative research where it was a challenge to find a research scope between all interesting facets of this subject. My goal with this research is not to propose a set plan that can be implemented immediately. This idea is more of a starting point, a start of a conversation, and for me personally a spark of passion. I hope you will enjoy reading the following research case as much as I enjoyed writing it.

Suzan Vellekoop.

Ter Aar, August 8th, 2020

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Table of acronyms

Agro-tech – Agricultural Technology

DIO – Directorate International Entrepreneurship **

GCC – Gulf Cooperation Council

MENA- region – Middle East and Northern Africa

The Nexus – Water, Energy and Food Nexus *

NIOZ – Royal Netherlands Institute for Sea Research

R&D - Research and development

SDG's – Sustainable Development Goals

The Gulf – The Arabian Gulf and the Gulf of Oman

TNO- Netherlands Organization for Applied Scientific Research

UN - United Nations

UAE – United Arab Emirates

WUR – Wageningen University Research

* Multiple Nexus synergies exist in scientific literature, but only the Water, Energy and Food Nexus will be mentioned in this report.

** This is the directorate where I did an internship

Summary

This research aimed to find out how the Netherlands and the UAE can collaborate on seaweed production by using the Dubai Expo to bring both parties together. Seaweed brings a green solution towards the Food Security index pressures felt in the UAE now. These pressures are; water availability, oceans and adaptive capacity to climate change. Since there are many seaweed varieties and they can grow under extreme conditions, this would help the UAE to be more adaptive. Furthermore, seaweed does not need fresh water and acts as a biofilter by taking up excess nutrients. The Netherlands has signed a MOU (Memorandum of Understanding) with the UAE to collaborate on Food security, but this is currently focusing largely on the greenhouse sector (Embassy of the Kingdom of the Netherlands in the UAE, 2018).

To know how seaweed can be incorporated in the Dubai Expo programme, existing models and tools have been searched in the first sub-question. The Triple Helix, Water-Energy-Food Nexus, the TRBNA methodology for collaboration and the Cultural dimension theory of Hofstede were found. These models cannot be applied literally to this case.

Interviews have been taken, which identified core needs of both the UAE side and the Dutch side. The Dutch side needs are classified as cooperation, access to finance, acceleration, green solutions and cultural sensitivity (Table 5). The offers of the Dutch side are green solutions, the wide array of applications of seaweed, government collaboration, acceleration and research and development (Table 6). The needs from the Emirati side are cultural sensitivity, a solution to problems felt by the COVID crisis, a need for food security and knowledge and technology (Table 7). Their offers are; green solutions, business deals, cooperation and shows (Table 8).

The Netherlands and the UAE can collaborate on seaweed production by using the Dubai Expo to bring both parties together. Many events are organized at the expo, from which the the ADSW (Abu Dhabi Sustainability Week), Floriade Dialogues, Wageningen Urban Farming challenge and digital events connect the best to seaweed stakeholders. Next steps to be taken are; to form a consortium with seaweed sector representatives, set targets, follow a training in intercultural communication and address the right stakeholders. In this way, the Dubai Expo is used as an international platform to advance green solutions for the Dutch side as well as the Emirati side.

1. Introduction

Context

Before the 17th century, the Arabian Gulf and Gulf of Oman were set apart from the rest of the world. Ships sailed over the water to exchange culture, commerce and ideas. This changed when the Europeans started to discover the world; the Arabian Gulf was a key international trade route connecting the Middle East to India, China, Southeast Asia and West Africa. Since 1623, the Dutch were trading with the United Arab Emirates (UAE), which was part of the Persian kingdom at that time. The Dutch were the dominant naval power in the Arabian Gulf by the 17th century. The UAE even marks the period of 1622-1750 as the “Dutch Era” (U.AE, n.d.).

In 2020, the Netherlands is working on a multi-year strategy to seek more connection to the Gulf Cooperation Council (GCC) again. The Netherlands has developed from the dominant naval power in the 17th century to the World’s second biggest agricultural exporter (viviano, 2017). There is little agricultural land available in the Netherlands; food is produced with specified knowledge and high-tech equipment. This caused the Netherlands to rank ninth worldwide in terms of food security. The UAE aims to increase food security by cooperating with the Netherlands (Ministry of Food Security, 2017).

The UAE ambitiously aims to be in the world food security top 10 by 2021 while ranking 21st place in 2020 (The Economist Intelligence Unit, 2020). The three most important challenges would be water, oceans and adaptive capacity as can be read in figure 1 and table 1 (Embassy of the Kingdom of the Netherlands in the UAE, 2018).

Table 1, UAE Food Security Index Pressures

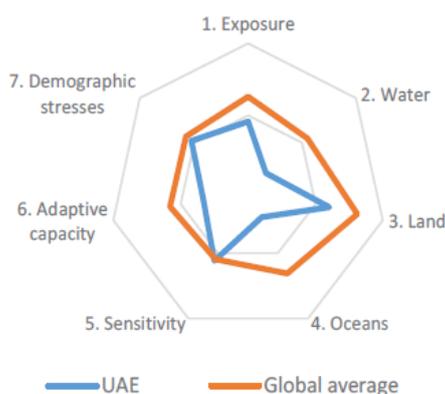


Figure 1, Food Security Index Pressures

Pressure	Food Security pressure components
1. Exposure	Temperature rise, sea level rise, drought, flooding, storm severity
2. Water	Agricultural water availability, water quality
3. Land	Soil erosion, soil salinity
4. Oceans	Eutrophication/hypoxia, marine biodiversity and protected areas
5. Sensitivity	Food import dependency, disaster risk management, natural capital dependence
6. Adaptive capacity	Early warning measures, climate smart agriculture, National agricultural risk management system
7. Demographic stresses	Population growth, urbanization

To combat these pressures, the UAE initiated a funding and tax incentive tranche of \$272 million to develop an agricultural technology (Agro-Tech) ecosystem including algae-based biofuels, indoor farming, precision agriculture and robotics (Martyn-Hemphill, 2019). This provides a broad economic opportunity for the Netherlands and the UAE, which led to a Memorandum of Understanding (MoU) to collaborate on food and water (Embassy of the Kingdom of the Netherlands in the UAE, 2018). A MoU is a non-binding agreement between two converging parties that intends future common action (Leader, 2017). In this case, it is an agreement to foster knowledge and technology in key areas (Jang, Patel, & Dufwenberg, 2018).

The Dubai Expo

An important point of future common action is the World Expo in Dubai, where the Netherlands will participate under the theme “Uniting Water, Energy and Food”. The world expo in Dubai is a business-minded event where more than 200 countries and organizations will exhibit opportunities and innovative solutions to common problems. The overarching theme is “Connecting minds, creating the future”. The Dutch Pavilion is located in the Sustainability District, which means the ecological footprint will be kept as small as possible. Local materials are used to build the pavilion and are repurposed after the Expo is finished in April. The theme of the Dutch participation is based on is a conceptual tool to stimulate sustainable development, named “the Water, Energy and Food Nexus” (Nexus) (V8 architects, 2019), (Kurian, 2017). The Dutch pavilion will be used to stimulate cross-linkages between nations and sectors as this is at the core of the Nexus concept. Small edible plants (cresses) and mushrooms will be grown inside the pavilion by using sustainable water and energy sources for an inspiring visitor experience. The system has been built with Dutch inventions and knowledge (Staalduinen, 2019). The following paragraph will explain why the Water-Energy-Food Nexus is connected to the local problems of the UAE.

The Nexus in the UAE

The energy consumption of the UAE has been rated as highly insufficient. If all countries would consume energy like the UAE, the world would warm up to $<4^{\circ}\text{C}$ (climateactiontracker, 2019). The Globally agreed Paris Agreement aims to “hold warming well below 2°C ” (Krewitt, et al., 2008).

Seawater desalination plants and air-conditioning of buildings consume the most energy. The harsh desert climate also makes fresh water one of the scarcest resources of the UAE (Ali Murad, Al Nuaimi, & Al Hammadi, 2006). Along with desalinated water (35%) there is groundwater being used (60%), as well as treated wastewater (5%). Agricultural irrigation only uses groundwater, which makes the groundwater table to fall by 1.5 to 5 metres per year. This causes various problems: seawater intrusion, drying of aquifers and water quality degradation (Saif, 2014). Meanwhile, the agriculture sector represents less than one percent of the GDP of the UAE. Furthermore, the coastal ecosystem is out of balance due to climate change, seawater desalination plants and agricultural runoff. This causes fish stocks to decline, “dead zones” without oxygen and seaweed overgrowth due to an excess of nutrients in the Arabian Gulf (Embassy of the Kingdom of the Netherlands in the UAE, 2018). Agriculture puts severe pressure on the ecosystem and natural resources of the UAE. Nevertheless, the UAE has the goal to increase food production to over 100.000 tons annually by 2021 (Ministry of Food Security, 2017).

Business as usual is not an option for the food production sector; local aquifers would dry up and the dead zones and excess of nutrients in the Arabian Gulf would increase to severely problematic levels. Furthermore, indoor farming is highly energy intensive due to the needed cooling with the harsh desert climate. Current agricultural methods would deplete local resources in such an amount that imported foods would be more sustainable. There is a need for new technology and new ways of resource consumption (EWS-WWF , 2017).

Seaweed as part of the Nexus solution in the UAE

An interesting perspective on a solution for the Nexus problems are future foods, which are nutritious but use little resources like fresh water or energy. Examples for future foods are insects, seaweeds and cultured meat (Parodi, et al., 2018). Specifically, seaweed cultivation has a positive effect on the ecosystem as a nursery for young fish and provide shelter (Hasselstrum, et al., 2018). Seaweed can absorb heavy metals, of excess nutrients and provide oxygen to the water (Reith, et al., 2005). Furthermore, it can serve as base material for biofuel, bioplastics, fertilizer, pharmaceutical compounds, direct human consumption and as a sustainable animal feed for fish and livestock (Jansen, et al., 2018).

The UAE is rich in coastal areas from the Arabian Gulf and Gulf of Oman. The water contains edible seaweeds that are adapted to the local climate. These species are; *Ulva Rigida* and *Ulva Fasciata* (Sea lettuce species), multiple *Gracilaria* species (Ogonori or Sea moss), *Palmaria Palmata* (Dulse, seaweed flakes) and *Caulerpa Racemosa* (Sea Grapes) (Ali Murad, Al Nuaimi, & Al Hammadi, 2006) (McHugh, 2003).

The global Seaweed market is growing by 7.5% annually and it is expected to reach 92 billion USD in 2025 (Global Market Insight, 2018). Another market research firm, Mordor Intelligence, is assessing the growth of the seaweed market with 9.7% during the period of 2020 to 2025. Experimental seaweed cultivation is increasing worldwide, but not fast enough to keep up with demand (Mordor intelligence, 2019). Researchers of the Embassy of the UAE have acknowledged this business opportunity. The following table indicates the risk and opportunity of seaweed cultivation.

Table 2, Seaweed cultivation risks and opportunities

Seaweed and Macro-algae cultivation	Approach strengths	Approach limitations	Maturity (1-5)	Growth opportunity (1-5)	Initiatives or programmes
	<ul style="list-style-type: none"> - Low input requirement - High in nutrients 	<ul style="list-style-type: none"> - Requires controlled conditions - May prove difficult to scale up 	1	5	No initiatives, approach is still in its early stage within the UAE

Seaweed cultivation has a high growth potential but is not mature in the UAE. Therefore, knowledge partners are required from the side of the UAE and the Netherlands (Embassy of the Kingdom of the Netherlands in the UAE, 2018). The following paragraph will describe the relevant Dutch and Emirati knowledge partners. Knowledge partners consist of business, research and governmental organizations. It is currently unknown if these organizations would be interested to cooperate on seaweed projects.

Possible knowledge partners in the UAE

Although there are no seaweed farms yet, multiple parties are involved in setting up a seaweed sector. The following table provides an overview of partners, which are important for the UAE. As can be read in the description below the table, the UAE government has a steering role when it comes to investments. Furthermore, the UAE is influenced by Global politics such as the United Nations Agenda 2030 for Sustainable Development. Knowledge partners are made **bold** to be found more easily in the text.

Table 3, Knowledge partners from an Emirati perspective

Government and intergovernmental bodies.	Business and investment	Research
The Ministry of Food Security	Gulfood	The Masdar institute of Science and Technology
The Ministry of energy	The FoodTech Challenge	The American University of Sharjah
The United Nations (UN)	Catalyst	The College of Food and Agriculture
Bureau International des Expositions (BIE)	Mubadala	International Centre for Bio Saline Agriculture
The Ministry of Environment and Water	The FoodTank	
Consulate General of the Netherlands in the UAE	Madar Farms	
Embassy of the kingdom of the Netherlands in the UAE		
Agriculture and Food Safety authority		

The ministry of Food security has set the goal to be the global number one on food security by 2051. This also means producing over 100.000 tons annually by 2021 to get in the top ten countries. (Ministry of Food Security, 2017). Looking at the climate conditions in the UAE, this is a very ambitious goal.

The ministry of Energy has initiated the UAE Water security strategy 2036. The aim is to reduce water demand by 21% in 2036 compared to 2017. This is a challenging goal concerning the increasing population and the increase in local agriculture, which is already 60% of current water use (Ministry of Energy, 2017). Seaweed requires no freshwater input and low energy input compared to indoor farming. **The ministry of environment and Water** is responsible for the data collection of natural seaweed growth and monitoring of nutrient levels (Gulf News, 2013). The consulate General and the Embassy of the kingdom of the Netherlands are both involved in the preparation of the Dutch participation in the Dubai Expo (Embassy of the Kingdom of the Netherlands in the UAE, 2018). The **Agriculture and Food Safety Authority** has been assigned by the government to control the Emirates Food and Agriculture establishments as well as imported and exported food items (Abu Dhabi Agriculture and Food Safety Authority, 2020). **The Bureau International des Expositions** (BIE) is an intergovernmental body, which organises the World Expo's as well as horticultural expos and specialized expos (BIE-Paris, 2020). **Gulfood** is a yearly occurring international food trade exhibition in Dubai in February, in the same period as the Dubai Expo (Gulfood, 2020) **The FoodTech challenge** has been initiated by the Emirati government. Ten people are chosen to pitch an idea in turn for a share of one million euros (FoodTech challenge, 2020). Furthermore, a start-up accelerator called **Catalyst** is building a start-up ecosystem focused on sustainability (Watson, 2018). The investment company **Mubadala** invests in agribusiness along with other sectors. The government of the UAE is the biggest shareholder of Mubadala (Mubadala, 2017). The **FoodTank** is involved with Artificial Intelligence projects to tackle food waste in the hospitality of the UAE (Dixon, 2020). **Madar farms** is working to tackle food and water security challenges in the gulf region (Almulla, 2019). **The Masdar institute of Science and Technology** started investigating the use of algae to make biofuels (Khalifa University, 2018). The **American University of Sharjah** has developed biodegradable packaging from seaweed (American University of Sharjah, 2019). **The College of Food and Agriculture** has been researching plant and animal production in the region since 1980 (College of Food and Agriculture, 2017). **The International centre for Biosaline Agriculture** is a non-profit research centre with tight government relations. One of their projects researches the use of seawater desalination brine in seaweed cultivation (ICBA, 2016). No other non-profit organizations have been found to be active in terms of seaweed.

Possible knowledge partners in the Netherlands

Seaweed is still not a major part of the Dutch Food system, but extensive research is being carried out. Most projects mentioned are connected through collaborative projects and government support, such as the ProSeaweed project. Making connections between the sectors mentioned in the table is done through the Triple Helix method (Leydesdorff, 1995). Furthermore, the Netherlands is influenced by Global politics such as the **United Nations Agenda 2030** for Sustainable Development.

Table 4, Knowledge partners from the Dutch perspective

Government and intergovernmental bodies.	Business and investment	Research
Bureau Internationale des Expositions (BIE)	Hortimare	Wageningen University Research
The Ministry of Foreign Affairs and the Netherlands Enterprise Agency	Omega Green	Netherlands Organization for Applied Scientific Research (TNO)
Topsector Agriculture and Food	Vobra	The University of Groningen
Ministry of Infrastructure and Water management (IenW)	Zeewaar	NIOZ
the Ministry of Agriculture, nature and Food Quality (LNV)	Olmix	
Ministry of the Interior and Kingdom Relations (BZK)	Westland cheese	
Ministry of Economic Affairs and Climate Policy (EZK)	Seaweedfarmers	
The United Nations (UN)	Noordzeeboerderij	

Pioneering projects which are establishing and coming up are largely focused on research. The following section will shortly explain how each party contributes to Dutch expertise on seaweed. The Proseaweed project is involving five consortia of businesses **and all ministries and the topsector** mentioned in the table. More knowledge is gained in the area of climate-neutral food and feed production (Veraart, Swam, & Bronswijk, 2019). **Zeewaar** is leading in sustainable seaweed cultivation in open systems in the Oosterschelde, which is an estuary in the Dutch province “Zeeland”. **Omega Green** has developed a sustainable method to cultivate seaweed on a large scale (Bourman, 2019). **Hortimare** is cultivating seaweed in closed systems for animal feed and cultivating young seaweeds, which can grow further in open systems at sea (Hart, 2011). **Seaweedfarmers** has started a pilot project with the young seaweed and cultivating it in the IJmond river as a natural bio filter to take up CO₂ and heavy metals. **Westland cheese** has started to experiment with adding seaweed to the feed to reduce methane emissions of cows (Westlandkaas, 2020). **Vobra** is a Dutch company specialized in pet foods, which included seaweed into the assortment of dog and cat food (Vobra, 2020). **Olmix** is processing seaweed into bio-based fertilizers (Olmix group, n.d.). The **Noordzeeboerderij** wants to realise a sustainable seaweed sector in the Netherlands without aiming for profit. This is done by founding a tasting farm on the North Sea and a seaweed platform with more than 80 members (Noordezeeboerderij, n.d.). **The University of Groningen** is researching biological effects of seaweed cultivation projects in the Wadden Sea (RUG, 2019). Furthermore, **Netherlands Organisation for Applied Scientific Research (TNO)**, has realized a seaweed processing lab (Nanninga, 2018). The **NIOZ** (Royal Institute for Sea Research) is researching if seaweed is a sufficient replacer of fishmeal in fish feed (Visser & Maat, 2017). **Wageningen University research (WUR)** was the pioneering seaweed research University, executing a triple P (Planet, People Profit) analysis of offshore large-scale seaweed cultivation in combination with offshore wind (Sander van den Burg, 2013). Also, the Wageningen University is taking big steps in bio refinery, where specific nutrients are extracted from seaweed (Jansen, et al., 2018).

The following paragraph will describe how the Expo Dubai can bring together the Dutch and Emirati knowledge partners

The Expo Dubai

The Expo Dubai expects 20 to 25 million visitors and has a business-minded approach. This makes the Dubai Expo the biggest event in the region where a step towards bilateral cooperation on seaweed can be taken. Examples of steps are a networking dinner, a policy-oriented summit or signing the contract of a collaborative business case. Furthermore, world expos historically have an impact on kick-starting projects by stimulating the economy. For example, the Shanghai Expo of 2010 has provided an additional economic growth of 1.35%. (Qu, 2011) The Milano Expo has provided a year on year growth of 1.3% to 4.2% in sectors as wholesale and distribution, hotels and catering, transport-related sectors and commercial services (Euler Hermes, 2015).

[Problem description](#)

At the side of the UAE, there is an important need to diversify the economy and be less dependent of imports in general. Climate-friendly solutions are needed to meet food security goals without depleting natural resources. With the world expo coming up, the UAE can profit from the Dutch knowledge regarding innovations in the seaweed sector. Currently there is a big focus from the Netherlands on showing opportunities around food in connection to energy and water. Seaweed farms provide promising possibilities, but applied research is needed to know how this connection can be made.

The subject of this research is the possible collaboration between the Netherlands and the UAE on sustainable seaweed farming, with the Dubai Expo acting as a catalyser to bring both parties together. Currently, it is not clear how such a collaboration would be realised. What would be necessary from both perspectives and which parties would be interested? Furthermore, it is not known how willing both parties would be to cooperate and what the appropriate step would be to take during the World Expo in Dubai. The outcome of this paper contributes to the long-term strategy in the gulf and the Expo Dubai programming. This paper can be a framework for action or further research on seaweed cooperation from the perspective of the government, research and business sectors.

This results in the following main question and sub-questions:

Main question: How can the Netherlands and the UAE collaborate on seaweed production by using the Dubai Expo to bring both parties together?

Sub question 1: Which models and tools apply to bilateral cooperation on seaweed?

Sub question 2: What is the offer and the specific “need” from the Dutch perspective on the bilateral cooperation on seaweed?

Sub question 3: What is the offer and the specific “need” from the UAE perspective on the bilateral cooperation on seaweed?

Sub question 4: How can the Dubai expo bring Dutch and Emirati professionals closer on seaweed production?

2. Method

To find out how the UAE and the Netherlands can collaborate on seaweed cultivation, qualitative research has been conducted. Firstly, research and organizational reports have been analysed to determine which useful models on bilateral cooperation exist. Secondly, in-depth interviews have been carried out to determine the Dutch and UAE perspective on the bilateral cooperation. Lastly, the gathered data has been put together to determine how a Dubai Expo can strengthen the bilateral relationship in terms of seaweed production. The planning of the research can be found in Appendix E. Each sub-question asks for a slightly tailored strategy, which will be explained in the following paragraphs.

Sub question 1: Which models and tools apply to bilateral cooperation on seaweed ?

This sub-question has been answered by looking for relevant cooperation models and tools which are applicable to seaweed and bilateral cooperation. The models and tools are about collaboration between multiple parties and can be used to design future cooperation. With these criteria, the framework of following actions can be scientifically justified. Scientific journals like “The Social Sciences Journal”, “Journal of Management” and “Journal of International Trade” have been explored using the following search criteria: “Bilateral Relationship” “Model”, “Foreign Policy”, “Bilateral Aid”, “UAE”, “Emirati”, Dutch and the Netherlands”. Peer reviewed literature fitting to the scope of this research question from the period between 2010 and 2020 has been read. Search engines like Google Scholar, PubMed, Wiley, JSTOR, Science Direct and Springer have been used.

Sub question 2: What is the offer and the specific “need” from the Dutch perspective on the bilateral cooperation on seaweed?

This sub-question has been answered by addressing individuals affiliated with seaweed, as described in table 3 and Appendix B. Six people from the Dutch seaweed sector have been interviewed. Further contacts were addressed through referrals by the first contacts, also known as the “snowball method”. Only referrals of professionals affiliated with the seaweed sector and operating within the Netherlands have been interviewed as this lies within the scope of the analysis.

The interviews have been carried out in Dutch or English. The interview questions can be seen in appendix A. Interviews have been carried out over the phone to ask follow-up questions.

The answers of the interview are summarized and checked by the interviewee, subsequently, coding was used to compare answers. Coding is an important step to secure the validity of the interview analysis by grouping answers on a specific subject.

Sub question 3: What is the offer and the specific “need” from the UAE perspective on the bilateral cooperation on seaweed?

To answer this sub-question, representatives of the UAE were addressed; these representatives are described in table 1 and Appendix D. Four people from the UAE were interviewed, which is lower than the target set in sub question 2. This is because of the cultural and physical distance as well as the smaller personal network made it more challenging to find interviewees. Further contacts were addressed through the “snowball method”. Only referrals of professionals operating within the Food system of the UAE have been addressed as this lies within the scope of the analysis. Furthermore, the interviewee had to have a minimum level of English or Dutch to avoid miscommunication. Interviews have been carried out over the phone so follow-up questions are possible, interview questions can be found in Appendix C. The interviews are written down, checked by the interviewee and coded just like the previous sub-question. Coding the interview results makes clear which answers can be grouped together.

Sub question 4: How can the Dubai expo bring Dutch and Emirati professionals closer on seaweed production?

The introduction of this sub-question is based on publicly available qualitative data from the Dutch and UAE governmental bodies and intergovernmental bodies like the BIE. The BIE provides examples from previous World Expo results. These might be comparable to this research if they are less than fifteen years old and linked to Food Security. Furthermore, opportunities at the Dubai expo and accompanying trade fairs will be inventoried to have an overview. Search keywords include: “The Netherlands”, “Dutch”, “Food security”, “World Expo”, “Dubai”, “2015”, “2010”, “2005”, “Dutch Dubai”, “Trade fairs Dubai 2021”, “Food Security”, “Strategy” and “Seaweed”.

A full-time internship for six months at the Ministry of Foreign Affairs in the Dubai Expo team also provided useful contacts and feedback. Observations at the Ministry will be kept confidential and do not lie within the scope of this research.

3. Results

Bilateral cooperation models between the UAE and the Netherlands

In this sub-question, the macro-perspective of bilateral cooperation will be discussed using scientific models and tools. In this case, it is not only important to cooperate bilaterally between countries, but also amongst sectors. This is because the government is highly involved in the world expo and seaweed businesses collaborate closely to the research sector. Therefore, the triple helix was chosen as an appropriate model. Since seaweed offers a solution to the high energy and water use of food production in the UAE, the Water-Energy-Food-Nexus model is explained to get a better insight of the interconnectedness of these sectors. Nexus research featuring a fitting roadmap to this research question is also used to outline a strategy for the future. Lastly, the intercultural differences between the UAE and the Netherlands have been outlined using Hofstede's six cultural dimensions theory.

The Triple Helix and the Quadruple Helix

Bilateral cooperation exists between nations and between sectors, the triple helix approach focuses on cross-sectoral collaboration to increase innovation. The triple helix stands for three sectors, the government, business and research and argues that the most innovative setting is at the middle, overlapping areas. Quadruple helixes also exist, which include either the civil society or non-profit organizations (Leydesdorff, 1995). For seaweed specifically, the main three spheres represented in figure three are relevant. New

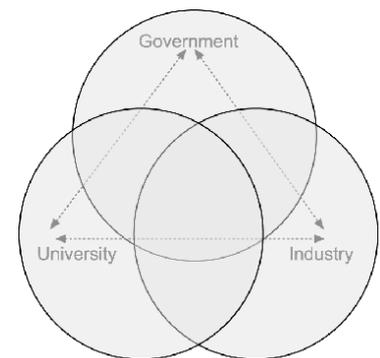


Figure 2, The triple Helix as described by Leydesdorff and Etkowitz

policy needs to be formed around new seaweed cultivation methods and businesses apply the new findings of the research sector. Civil society and non-profit organizations could play a role in seaweed innovation, but is not likely to be involved in the initial business dialogue and is therefore not focused on in this paragraph.

The Dutch Expo strategy also mentions the triple helix in the following quote: *“One of the main areas the UAE can adopt from the Netherlands is their Dutch Triple Helix approach that strengthens synergies between government, industry, academia and society”* (Embassy of the Kingdom of the Netherlands in the UAE, 2018). World Expo's typically include many universities, businesses and governmental bodies from all over the world, which creates many opportunities of cross-sectoral collaboration between nations.

The Water-Energy-Food Nexus

Like the previous model, the WEF-nexus (Water-Energy-Food Nexus), is mainly focusing on cross-sectoral collaboration. The WEF Nexus model argues that water, energy and food are all interconnected, and by looking at these linkages, system problems can be solved more holistically. This can be used to increase food security in a sustainable way, and is therefore also used by the United Nations (Simpson & Jewitt, 2019)

The Dutch participation in the Expo Dubai tries to convey this message in an interactive way. A graph of the WEF-Nexus is provided below.

As can be seen in the diagram above, conventional food production uses water and discharges nutrients in the water. Furthermore, food production uses energy, for example, greenhouses need to be cooled in the UAE. Then, some part of the production, such as inedible parts of corn, are used for energy generation (Marston & Cai, 2018). In this food system, problems occur, which have been introduced more extensively in the introduction. For example, the energy use in the UAE is already highly insufficiently sustainable, agricultural runoff is polluting the water and local aquifers are drying up (Embassy of the Kingdom of the Netherlands in the UAE, 2018). As seaweed can propose an alternative or take away some of these negative advantages, there is value created in all three areas of the nexus.

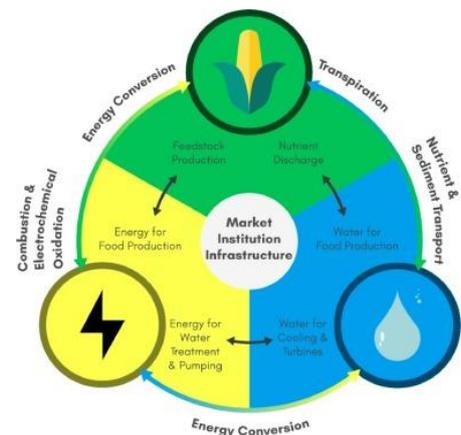


Figure 3, Nexus diagram

The sustainable development goals

The Netherlands and the UAE are both part of the United Nations (United Nations, 2020). This organization has made a tool to set global goals towards a more social, environmental and economically sustainable world. These goals are also known as the Sustainable Development Goals or SDG's. Two goals connect the most to the scope of this research; "Zero Hunger" and "Partnerships for the Goals". "The 17 Goals are all interconnected, and in order to leave no one behind, it is important that we achieve them all by 2030" (United Nations, 2020).

Smart goals

SMART stands for; Specific, Measurable, Attainable, Relevant and Time bound. This tool helps to make a goal more concrete, which increases the probability of achieving it. SMART goal setting is proven to be helpful to attain financial and professional success (Robins, 2014).

The TRBNA methodology

A roadmap of the Water Energy Food Nexus through stakeholder dialogue is shown below, which is officially called the TRBNA methodology. The model has been developed to increase cooperation between multinational stakeholders of a river, using the WEF-Nexus. For seaweed, the context is different, but the structure still provides a step-by-step approach to stakeholder dialogue.

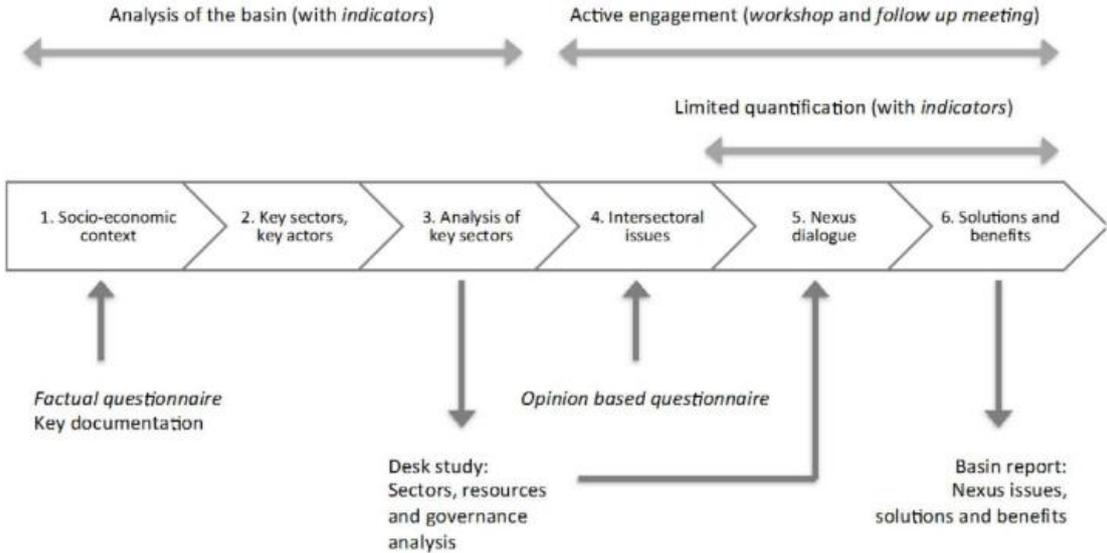


Figure 4, The TRBNA methodology for collaboration

According to this figure, the socio-economic context has to be analysed first using desk study, key actors and sectors are identified at the second step to be involved in the assessment later. Then, the sectors will be analysed using interviews to find out about intersectoral issues. In the fifth step, the outcome of earlier research can be presented and stakeholders can be invited to brainstorm about solutions. The application of these solutions is a sixth, critical step. In this instance, the Nexus research already covered the first two phases, this research paper aims to cover the thirist and fourth phase, and execution of the plans would cover the fifth and sixth phase.

6 cultural dimensions

Geert Hofstede has developed a system with six cultural dimensions: power distance, individualism, masculinity, uncertainty avoidance, long term orientation and indulgence. Long term orientation and indulgence have not been assessed for the UAE. Compared to the Netherlands, the UAE has a higher power distance (90/100) than the Netherlands (38/100), which means there is a higher amount of hierarchy in society. The difference on the individualism-scale is just as big, where the Netherlands is more individualistic (80/100) and the UAE is more collectivistic (25/100).

To summarize, there are many dynamics playing a role in seaweed collaboration, with intersectoral and international collaboration taking place. The TRBNA methodology comes close at combining these factors into a collaboration model, but this research focuses mostly on the third and fourth stage within this model. Furthermore, SMART goal setting increases the likelihood of attaining a certain goal. The United Nations has set 17 goals which are important to achieve before 2030, which invites members like the UAE and the Netherlands to make partnerships (United Nations, 2020). Cultural differences also play a role while collaborating, from which the biggest general cultural differences in this case are individualism and power distance.

Identified needs and offers from the Dutch perspective on the bilateral cooperation on seaweed

To identify needs and offers in the second and third sub-question, 10 interviews were taken in total, according to the methods written in chapter two. The respondents from research, government and business spheres were addressed according to appendix A. Only a few of them have responded. Some respondents also referred to other organizations which would know more of the sector itself. An overview of people which have been interviewed can be found in Appendix R.

The interpretation of the interviews has been done according to coding to avoid bias and to validate the formation of different groups of needs and offers. First, the interviews were summarized, which can be read from the 6th appendix to the 16th appendix. Every sentence which expressed a need or an offer was marked in the interviews, with a corresponding label. These labels can be found in Appendix P and 18, under the “open coding” line. Later, these labels were groups under umbrella terms, which can be found in the same appendixes under “axial coding”.

The needs and offers identified by the interviewees have been labelled and grouped through a method called coding. The interview partners and their affiliation with the seaweed sector will be briefly described here:

- Niek de Regt works at the Ministry of Foreign Affairs and is a former United Nations diplomat. He has grown up with seaweed because he lived on the coast and has given lectures about seaweed during his time at the UN (Appendix J).
- Lena Hildmann works at the Bureau Internationale des Exposition in Paris and is the country representative of the Netherlands. Because she sees both the UAE and Dutch perspective, her answers are also used for the next chapter (Appendix M).
- Petra Steenhoek works at Hortimare, one of the biggest seaweed seedling breeding companies in the Netherlands (Appendix K).
- Adrie van der Werf works at Wageningen University as a scientist, he analyses the seaweed value chain. He is put under the business umbrella because he is leading a consortium on seaweed in Saudi Arabia (Appendix L).

- Jaap van Hal works at the TNO and has opened a seaweed processing lab, in which he received people from the Expo organization. No direct cooperation has resulted from this meeting (Appendix F).
- Klaas Timmermans works at NIOZ, a governmental research institution monitoring the sea quality. He is currently researching how seaweed can be used as fish feed (Appendix H).

Needs to participate in a bilateral collaboration from the Dutch perspective:

The table below describes how many times a certain need has been mentioned during the interview, sorted from high to low.

Table 5, Core needs of the Dutch perspective

Core needs	Business	Government	Research	Total
Cooperation	9	3	9	21
Access to finance	6	2	6	14
Acceleration	3	3	7	11
Green solutions	4	2	6	10
Cultural sensitivity	4	1	2	7

The full coding of this research question can be found in Appendix P, from which the quotes are summarized below.

Cooperation

Cooperation is mentioned especially by Petra Steenhoek from Hortimare, she is looking for consortia and expanding the network in the Arab community. They would like to be part of seaweed cultivation projects in the middle east. Niek de Regt mentions it would be very relevant for the government point of view if seaweed professionals collectively enter the expo. Furthermore, Klaas Timmermans mentions that broad support starts from the individual, suggesting citizens and consumers also play a role in cooperation. Adrie van der Werf mentions that cooperation is needed because the sea has all kinds of functions (e.g. tourism, shipping or ecology), so different needs have to be taken into account. Adrie has visited an Expo before, but found it hard to make a connection there since it was so business focused. Furthermore, the research sector also described a need to cooperate with the government, Jaap van Hal stresses the need for financing instruments from the government and Klaas Timmermans talks about a CO2 tax.

Access to finance

Jaap van Hal mentions that scale is needed to make seaweed processing profitable. Petra Steenhoek mentions that the finance of the government or business sector is essential to go from start up to scaleup phase in time. But as it has also been said in the previous paragraph, there is a shortage of finance in the seaweed sector. On the other hand, as soon as the initial investment is made, buyers can be found even if you grow bigger (Adrie van der Wef, Appendix L). The application of seaweed also determines the profitability. Adrie van der Werf mentions that in his experience it was not possible to make a business model out of biomass. Furthermore, Niek de Regt looks at direct consumption of seaweed and mentions that if seaweed would replace a part of animal protein, this would limit the access to finance of certain communities. Klaas Timmermans mentions that the urgency of the climate problem is not felt by everyone and fossil fuels are very cheap in comparison to biofuels.

Acceleration

Internationally, there is exponential growth in international cooperation and trade in seaweed. But still, the industry is not self-propelling, meaning that external help is needed to make the industry grow. Lena Hildmann mentions that history has shown us that the World Expo is an excellent leap forwards to scale up. Jaap van Hal mentions that priority is needed to scale up, and currently his priorities are on other projects which require a lot of time. Adrie van der Wef mentions that a lot is unknown about seaweed cultivation and this also poses a threat to scale up seaweed production. The scaleup has to be done sustainably since we know pesticides and fertilizers do not have a good effect on the health of the ecosystem. Land-based food production has had thousands of years of co-evolution, which is not always taken into account when people think they can quickly scale up the seaweed sector.

Green solutions

Seaweed is cultivated all over the world, but in Europe, production costs are higher, so a new idea is needed to make it profitable, Adrie van der Werf mentions the idea of large scale cultivation in the middle of the ocean. Petra Steenhoek mentions that resources have to be used and distributed in an ecologically smart way. Jaap van Hal mentions that the offer of raw materials, energy and food has to be ecologically balanced as well.

The demand side would need to change as well, Klaas Timmermans wishes the demand from the business side to go greener would be stronger. Lastly, Lena Hildmann mentions that every country suffers differently under climate change, but the need to fight it is global.

Cultural sensitivity

Petra Steenhoek mentions that the ethical aspects of the working methods of the parties cooperated with are important for Hortimare. Adrie van der Werf mentions a different part of culture since new foods have to undergo a consumer acceptance process. Working processes also differ, Petra Steenhoek, Klaas Timmermans and Jaap van Hal both mention that there was no follow up after initial connections with the Gulf region. Niek mentions that what you eat is cultural and this is very hard to overcome, but it can be changed. Jaap van Hal mentions that a close connection to somebody local that can access the right tables is essential for a project.

What can be offered from the Dutch perspective in a bilateral cooperation

The same process has been conducted for the other part of this chapter, what can the Netherlands offer?

Table 66, Core offers from the Dutch perspective

Core offers	Business	Government	Research	Total
Green solution	4	6	5	15
Wide array of applications	3	1	3	7
Government collaboration	1	1	3	5
Acceleration	3	0	1	4
Research and development	3	0	3	3

Green solution

Seaweed offers a green solution to problems of today, Niek de Regt mentions that seaweed protein produces a lot less greenhouse gasses than animal protein during the production. According to Petra Steenhoek, Hortimare is already sought-after partner for international projects because of the supply of seeds and advanced research and development knowledge. Dutch professionals are already working together to cultivate seaweed in Saudi Arabia instead of the former water-intensive soy beans for local animal feed. Klaas Timmermans expects green solutions to gain more importance in the future and Niek de Regt mentions that seaweed positively contributes to 80% of the sustainable development goals.

Wide array of applications

There are many applications of seaweed, in Appendix P even more applications are listed, this paragraph will focus on applications for Food Security. Klaas timmermans mentions seaweed has around 10 to 10% protein and carbs, which are high percentages in terms of nutrition. Petra Steenhoek mentions that seaweed can reduce cow methane emissions and promote animal health to limit the use of antibiotics. Furthermore, seaweed is used as a binder and the nutrients can be extracted to replenish nutrients in drinks and other superfood products. Seaweed extracts can also be used to increase production of land-based agriculture with 10 to 30% according to Adrie van der Werf. Klaas timmermans mentions that NIOZ is researching seaweed as fish feed to replace imported soy.

Government collaboration

The EU is responsible for 50% of the contribution to the seaweed project of Adrie van der Werf in Saudi Arabia. Furthermore, Klaas Timmermans mentions most of his research is initiated by the government and shared publicly, therefore it is applied worldwide. Also from a government point of view, Niek de Regt mentions that seaweed is a good way to promote the nexus on the Expo. A trade mission with seaweed businesses has also been organized by the Ministry of the Foreign Affairs in the past.

Acceleration

Petra steenhoek mentions: "The business sector can accelerate these processes and broaden networks and partnerships". A few examples of this have been given by other interviewees. New initiatives are coming up, mentions Klaas timmermans, and Adrie van der Werf stated "After some hurdles, we got a project of 200M euro in Saudi Arabia , focused on animal food production".

Research and development

No interviewee from the government has actively mentioned the offer of research and development from the Netherlands. But, Petra Steenhoek from Hortimare, Jaap van Hal and Klaas Timmermans tell about their offer of seaweed knowledge and experience. Hortimare states that the delivery of a uniform product with good predictability is necessary for the customers to be able to scale up without too many risks and allows the industry to process

seaweed as economically as possible. Furthermore, new seaweed species are being researched, such as the cycle of red seaweeds, which is more complicated than green and brown seaweeds. Jaap van Hal mentions the Paris agreement, which states innovation is needed for a food transition. Klaas Timmermans is researching seaweed as fish feed and the production of high quality carbohydrates and protein at NIOZ. He has been approached by parties from the UAE for the knowledge in sustainable biofuel.

To summarize: The Dutch side needs are classified as cooperation, access to finance, acceleration, green solutions and cultural sensitivity (Table 5). The offers of the Dutch side are green solutions, the wide array of applications of seaweed, government collaboration, acceleration and research and development (Table 6).

Identified needs and offers from the Emirati perspective on the bilateral cooperation on seaweed

This data has been gained following a similar approach as the Dutch perspective in the previous sub-question. The organizations and professionals described in Appendix C have been addressed, but the response rate was even lower than the Dutch perspective. In this case, four interviews were taken for the UAE side and one interviewee has been used for both sides, which means that there are five interviews in total. An overview of people which have been interviewed can be found in Appendix R.

The needs identified by the interviewees have been labelled and grouped through a method called coding. The interview partners and their affiliation with the seaweed sector will be briefly described here:

- Erik Smidt is a member of the expo steering committee with experience as an agricultural counselor in the Gulf region. He supports Dutch companies in the Agri sector with ambitions in the Gulf region (Appendix I).
- Samar Kadri is an agricultural counsellor in Dubai. During her working time, she has seen the UAE shift from focusing on tourism and construction to food security (Appendix O).
- Lena Hildmann is the country officer of the Netherlands at Bureau Internationale des Exposition. Because she sees both the UAE and Dutch perspective, her answers are also used for the next chapter (Appendix M).
- Hector Hugo Hernandez works at Masdar at the business side of the seaweed biorefinery (Appendix N).
- Bob Baldwin is the predecessor of Hector Hugo Hernandez and has set up a seaweed biorefinery to make biobased fuel (Appendix G).

Just like with chapter four, the coded interviews are grouped, resulting in five core needs. Compared to chapter two, some results can be related to each other; knowledge and technology relates to the offer of the Netherlands of Research and Development and the need for Cultural sensitivity also revealed at the Dutch perspective.

Needs to participate in a bilateral collaboration from the Emirati perspective:

The table below describes how many times a certain need has been mentioned during the interview, sorted from high to low.

Table 7, Core needs of the UAE perspective

Core needs	Business	Government	Research	Total
Cultural sensitivity	1	6	0	7
Food security	1	4	0	5
A solution to problems felt by the COVID-19 crisis	2	1	0	3
Knowledge and technology	1	1	1	3

Cultural sensitivity

Cultural sensitivity is mentioned the most by the government in this perspective. Erik Smidt mentions that being familiar helps to close business deals quickly and gives the advice to see a business partner once or twice and possibly eat together to show a long term view. Certifying products with Halal is also important regarding export and processing products in a certain way makes them more palatable for certain markets (appendix I). Samar Kadri tells about cultural differences in communication styles, such as looking people in the eyes and being very friendly before asking for a price. Compared to innovations from India and China, the prices of Dutch innovations are rather high, therefore, it is important to be patient and communicate quality. Furthermore, Hector Hugo Hernandez says that skilled workers were hard to find, but more and more people are becoming interested in sustainability and food.

Food security

Robert Baldwin mentions that the goal of his seaweed biorefinery was to link it with food security, to create local food without creating an environmental disaster. Erik Smidt also sees the importance of this, “the world still needs to be fed in 30 years' time, more local production will have to be done”. Governmental actions from the UAE also reflect the increasing need for food security, with a Food Security office created in 2005, which later became a ministry of food security and was changed to Food Security and Water last year according to Samar Kadri. Nevertheless, Erik Smidt believes that the UAE becoming self-sufficient in terms of food production will require more time than is assumed.

A solution to problems felt by the COVID-19 crisis

The Covid-19 crisis has had an enormous effect on the world and its economy (WHO, 2020). . Samar Kadri explained that this has once again (after the economic crisis of 2008), shaken up the Arabic world to focus on being self-sustaining. Kadri: *“You see jobless people, hotels which have been shut down and the dependence of the UAE on tourism”*. Robert Baldwin states that the government has to involve and provide incentives, otherwise the economy will draw back to fossil fuels. He also sees problems with the collapse in oil prices, which came along with the crisis and may burden green recovery by limiting cash flow in the UAE.

Knowledge and technology

The assets of the UAE itself will have to be discovered in terms of food security. The resources are described by the three S, Sand, Sun and Sea, according to Samar Kadri. Climate conditions are also changing fast, which requires knowledge on how to adapt to the new circumstances according to Hector Hugo Hernandez. Erik Smidt says: *“the Netherlands cannot feed the world, but we can transfer the knowledge”*. The UAE wants to be a knowledge and technology hub to decrease desertification, which is a challenge, looking at the increasing water scarcity of the region according to Samar Kadri. To gain this knowledge, the right researchers have to be attracted, a lot still has to come from abroad, Hector Hugo Hernandez states. The Dutch Wageningen University is known to be world leading in terms of seaweed innovations.

What can be offered from the Emirati perspective in a bilateral cooperation
Table 88, Offers from the UAE perspective

By grouping coded interviews, four themes repeated themselves, the core offers from the Emirati side. Cooperation was a need from the Dutch side as well as Green solutions. Furthermore, the Emirati offer of business deals speaks to the Dutch needs for Access to finance and Acceleration.

Core Offers	Business	Government	Research	Total
Shows	1	5	0	6
Green solutions	2	2	1	5
Business deals	1	1	1	3
Cooperation	1	3	0	4

Shows

The Dubai Expo is a wonderful way to show off successful projects, according to Robert Baldwin, in which he is referring to his former seaweed project at Masdar. Lena Hildmann states that a world expo is a good place to show mixes of different cuisines since food connects cultures and people. Country pavilions are also known to share national food dishes. Samar Kadri argues that the water energy food nexus story at the expo is a good way to show how seaweed connects these sectors positively.

Green solutions

The UAE offers knowledge towards green solutions, by experimenting with seaweed at Masdar for example. Masdar is a district close to Abu Dhabi which is completely built to have a climate neutral footprint, where Robert Baldwin and Hector Hugo Hernandez both work(ed). Initiatives to gather international knowhow are organized to increase sustainable innovations in food cultivation according to Samar Kadri. She also mentioned how the government of the UAE seeks to decrease desertification.

Business deals

The UAE government is very forward looking and strongly pushes innovation forwards. This can help businesses overcome the starting phase in the experience of Robert Baldwin. After the research and development phase is over, the business focused mentality of the UAE also helps to increase innovation according to Hector Hugo Hernandez. Erik Smidt says that deals can be closed very quickly in the UAE, but it helps to be familiar and very friendly.

Cooperation

Cooperation is also an offer mentioned by the government and the business spheres. Robert Baldwin mentions the Dubai Expo could be a connecting factor for researchers and innovators all over the world. Furthermore, he told about how the seaweed project at Masdar started with a consortium of cooperating parties like Boeing, Etihad airways, Safran and the government. Furthermore, there is a consortium of Dutch seaweed professionals, together with Wageningen University and the agricultural council already operating in Saudi Arabia.

To summarize; The needs from the Emirati side are cultural sensitivity, a solution to problems felt by the COVID crisis, a need for food security and knowledge and technology (Table 7). Their offers are; green solutions, business deals, cooperation and shows (Table 8).

Opportunities at the Dubai Expo to bring Dutch and Emirati professionals closer on seaweed production

As famous historian George Santayana said: those who cannot remember the past are condemned to repeat it (Dictionary.com, 2017). Therefore, this chapter starts with a small explanation of previous expo's and how sustainability, food and sometimes even seaweed played a role there. Furthermore, opportunities at the Dubai Expo, under the current planning, will be highlighted.

2015 Milano: the Dutch Pavilion had an open-air stage to create a festival experience under the theme “share grow live”. The theme of the expo was: Feeding the planet, Energy for life (Oerlemans, 2015). The Food trucks at the Dutch pavilion also offered sustainable food solutions, such as seaweed, bugs and cookbooks for lab-grown meat (Albeck-Ripka, 2015).

2010 Shanghai: the Dutch pavilion celebrated Dutch innovation in the areas of space, energy and water. The Netherlands wanted to position itself as innovative and progressive in the fields of sustainability, environment and urban development. Seaweed as an innovation within these themes was not mentioned for the Dutch pavilion (Warmann, 2010).

2005 Aichi: The Netherlands had chosen “Land of water” as the central theme, where the Netherlands was presenting the dynamic balance between land and water, man and nature (expo2005, 2005). Since the event was held in Japan, seaweed was served in the restaurants, but was not a big part of the Dutch message.

2021 Dubai: there are multiple algae-related initiatives. Italy is integrating algae in the pavilion to produce energy and food. Microalgae like chlorella, spirulina and Dunaliella will purify CO₂ from the air into oxygen, which is organized by Tolo Green, an Italian company and technological partner during the expo (Algaeworldnews, 2019). The Czech Republic will showcase its innovative Solar Air Water Earth Resource (S.A.W.E.R) system, which uses solar energy to collect water from air, using a photobioreactor and compost tea. Scientists have successfully used this water to produce an algae that helps grass, herbs and crops grow in desert sand (Expo2020dubai, 2018).



Figure 5, Italian pavilion



Figure 6, S.A.W.E.R system from the Czech pavilion

It's also a possibility to serve seaweed at the Expo an experiment with the national Dutch cuisine. To serve seaweed in independent restaurant pavilions, it should comply with the food ethos, a set of guidelines to push the hospitality sector to a greener level. The ingredients should be locally sourced in the gulf region, be certified organic, have sustainable packaging and be affordable for the end customer. The Expo has more requirements, but seaweed already fits these; like vegan destinations and dietary options (Lena Hildmann, Appendix M).

Specific other opportunities at the expo for cooperation:

The Expo is a door to an international podium and is connected to all kinds of fairs in the UAE. In the following paragraphs, the opportunities for professionals affiliated with seaweed will be explained in the following paragraph, sorted by target group.

The general public:

- Digital or real-life tours can be given through the pavilion, where visitors can experience the connection of water, energy and food. Seaweed is a good example to give, along with greenhouse farming, which is the Dutch main focus for food. All interviewees confirmed that seaweed fits well into the WEF-Nexus theme.
- Seaweed could be served in the food court of the Dutch pavilion

Government to Government

- The **world government summit** is held alongside of the Expo in Dubai, which includes a series of forums such as the Global Policy Platform and the Climate Change Forum. The agenda is not known yet, but the 2019 edition included The World's next Resources which also suits to seaweed and algae. This would be a good way to tell about the Dutch plans to cultivate seaweed large scale and the policy required to realise this (worldgovernmentsummit, 2019). At these kind of events, the Dutch Minister President would usually join and give a speech.
- **Floriade dialogues** are sessions where global expertise on soil, water, food, energy and socially related solutions will be brought together. It will not only explore this topic from a technological perspective but added subjects like resilience-based policy information systems, capacity building policy and proper investment perspectives. This will be digitally connected to the Expo Dubai and an easy way for seaweed producers in the Netherlands to get a stage at the Expo (Floriade Expo 2022, 2020).

- **Organised panel discussions** this could be with organizations like the EU, the UN and national governments, to discuss algae policy on a global scale with researchers and businesses.

Business to business

- **Gulfood** is a trade fair where essential contacts can be made to the Middle East and beyond. This will not be meant for builders of seaweed systems, but for exporters of specialty seaweed products and processed items. It will not be held at the expo, but alongside it, an evening programme can be custom-made for the participating businesses (GulFood, 2020).

The **Abu Dhabi sustainability week** is a global platform for accelerating the world's sustainable development. ADSW 2020 hosted around 45,000 attendees from 170 countries, with more than 500 high-level speakers from around the world. The pillars of coming session in 2021 (official date remains unknown), are: energy and climate change, the future of mobility, water and food, biotechnology and health, space and tech for good. The ADSW seeks to be aligned with the SDG's. (Abu Dhabi Sustainability Week, 2020)



figure 7, Abu Dhabi Sustainability week statistics 2019

- The **GFIA**, also known as the Global Forum for Innovations in Agriculture, is usually held at the beginning of march. The focus themes where seaweed can play a role are, aquaculture, indoor farming and hydroponics and livestock and animal production (feed). There will also be a Dutch pavilion at the GFIA, where companies can attend under more attractive conditions and represent the Netherlands. (Ministry of Agriculture, Nature and Food Quality. , 2020)

Knowledge to knowledge

- **Abu Dhabi sustainability week** incorporates the research sector as well, by trying to connect to the youth (future researchers) and experienced researchers (Abu Dhabi Sustainability Week, 2020).
- **Wageningen Urban Farming challenge** winners will be chosen at the Dubai Expo, which leaves room for a talk of a Wageningen professor about greenhouses which integrate algae, called aquaponics (Pals, 2018).
- **Digital events**, like Webinars are an option which easily makes the connection to a crowd without having to travel physically. Existing webinars can be joined if the subject matches the field of study of the researcher. Webinars can also be set up around the themes of knowledge and technology, green solutions, food security, etc. Agricultural counsellors from the Netherlands in the gulf region are a good partner, as well as Masdar, Wageningen university, governmental representatives from both sides and different investment offices in the UAE.

Although seaweed has not been a major part of expo's in the past, Dubai's new take on world expo's and sustainability already invited Italy and the Czech Republic to incorporate seaweed into their pavilion. Other than being incorporated in the Dutch Nexus storyline, seaweed could be part of some of the many events organized at and around the Expo.

4. Discussion of results

Sub question one: Bilateral cooperation models between the UAE and the Netherlands

For this research question, desk research has been used to find fitting models to a bilateral cooperation on seaweed. What made the search for fitting business models harder was that many research papers which features the word “model” in the title did not feature a model in the research paper. Instead, a more political disquisition is associated with bilateral cooperation model in scientific literature, featuring extensive analysis using the prisoners dilemma (Dai, Snidal, & Sampson, March 2010). Since this bilateral cooperation is not between two organizations, but between different sectors and spheres (business, government, university), conventional management models applicable for businesses also did not fit. The Triple Helix was explained in this chapter and mentioned in the interviews, for example by Petra Steenhoek: “*we need each other*” (Appendix K). This justified the strategy to take interviews from business, government and research perspectives and to group expo opportunities according to the triple helix as well. Furthermore, the cultural dimensions theory of Hofstede only takes into account a general view of a country’s cultural pillars, while the UAE is known to be very multicultural (Embassy of the Kingdom of the Netherlands in the UAE, 2018).

Sub question two and three: The needs and offers of the Dutch and Emirati perspective

To identify needs and offers in the second and third sub-question, ten interviews were taken in total, according to the methods written in chapter two. Concerning time, this was the utmost achievable within the limited timeframe. Therefore the sample was small and not randomly picked, as most interviewees were warm contacts or were recommended by earlier interviewees. All parties mentioned in table 4 were addressed, but only a few of them were up for an interview, many forwarded the email to a colleague which was more of an expert in the subject. It was sometimes hard to make a clear distinction between the Dutch and UAE side as well. For example with Erik Smidt, who is a Dutch agricultural counsellor working in the gulf area. The interview with Lena Hildmann was used for both the Dutch and UAE side because she is the country director of the Netherlands from the BIE organization which organizes the world expo. The interviews showed links to possible cooperation partners, but do not make the interview results generalizable to the whole seaweed sector.

The interview questions can be read in appendix A, where many questions can be answered with either yes or no. This increases the risk of participants agreeing with the interviewer, just to complete the interview. But, when carrying out the interview, the respondents usually just kept talking after the first question was asked, answering multiple questions at once. Therefore, the influence of the formulation of the specific questions only limitedly affects the obtained results. Furthermore, there is a risk of participants reacting differently because the interviewer was not anonymous. Before the interview was taken the interviewee already knew that the interviewer did an internship at the Ministry of Foreign Affairs. Because many seaweed businesses and researches are partly sponsored by the government, this could also have influenced the results. In one interview with Petra Steenhoek from Hortimare, subsidies are directly addressed without the interview question being pointed in this direction. Although it is clear that there is a need for funding for emerging projects, it's questionable if these answers are fair.

Sub Question four: Opportunities at the Dubai Expo to bring Dutch and Emirati professionals closer on seaweed production

In chapter six, desk research was used to identify specific opportunities at the world expo for seaweed businesses. In this section, it was hard to find independent sources without a shared interest in the Expo. On the basis of obtained data, it cannot be concluded if the choices made for the past expo's were successful, or factually predict which expo opportunities will be the most successful. In the interviews, more critical opinions have been voiced. Adrie van der Werf mentioned that as a researcher, world Expo's are not the place for scientist as it's too business focused (Appendix L). It should be mentioned that this list of opportunities do not necessarily need to appeal to all stakeholders of the seaweed sector. Furthermore, the pandemic of 2020 also seriously affects the coming trade fairs and the expo, the exact dates of the fairs are not known and the expo has been postponed with a year. Furthermore, there will also be socio-economic, financial and political effects of the coronavirus, which shape a unique background of mega events like a world expo.

Interpretation of results

In this part, the linkages will be found between obtained results and the interpretation thereof will be discussed.

Sub question one: Bilateral cooperation models between the UAE and the Netherlands

As mentioned before, the triple helix (Figure 2) was a big part of this research, which is why interviews were taken from all members of the triple helix, and interviewees were asked to name what they would need from other parties of the Triple Helix, like the government or businesses. The researcher Klaas Timmermans mentioned, “It starts from the individual; broad support is needed from all sides to increase plant-based raw materials like seaweed”. This means that there would be a chance that the quadruple helix is relevant, which also includes citizens. This is a surprising remark since the desk research in the introduction did not show any sign of the citizens being involved in the seaweed process.

The WEF- Nexus was explained as a model as well (Figure 3), from which all interviewees thought that seaweed would be a good example to explain the interlinkages of these sectors. From the Water-Energy-Food Nexus perspective, it is perceived that the need for Food Security is the most prevalent in the interviews, with food security being the second core need from the UAE. It should be said that energy and water are inputs for this need, for which water is the most scarce in the dry climate of the UAE (Embassy of the Kingdom of the Netherlands in the UAE, 2018), (Appendix P), (Appendix Q).

The TRBNA methodology for collaboration (Figure 4) can be used as a roadmap to the Expo Dubai since this is a plan for a stakeholder dialogue between parties to find solutions on intersectoral issues.

Cultural sensitivity was marked as one of the core needs of the Dutch and Emirati side, but Hofstede was not mentioned literally. At the Dutch side, it was marked as the fifth most important and at the Emirati side, it has been marked as the first most important factor. Intercultural sensitivity was taken as a broad concept including eating culture, working culture and national culture. This gap can be explained by a lack of knowledge of the different cultures, which could be improved by a training or briefing session.

Sub question two and three: The needs and offers of the Dutch and Emirati perspective

When putting the needs and offers of these questions next to each other, it can be seen that there are chances for possible synergies.

First and foremost, the demand from the Emirati side for specifically seaweed projects is high. This can be seen by the willingness to invest in such technology. *“The UAE has created the Abu Dhabi investment office, which launched about 1 billion dirhams to expand the knowledge in 3 areas: seaweed, robotics and inventive ideas. There were many worldwide applicants and they will apply this mainly in greenhouses”* (Samar Kadri ,Appendix O).

And, by the willingness to invest in algae research: *“there is also the Gharifa fund, which supports research, from which a part is seaweed and algae. The climate in UAE is very good for algae growth, because of our humidity and salty water its very good for algae”* (Samar Kadri ,Appendix O).

The interviews have also shown that the Netherlands is known to have a very good reputation around seaweed. Robert Baldwin, a former researcher at Masdar in the UAE stated *“Wageningen is the leader in the world as well as some other universities in the US, but Europe is at the forefront”*. And Samar Kadri stated: *“Dutch costs are high compared to China and India. We are expensive because of the quality. Being culturally sensitive and patient is very, very important”*.

This means that there is an opportunity to start a specific seaweed cooperation trajectory. The coding showed how the needs and offers of both sides can be linked in certain areas.

- The Dutch side has a need for cooperation and the UAE can offer cooperation
- The Dutch side has a need for access to finance and acceleration, while the UAE can offer a world stage (show) and business deals.
- The UAE side has a need for knowledge and technology, food security and a solution to problems felt by the COVID crisis, which can be offered through Dutch Research and Development
- Both parties have a need for intercultural sensitivity
- Both parties can offer green solutions

This can be read further in detail in Appendix P and 18. A small note should be made that this collaboration is not between countries, but between stakeholders operating in a specific country. However, the efforts of these stakeholders will contribute to national goals; increasing food security in the UAE and the export of knowledge from the Netherlands.

Since the Dubai Expo is world Expo, businesses or research institutions will have to work together with their national government to be part of the program at a national pavilion. From the Dutch point of view, some needs for increased collaboration within the spheres of business, government and research were mentioned.

- Jaap van Hal from the research sector mentioned that the financing instruments (from the government) are rare, mildly speaking, and that the capacity at TNO is limited (Appendix F).
- Petra Steenhoek (business) mentioned she is looking for consortia to expand the network in the Arab community (Appendix K).
- Adrie (business) mentioned that in his experience, it was hard to get access to the right partners at an expo (Appendix L).
- Niek de Regt mentions as the project leader of the expo that it would be relevant if 'they' could collectively enter the expo (Appendix J).

As it can be seen, all three spheres can benefit from a closer cooperation, it would be in terms of network, impact and financing instruments.

Sub question four: Opportunities at the Dubai Expo to bring Dutch and Emirati professionals closer on seaweed production

The general public: since all interviewees (Appendix F-16) found seaweed connects very well to the story of uniting water energy and food, there is an opportunity to add seaweed to the main message of the Dutch Pavilion at the Expo in Dubai. It is unknown since the COVID-crisis if there would still be as much visitors as expected in 2020, to limit the change on infection (WHO, 2020).

Government to government: seaweed contributes positively to 80% of the SDG's (Niek de Regt, Appendix J). Therefore, seaweed innovation can also be a solution to some geopolitical problems of today, but this does not mean that it would be something for the World Government Summit, where numerous heads of state discuss policy ambitions.

It could be an option to organize panel discussions at the Dubai Expo, but this might also require time and manpower. As it was stated earlier, capacity is scarce in the seaweed sector (Jaap van Hal, Appendix F), which is why an existing event might be better. Therefore, the Floriade Dialogues seem like the best option to give the Dutch seaweed sector a platform in the UAE.

Business to business: the Abu Dhabi Sustainability Week seems like the most interesting event from those listed in this category since this event is focused on speakers with an inspiring story. GulFood and the GFIA are much focused on innovations and selling of products, for which the Dutch seaweed sector might still be too young.

Knowledge to knowledge: in this part, the Abu Dhabi Sustainability Week is mentioned again since this week is also used to connect the youth to fellow researchers. However, that might not be the reason for a Dutch seaweed researcher to travel to the UAE. It's more interesting for them to play a role in existing events, such as the Wageningen Urban Farming Challenge for the connection of seaweed and greenhouses. Another option, for which no travels would have to be made, are digital events like webinars, where seaweed researchers could share knowledge on food security.

5. Conclusion and recommendations

This research aimed to find out how the Netherlands and the UAE can collaborate on seaweed production by using the Dubai Expo to bring both parties together. To know the answer to this question, existing models have been searched to find a framework, interviews were carried out and opportunities at the Dubai Expo for the seaweed sector were identified.

1. Which models exist for bilateral cooperation?

Examples of existing tools and models are; the Triple Helix, Water-Energy-Food Nexus, the Sustainable Development Goals, SMART goal setting, the TRBNA methodology for collaboration and the Cultural dimension theory of Hofstede. A predefined model for this particular case has not been found.

2. What is the offer and the specific “need” from the Dutch perspective on the bilateral cooperation on seaweed?

Needs: cooperation, access to finance, acceleration, green solutions and cultural sensitivity. This can be read in further detail in Appendix P.

Offers: green solutions, the wide array of applications of seaweed, government collaboration, acceleration, research and development. This can be read in further detail in Appendix Q.

To satisfy these needs, it is advised to target the Dubai expo cooperatively. Some form of financing is needed for this, as collaborating takes time and money. For this, government collaboration could result in some form of financing, otherwise this finance would have to be sourced elsewhere. After the initial financing, made business deals can add to the need of acceleration. The need for further green solutions from the Dutch perspective links to the offer from the Emirati side of green solutions, where they have been experimenting with carbon-neutral living at Masdar city (Hector Hugo Hernandez, Appendix N). A training in intercultural sensitivity could help to solve this need and make the collaboration process smoother.

3. What is the offer and the specific “need” from the UAE perspective on the bilateral cooperation on seaweed?

Needs: cultural sensitivity, a solution to problems felt by the COVID crisis, a need for food security and knowledge and technology. This can be read in further detail in Appendix P.

Offers: green solutions, business deals, cooperation and shows. This can be read in further detail in Appendix Q.

Cultural sensitivity would be already acted upon by the training mentioned in the previous paragraph. The solution to problems felt by the COVID crisis, food security and knowledge and technology can all be linked to the offer of research and development and acceleration at the Dutch side.

4. How can the Dubai expo bring Dutch and Emirati professionals closer on seaweed production?

The recommended way to bring Dutch and Emirati professionals closer using the expo has been made into a figure. From left to right: different stakeholders, steps and desired outcomes have been identified. A recommendation of events at the Expo has been made between the different events described in chapter four, based on the focus on green solutions and attainability of the project. The green colour stands for all parties, blue textboxes are focused on business, yellow for government and red for research. Below, a textbox has been added for economy, environment and pandemic context, as these changing circumstances were considered a major hurdle for most interview partners.

Main question

To answer the main question: “*how can the Netherlands and the UAE collaborate on seaweed production by using the Dubai Expo to bring both parties together?*” a new model will be made, using the gained insights of this research.

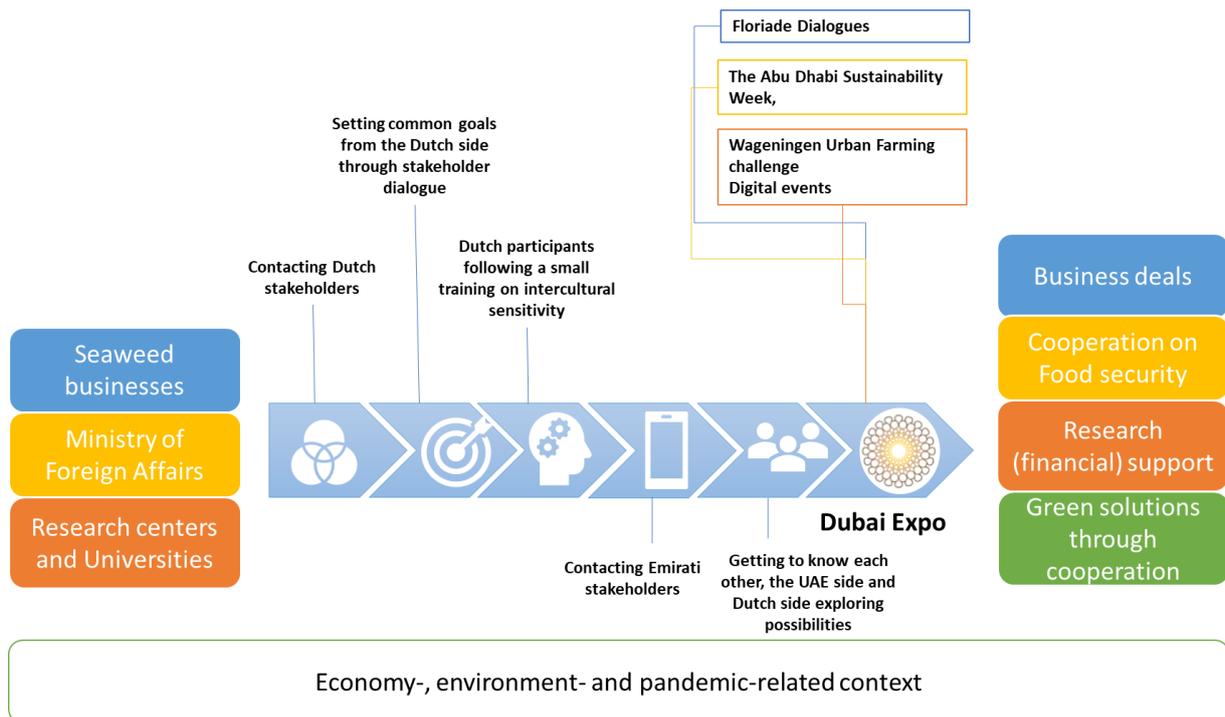


figure 9, Seaweed Road to Dubai Expo

As can be seen above, the first step is to identify stakeholders from the triple helix, affiliated with seaweed. The interviews of this research have provided useful links to these stakeholders.

Dutch side
<ul style="list-style-type: none"> • Niek de Regt (government) is leading the expo project • Samar Kadri (government) could be called in sometimes for intercultural consultation • Erik Smidt (government) can be called in for consultation concerning the seaweed project in Saudi Arabia • Klaas Timmermans (research) is working on fish feed with seaweed, which can be linked to Masdar's seaweed aquaculture project • Jaap van Hal (research) • Petra Steenhoek or somebody else from Hortimare (business) • Adrie van der Werf could provide further contacts to wageningen university

Then, the second step is to set common goals through stakeholder dialogue. This can be done according to SMART goal setting described in the first sub-question. Then, to tackle the need for intercultural sensitivity, a training or counselling on this issue can be offered.

The fourth step includes contacting the Emirati counterparts, for which this report has also provided links to partners which may be interesting.

<p>UAE</p> <ul style="list-style-type: none"> • Hector Hugo Hernandez from Masdar • Samar Kadri might be able to provide contacts to: ICBA: International Centre for Bio saline Agriculture, • The al ain university in the UAE • The Abu Dhabi investment office • The Gharifa fund for research, from which a part is algae • Representatives of the Ministry of Food Security and Water. • The ATIC food participation challenge • The BIE organization, possibly via Lena Hildmann • The Czech and Italian pavilion for collaborative events

Getting to know each other if the next step, preferably before the Expo starts so possibilities of cooperation can be explored. At the Dubai Expo, seaweed stakeholders can join events to get a podium in the UAE. The aforementioned most fitted events are listed above this step. The yellow colour of businesses at the left side, corresponds to the yellow desired outcome on the right side, business deals. The desired outcome from a government perspective is to collaborate on Food Security and the research sector would benefit by supporting each other with investigations, which could also be financial support. A fourth desired outcome is marked green since green solutions through cooperation would benefit all stakeholders. A fourth desired outcome is marked green since green solutions through cooperation would benefit all stakeholders. This “road to the expo” will also be influenced by the economy and by global events such as the COVID pandemic of 2020.

There are certain uncertainties and gaps found in this thesis which call for further research. In the short term, the COVID pandemic of 2020 brings uncertainties since the Dubai expo initially aimed to bring people together physically. This might not be possible anymore due to the measurements to keep 1.5 meters distance and largely stay at home. Further research is needed to find out how to build a personal bond and collaborate without forming a public health hazard. Furthermore, since the world expo is not only directed to the Emiratis, but there are other countries participating, there are opportunities to collaborate with more stakeholders from different countries. Italy and the Czech republic are interesting parties to explore collaboration with on the Dubai expo since they are already incorporating seaweed in the pavilion.

In the long term, as the collaboration has been formed, it is to be recommended to also conduct further research on how seaweed can exactly be used for food security in the Emirates. This research has made clear that there is also a consumer acceptance process to be followed. The seaweed processing method and appealing marketing methods for the Emirati market still need to be explored.

As the Dubai Expo states: connecting minds, creating the future. The connection of stakeholders is key to find out how seaweed can be used to increase food security in the UAE.

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Appendix A: The interview questions of the second sub-question.

The website of Dutch Dubai will be given in the email as well as a small introduction to the Nexus concept.

Sub-question: What is the offer and the specific “need” from the Dutch perspective of the bilateral cooperation on seaweed?

Interview questions:

1. What is your Profession and field of expertise?
2. (If applicable) In what way does your expertise contribute to the Food System in the Netherlands and possibly across the border as well?
3. What is your organization’s vision for seaweed in the future?
4. Can you name some current hurdles and struggles of your organization in terms of seaweed production?
5. What would be needed in your organization to overcome these hurdles?
6. Follow up: and in terms of research or government or business?
7. What is your organization’s strategy in terms of international cooperation on Seaweed?
8. Is the Gulf region currently of interest to your organization?
9. Do you think seaweed cultivation is an important part of the water, energy and Food Nexus?
10. A: If Yes: How?
B: If no: Why?
11. The Expo Dubai is coming up, is this of interest for your organization?
12. A. If yes: In what way could your organization contribute in the Expo Dubai?
And: What would you hope to gain from the participation?
B. If No: Why?

Appendix B: List of contacts to address for the interviews of the Dutch side.

The goal was to have at least six respondents, spread out over the business, government and research areas. Therefore, the following people have been contacted, and due to the snowball effect, six people have been interviewed.

Table 99, Contacts sub-question two

Government and intergovernmental bodies.	Business and investment	Research
Bureau Internationale des Expositions (BIE) – Lena Hildmann (Country officer)	Hortimare – Jos Heldens (Senior Scientist)	Wageningen University Research – Ineke Ammerlaan (contact person seaweed research)
The Netherlands Enterprise Agency (RVO) and The Ministry of Foreign Affairs - Rogier van der Pluim (Director of the MENA team) Nicolaas de Regt (Director of the Expo team) Daan Stoop (Manager of Dutch pavilion from the Netherlands Enterprise Agency)	Omega Green – Nouraddine Gribi (project developer)	Netherlands Organization for Applied Scientific Research (TNO) (Jaap van Hal – seaweed pioneer within the organization)
Topsector Agri & Food – Willie van den Broek (Project leader of seaweed for food and feed)	Vobra – Wendy Nijhuis (accountmanager of pet food health care)	The University of Groningen Alexander Lubsch (researcher of nutrient absorption of seaweed farming)
Ministry of Infrastructure and Water management (IenW)	Zeewaar – Matthijs Strosnijder (Director of farm operations)	NIOZ (Royal Netherlands Institute for Sea Research)

Mohammed al hi – involved with the Expo Dubai		Amy Mairo (current intern, known through mutual connections)
The Ministry of Agriculture, nature and Food Quality (LNV) - Pieter Vaandrager – Organizer of the Dutch participation of the Horti Expo 2021 in Qatar	Olmix – Hans Bleumink (Territory Manager of the Netherlands)	
Ministry of the Interior and Kingdom Relations (BZK) - Willie van den Broek (Project leader of seaweed for food and feed)	Westland cheese – Henk Westland (Commissioner) or Ingeborg Haagsma (research and development (R&D) director)	
Ministry of Economic Affairs and Climate Policy (EZK) – Nathalie Scheidekker (projectmanager at EZK on seaweed)	Seaweedfarmers – Nikki Spil (Co-founder and biological architect)	
The United Nations (UN)– Nicolaas de Regt (Former Diplomat at the UN)	Noordzeeboerderij – Marlies draisma (Manager markets and applications)	

Appendix C: The interview questions of the third sub-question.

Sub-question: What is the offer and the specific “need” from the UAE perspective on the bilateral cooperation on seaweed?

Interview questions:

1. What is your Profession and field of expertise?
2. In what way does your expertise contribute to the Food system in the UAE and possibly across the border as well?
3. What is your organization’s vision for future local food production in the UAE?
4. Can you name some current hurdles and struggles of your organization to increase local food production in the UAE?
5. What would be needed in your organization to overcome these hurdles?
6. The Expo Dubai is coming up, is this of interest for your organization? I
7. A. If yes: How will you be involved in the Expo Dubai?
B. If No: Why?
8. The Netherlands is working on showcasing the connection between water, food and energy for the World Expo in Dubai, does this connect to your work?
9. A: If Yes: How?
B: If no: Why?
10. Is seaweed something that’s currently of interest for your organization?
11. A. if yes, in which way? Do you work together with other organizations on this matter?
B. If no, why? Have you heard if other organizations are interested in seaweed?

Appendix D: List of contacts to address for the interviews of the UAE side.

The website of Dutch Dubai will be mentioned in the email so the participant can gain insight into the Dutch participation of the Expo Dubai.

Table 10, contacts for sub-question three

Government and intergovernmental bodies.	Business and investment	Research
The ministry of Food Security H.E. Rashed al Shuraiqi, Senior Advisor for Agriculture	Gulfood – contact list on gulfood.com	The Masdar institute – Dr. Robert M. Baldwin (Professor Chemical Engineering)
The ministry of energy – Hind Almutawa (Innovation manager at the Ministry of Energy)	The FoodTech Challenge (Info@FoodTechchallenge.nl)	The American University of Sharjah – Adran Elouisi (Senior Industrial engineer of seaweed packaging)
The United Nations – Nicolaas de Regt (Former UN diplomat)	Catalyst – Dominique Jade Chatfield or Amna al Baloushi (Program Managers)	The College of Food and Agriculture – Mamdouh Kawna (Lab specialist in the field of arid agriculture)
Bureau International des Expositions (BIE) Lena Hildmann (Country officer)	Mubadala – Khaled Abdulla Al Qubisi (Chief Executive Officer Aerospace, Renewables and IT)	International Centre for Biosaline Agriculture - Dr. Dionysia Lyra (Halophyte Agronomist)
The Ministry of environment and water – Ibrahim Muhammad (Water resources Engineer)	The FoodTank - Danielle Nierenberg (Co-founder and president)	
Consulate General of the Netherlands in the UAE - Suzanne Hartog (Programming Director from the UAE)	Madar Farms - Abdulaziz al mulla, (Co-founder and CEO)	

Embassy of the kingdom of the Netherlands in the UAE – Fleur Stevens (Regional advisor for Water and Energy Security)		
Agriculture and Food Safety authority - DR. HANAN Afifi. (Lead researcher)		

Appendix E. Planning

Table 11, Planning

What	When	Who is involved?
Starting point	Monday, November 4 th .	D. Ekkel
Informing my internship on my thesis research proposal and plans	Monday, January 13 th	The ministry of Foreign Affairs
Start of the internship at the ministry of foreign affairs	Monday, February 3 rd	The ministry of foreign affairs
Sending research proposal	Saturday, April 26 th	D. Ekkel
Deadline research proposal	Monday, May 11 th	thesis.almere@aeres.nl
Finish sub-question 1, <i>Which models exist for bilateral cooperation?</i>	Monday, June 22 nd 00:00	-
Start addressing the possible interviewees.	Monday, May 18 th	The table of contacts provided in Appendix B and 4.
Deadline to finish all interviews verbally and transcribe 75% of all interviews	June 29 th	
Finish sub-question 2, <i>What is the offer and the specific "need" from the Dutch perspective on the bilateral cooperation on seaweed?</i>	Monday, July 6 th	The table of contacts provided in Appendix B
Finish sub-question 3, <i>What is the offer and the specific "need" from the UAE perspective on the bilateral cooperation on seaweed?</i>	Monday, July 6 th	The table of contacts provided in Appendix D
Finish sub-question 4, <i>How can the Dubai expo bring Dutch and Emirati professionals closer on seaweed production?</i>	Short version (July 13 th)	Colleagues at internship for feedback
Conclusions and Discussion	After July 13 th	Colleagues at internship for recommendations
Finishing the rest of the report (Grammar, layout, sourcing and last checks)	After July 13 th	-
Final report	10 th of august	Thesis committee and Ephorus

Appendix F Interview - Jaap van Hal (Dutch Side)

1. What is your Profession and field of expertise?
PhD in chemistry, project coordinator at ECN for Seaweed biorefinery and since 2018 innovation manager biorefinery at TNO. TNO has a seaweed processing lab where biorefinery experiments are carried out.
2. (If applicable) In what way does your expertise contribute to the Food System in the Netherlands and possibly across the border as well?
Food is not the main focus of my work, Certain aspects of the Food system transition like logistics, energy needed for processing and technology are part of my tasks. TNO also has a department called "healthy living", where research is carried out on themes like diet and behaviour of people's health and wellbeing.
3. What is your organization's vision for seaweed in the future?
TNO is often carrying out research for the government, in this case, the EU and the Paris agreement have identified specific innovation sectors, from which the Food transition is named E12. It is strived to have a balanced consumption and offer of food, raw materials and energy.
4. Can you name some current hurdles and struggles of your organization in terms of seaweed production?
Scale, scale and scale. This is necessary to make seaweed and processing thereof profitable. There is still a lot of innovation necessary to make this happen, this phase is also known as the valley of death. Scientifically, there is a lot possible, but now it needs to be economically viable. There are many chances, but with limited capacity, priorities have to be made. Seaweed producing systems cost between 10 and 25 million, harvesting boats not included. In terms of CO2 absorption, the faster the technology is implemented, the more it benefits nature. Financial instruments from a government point of view are rare, mildly speaking. A change in policy is necessary as the current work method is time consuming and this innovation is classified as a high-risk investment. Knowledge and broad support are needed. This results in long meetings, where parties like Greenpeace and Van Oord are involved but have different interests.
5. What would be needed in your organization to overcome these hurdles?
In terms of international cooperation, with the UAE for example, we would need somebody local that can get involved at the right tables and can give priority to the project. There are chances enough, but since it is upcoming, the low hanging fruit will be taken at first.
6. Follow up: and in terms of research or government or business?
government: more priority to implement these tools fast, which would also mean more financing instruments.
7. What is your organization's strategy in terms of international cooperation on Seaweed?
The international collaboration is closest within the EU, with Denmark, the Baltic

states, Belgium, maybe France and the DG mare of the EU. The goal of this collaboration is to let seaweed be part of the European policy, to address stakeholders together and share information amongst each other.

8. Is the Gulf region currently of interest to your organization?

We have had conversations with Masdar, a big UAE company looking for sustainable solutions. This was a time intensive process, without much happening. The UAE is suitable for Ulva and some red seaweeds for sure, but it does not have a priority for me. People from the Expo have also visited us, and we have made clear to want to cooperate concerning seaweed production. There are also chances in the UAE for seaweed for sustainable protein and sustainable raw materials. Because of other priorities, there is more low hanging fruit available. We do not have enough capacity to serve everybody.

9. Do you think seaweed cultivation is an important part of the water, energy and Food Nexus? Yes

10. A: If Yes: How?

B: If no: Why?

11. The Expo Dubai is coming up, is this of interest for your organization? Yes, but no priority

12. A. If yes: In what way could your organization be contributing in the Expo Dubai? Exchange practical knowledge in terms of seaweed production and thereby cooperating on a sustainable solution.

B. If No: Why?

13. Do you have further contacts that could be of use? Alejandro Rios Galvan from Masdar and Khalifa University in the UAE.

Appendix G: Interview - Robert Baldwin (UAE side)

1. What is your Profession and field of expertise?

I spent almost 8 years living and working in the UAE (Abu Dhabi) first at the Petroleum Institute and later at Masdar Institute so I'm very familiar with the territory. I also worked on algae while at Masdar including macroalgae (seaweed) so I know a bit about the resource there. I currently work for the national renewable energy laboratory; we are one of the DOI national laboratory US energy labs. We have a single focus mission in the renewable space, so we do all forms of energy efficiency and renewable energy. We are looking into renewable, solar, geothermal and energy security. The area I work in is in Biomass, half of the research at the lab is in the area of Biomass.

2. Does your expertise contribute to the Food system in the UAE and possibly across the border as well?

Via my practical experience with biomass and connections at MIT I got to Masdar. Masdar was looking to start an energy programme where food production and energy production in the form of biomass are combined. I do not know where the algae project of Masdar stands now, but they are still continuing the work I started. I could introduce you to the person in charge there, they are now using microalgae. I don't know if they are doing macro algae as well, but I don't see why that would not work in the system.

3. What is your organization's vision for seaweed in the UAE?

The initial vision was to combine Biofuel production and Food production. This is an old concept; we did not invent this. In the shallow waters of the gulf, there are a lot of different indigenous macro algae species. This means that macro algae could be cultivated without making big ecosystem changes. The Etihad airways wanted to have a source of biofuels and look if this could be linked with food production without creating an environmental disaster. In south America, Latin America, Honduras, India there are lots of examples of people that did aquaculture (fish) in open systems and created an environmental disaster. It created dead zones in the ocean because of an excess of nutrients. The algae would be used to do the remediation of nutrients, which can work with both macro and macro algae.

4. Do you see opportunities for seaweed in the Food sector of the UAE?

We got strong support from the government initially to have this sustainable food and feed production system, for the rest there was not a lot of public reaction. We also got support from Masdar institute and lead a consortium with Etihad airways, Boeing, Safran (French multinational aircraft/engine manufacturer) to start a pilot project. That was 7 years ago.

5. Can you name some current hurdles and struggles of your organization when innovating with seaweed in the UAE?

At the start of the project, we were looking if it was technically feasible, this was solved first before we thought about the economic aspects. At this time, fuel was very expensive, and the airlines were squeezed by carbon tax. The economics were also

motivated by the carbon tax, to look for ways to offset carbon. But again, we were mostly focused on technical feasibility. So: problems we faced were: where will we site this project, how will we get the resources lined up, etc.

6. What would be needed in your organization to overcome these hurdles?
In terms of government in the UAE, they are very forward looking and influence these innovations. This strong government push helped us to overcome the hurdles of the starting phase. But whether this is true still looking at the oil prices, I don't know. This crisis might give us an opportunity to build back greener, but I am critical if this will truly happen. At the end of the day, when oil is 10 dollars a barrel, seaweed won't even be a choice in terms of biofuel. The government has to involve and provide incentives, otherwise the economy will draw back the innovation to fossil fuel in my opinion.
7. The Expo Dubai is coming up, is this of interest for your organization?
I have been to a world expo once, it was a wonderful show. I do not know if Masdar is interested. But if the seaweed project has made a lot of progress it would be a wonderful way to show this off.
8. A. If yes: How will you be involved in the Expo Dubai? I do not know.
B. If No: Why?
9. The Netherlands is working on showcasing the connection between water, food and energy for the World Expo in Dubai, does this connect to your work?
I totally agree and this was exactly what Masdar was intending with this project. I know Saudi Arabia is looking at this as well.
10. A: If Yes: How?
It could also be a connecting factor for researchers and innovators all over the world. There is already a good scientific community all over the world. Wageningen is the leader in the world as well as some other universities in the US, but Europe is at the forefront. In china, there is a lot of algae being cultivated, I think it is mainly for food, I don't know if they are looking for biofuel.
B: If no: Why?
11. Is seaweed something that's currently of interest for your organization? Yes
12. A. if yes, in which way? Do you work together with other organizations on this matter? *As said before, the government, Etihad airways, Boeing, and Safran we are working towards seaweed cultivation to have an environmentally sustainable fish production and create biofuel with the algae biomass created.*
B. If no, why? Have you heard if other organizations are interested in seaweed?

...
13. Do you have further contracts?
I could introduce you to a former colleague, DR. Hector Hugo Hernandez.

Appendix H: Interview – Klaas Timmermans (Dutch side)

1. What is your Profession and field of expertise?

Prof. Dr. K.R. Timmermans has done a master's in biology and started working at the NIOZ on Texel. Under the lead of Klaas Timmermans, the NIOZ seaweed center was realized. Since 2014, he is a professor at the department of Ocean Ecosystems (Faculty of Mathematics and Physics) at the University of Groningen. He teaches "Marine Plant Biomass, under ESRIg, Energy and Sustainability Research Institute Groningen.

2. (If applicable) In what way does your expertise contribute to the Food System in the Netherlands and possibly across the border?

I carry out research for the possibilities to use (among others) seaweed to produce high quality products (protein, carbohydrates, etc.) In combination with the University of Groningen, the goal is to further develop micro-algae, seaweed and salt tolerant landplants. This can be made available for companies to produce a.o. food and energy. As partner of the Macumba project of the EU, culture protocols are developed. In this way, several applications of marine micro-organisms are made possible, for example for protein, medicine or biofuels.

3. What is your organization's vision for seaweed in the future?

There is a lot of interest and new initiatives are coming up, it is hard to tell which ones are promising and which are deemed to fail. I have been approached by parties in the UAE to share knowledge and experience in terms of sustainable biofuel. There is a demand from the middle east, which resulted in a trade mission. When the seaweed farmers came back, everybody was very enthusiastic, but in the end, there was not much follow-up. In the Netherlands, this industry is still coming up, but in the future these kinds of solutions will become more relevant. Seaweed can be cultivated in the UAE, there is plenty of sun and salt water. The fossil fuels, their economy is largely based on, should be diversified. Fossil fuels are basically plant sediments, created over thousands of years. By using biomass technology, fuel and gas can be created from plants directly. We have a climate problem, but the urgency is not necessarily felt by everyone, especially now fossil fuels are so cheap.

4. Can you name some current hurdles and struggles of your organization in terms of seaweed production?

It's more easily said than done to get enough biomass and make the process economical. In terms of seaweed, it also must be brought from the water to the land, which is an overlooked step. Also: what to do with the seaweed? It is full of protein, carbs and other high-quality nutrients, but how do you extract it? Biogas is also an option that is working well on lab scale but scaling up is a hurdle in terms of investment. Until now, alternatives (fossil) are many times cheaper, we know the technical feasibility, but what about the economic feasibility? I am mainly working in the scientific part of seaweed production and processing.

5. What would be needed in your organization to overcome these hurdles?
More investment and funding.
6. Follow up: and in terms of research or government or business?
Since the market is mostly B2B, there should be a higher demand from the business side to go greener. In terms of government, CO2 emissions are still not being taxed, this price will have to be paid by the next generation. For example, kerosene does not have a tax at all. The CO2 emission curve must be lowered. For a country like the Netherlands that is under sea level, climate change and sea level rise is concerning, which is the area of research of the NIOZ. It starts from the individual; broad support is needed from all sides to increase plant-based raw materials like seaweed. An additional benefit of seaweed are the system-effects, having a positive effect on the fish population and nutrient levels.
7. What is your organization's strategy in terms of international cooperation on Seaweed?
Since we are a research organization, we are transparent about our findings, but do not have a specific international strategy. The sustainable management of the sea is the area we are operating in, so this is our focus. We are internationally connected as an institute and as individual scientists. Everything we produce is public, so somebody in the Emirates can use this knowledge freely.
8. Is the Gulf region currently of interest to your organization?
My organization does not focus on the gulf region, but our knowledge is publicly available, and we think global sustainability goals are important.
9. Do you think seaweed cultivation is an important part of the water, energy and Food Nexus?
Eminently
10. A: If Yes: How?
It grows in salty water, which is relevant for the middle east and globally. Seaweed is good to convert into biogas and it is also a good source of food and feed. Seaweed is connecting water, energy and food, but a lot has to happen to facilitate this innovation. We are now researching seaweed as fish feed at NIOZ, as an alternative to (imported) soy. There are many varieties, ranging from 10-20% protein and carbs, which are pretty high percentages. It brings perspective but needs more investments to make this all true. Entrepreneurs have to be stimulated to apply this in a sustainable manner.
11. The Expo Dubai is coming up, is this of interest for your organization?
Not for us, but I know someone that went on a big trade mission with the Dutch Enterprise Agency a while ago. Everybody came back very enthusiastic, but not much came from it. I can connect you to Theo Verleun, who went with them on a trade mission with Wageningen University.
12. If No: Why? *Our focus is to research the Dutch North Sea and the sustainable management thereof, so the UAE does not lie inside of our operational scope. Nevertheless, we are internationally connected as an organization.*
13. 13. Do you have further contacts who could be valuable to speak with?
Theo Verleun (Goa ventures) he is doing a lot with seaweed for food as well.

Appendix I: Interview Erik Smidt (UAE side)

1. What is your Profession and field of expertise?

I am a member of the expo steering committee with experience as an agricultural counselor in the Gulf region (Saudi Arabia, UAE, Kuwait, Qatar, Oman and Bahrain). From this position, I support Dutch companies in the Agri sector with ambitions in the Gulf region.

2. In what way does your expertise contribute to the Food system in the UAE and possibly across the border as well?

I help entrepreneurs in all links from production to consumer, from starting material (seeds, animal feed) and raw materials to end products, including the processing industry, the supply chain, technology, services and trade.

3. What is your organization's vision for future local food production in the UAE?

Now, what the Emirati's focus on is food security, which means to produce more themselves and draw up long-term contracts for imports. Currently, eggs are incubated in the Netherlands for 1 to 2 days, then transported to the UAE and then incubated there, using Dutch machines. If the world still needs to be fed in 30 years' time, more local production will have to be done, so the Netherlands cannot feed the world, but we can transfer the knowledge.

4. Can you name some current hurdles and struggles of your organization to increase local food production in the UAE?

If the question would be framed like that – no. There are some small hurdles, mainly import problems, for example Halal. The Halal Institute in the Netherlands is accredited for this, so the threshold can certainly be overcome. The Emirati are open to talk to about import restrictive measures in the field of food, we are talking about this at EU level. They also adhere well to WTO rules, while other countries in the region don't.

Where I do see hurdles for the UAE itself is their mentality, they think they can be self-sufficient very soon, but I doubt that. For example, a deal was closed yesterday where a billion dirhams were invested in 3.5 hectares of greenhouses. But still, this will feed 10,000 people in total per year, it's a good step, but they are not 100% self-sufficient.

5. What would be needed in your organization to overcome these hurdles?

In the emirates I think they come to a decision very quickly, but not in the first few visits, the 2nd or the 3rd time, much more can happen, especially if you have an introduction via the embassy. By seeing each other once or twice and possibly eat together, you show you're not just there for a project, but you have a more long-term view. Due to lockdown measurements, international cooperation should be virtual, which takes away the cost and time intensive processes of flying. That's why we have

had a few cases where deals were closed very quickly, Omar, Samar and I were there too, we were already familiar, so that might have helped.

6. The Expo Dubai is coming up, is this of interest for your organization?

Yes

7. A. If yes: How will you be involved in the Expo Dubai?

Right now, the schedule is changing, but we were planning to have a big economic mission in the horticultural week and the green city week. Furthermore, there will be a recurring fair called Gulfood, where companies like Duo Penotti, alcohol free beer producers and Tony Chocology will go, they might also want to present themselves on the Dubai Expo. The dairy sector is also coming to the Expo, Campina and a private label brand are working together on this. The veal sector also wants to participate but this has not been planned yet. These weeks are being programmed by Bram in the Hague and the core teams, but the agricultural counsellors in the region will be working out the events and ensuring that the good companies get there from the UAE side. There will also be a government trainee for all countries, who will ensure that all kinds of companies will be involved. Core team horticulture is now also very active. We encourage companies to participate in strategic fairs.

- 8 The Netherlands is working on showcasing the connection between water, food and energy for the World Expo in Dubai, does this connect to your work?

Yes

9. A: If Yes: How?

The WEF Nexus is central to my work.

10. Is seaweed something that's currently of interest for your organization?

Yes

11. A. if yes, in which way? Do you work together with other organizations on this matter?

There is a consortium, led by my predecessor, he is currently leading it as an entrepreneur, I'll just share the phone number. They are preparing to collectively access the Gulf market with seaweed researchers from Wageningen University, Dutch businesses and they want to collaborate with the UAE side. This concept is really being developed, seaweed falls under food security, so you also look at alternative food sources. Proteins from seaweed compared to meat, use significantly less water. There is enough salt water in the UAE. The name of the contact I'll share with you is Hans van den Broek.

We had the same situation when I was an agricultural workshop in Russia. They already grow a lot of seaweed there, this is eaten and processed minimally according to a traditional way. The Netherlands has helped with the processing (e.g. seaweed

burgers), to make it more palatable for the Western market. In terms of best practices, this mainly applies to the Russian situation. In Russia you must bring your own money to put people to work. In the emirates they are willing to invest money, but they want to see an investment back, not necessarily in money, but in (long-term) involvement.

10. Do you have any further contacts that could be of value to engage in a conversation with?

Samar Kadri, the agricultural colleague in Dubai. She is good to discussing things further. And if you're interested to know about seaweed on a global scale, I have another contact for you from Russia. I'll send you an email with the details.

Appendix J: Interview Niek de Regt (Dutch side)

Interview- Niek de Regt

Sub-question: What is the offer and the specific “need” from the Dutch perspective of the bilateral cooperation on seaweed?

Interview questions:

1. What is your Profession and field of expertise?

Experienced senior diplomat with a demonstrated history of working in government, private sector and public administration. Skilled in international negotiation, (economic) development, public-private cooperation, public reform and sustainability (SDGs). Strong community and social services professional with a MA in Political Science & International Relations, Int Business Management, and PhD candidate. Working for Dutch Foreign Service. Volunteer and fundraiser for local communities. Excellent negotiator, connector, communicator and networker. Furthermore, I grew up in the province Sealand, which makes that I have seen seaweed production and tasted it.

2. (If applicable) In what way does your expertise contribute to the Food System in the Netherlands and possibly across the border as well?

When working at the UN, I have led a consortium on Food Security, with the mission to initiate a food transition. In 2050, I think there will be around 6,5 to 7,5 billion people on the world, which all need to be fed. If this will be done according to the current food system, with intensive agriculture and heavy processing, there will be no more arable land left. We organized a “Future Food” expert roundtable with the FAO and the Club of Rome, focusing on insects, seaweed and soy. In this area, there are very practical things that can be pushed to a global scale, to go from intensive livestock to sustainable food production. In the sea, I think there is a big solution since 75% of our world is oceans. The technology is quite simple from what I know from Sealand, it’s a net hanging on different depths according to the species. Seaweeds are very nutritious and have been used for 10.000 of years, even as a medicine. I think seaweed is a solution for energy and food, but also for medicine. At the UN, we also tried to make the food system more sustainable, with “less red, greener” campaigns, for example. But we were thinking most about food security in terms of conflict and natural disasters. When thinking more long-term on sustainability, Food impacts 9 of the 17 SDG’s.

3. What is your vision for seaweed in the future?

I think, next to soy and insects, this really is an alternative food source with a lot of “green components”. If you do it well, it can be very sustainable and climate neutral. Especially compared to the global food systems, which have huge problems. It can not only be a solution for water, energy and food, but also has potential for the Pharmaceutical industry. Seaweed connects positively to 80% of the SDG’s (sustainable Cities, climate action, Sustainable consumption and production, Good

health and wellbeing, Zero hunger, etc). Dutch seaweed technology can serve practical solutions, seaweed is also very well known in Asia. Dutch seaweed is even exported to Japan, which I'm not a huge supporter of. Although it can be a local solution for food shortages, it is still not high on the agenda in the UN. The UN mainly focuses on conflict areas and acute hunger, it's the humanitarian side of the story.

4. Can you name some current hurdles and struggles of your organization in terms of seaweed production?

There are multiple factors forming a hurdle, these are: Economic, socio economic, financial, Lobbies, educational and cultural factors (habituation).

Culture is very hard to overcome, but it can't be a reason not to do it. What is culture? What you eat is often cultural, but it can be changed. As early as the primary schools, if children get lunch at school, the goal can be to at least get fruits and vegetables. Furthermore, if you look at some countries in Africa, your livestock is your life, your food and could even play a role in marriages.

Political factors play a role in the Netherlands as well, for example the CDA will not vote for sustainable livestock production since they will lose votes on this. Also, in Brussels, the Lobby of meat is very big. Negative **Economic-social factors** of meat compared to seaweed are less CO2 production, which contributes to global warming and the degradation of the nearby surroundings. **Financial factors**, which the Netherlands is a clear example of, there is much knowledge available for sustainable food systems. Still, looking at the greenhouse gasses and the meat consumption, it's concerning. We might say we've got the solution but have stronger financial motives to continue business as usual, with climate consequences. **Economic factors** are the farmers which are dependent on livestock, for example 60% of the inhabitants in the mid-west. This produces huge meat-lobbies, but I am sure that by focusing on more sustainable ways of income, the economic benefits will be greater. The lobby of the food industry is huge, especially from countries that depend of meat production for their income.

5. What would be needed in your organization to overcome these hurdles?

Seaweed businesses need to be developed in such a way that they have an international agenda, in order to be applicable for the Dubai Expo participation. But I think it would be very interesting to look into. It's relatively easy to produce seaweed, and if there is a market for these products, I think it could work.

6. Follow up: and in terms of research or government or business?

It would be relevant for us if they could collectively enter the Dubai Expo.

7. What is your organization's strategy in terms of international cooperation on Seaweed?

It would fit in the Water-Energy-Food Nexus theme.

8. Is the Gulf region currently of interest to your organization?

Yes of course! And after this conversation, let's put more seaweed in the pavilion. I would really like it that in terms of food security we would have a lot of good companies producing seaweed.

9. Do you think seaweed cultivation is an important part of the water, energy and Food Nexus?

Yes

10. A: If Yes: How?

As said before, it also does not need any pesticides, which I am also a high benefit. Looking at the nexus on the Expo, it would be very nice to promote seaweed businesses with an international agenda. Next to horticulture, seaweed also embodies the nexus.

B: If no: Why?

11. The Expo Dubai is coming up, is this of interest for your organization?

Yes, I'm the project director of the Dutch participation of the Expo, from the side of the Hague.

12. A. If yes: In what way could your organization be contributing in the Expo Dubai?

And: What would you hope to gain from the participation?

Too much to tell right now, we are organizing the Dutch participation of course.

B. If No: Why?

Appendix K: Interview - Petra Steenhoek (Dutch side)

1. What is your profession and field of expertise?

Petra Steenhoek works as HR & Office Manager at Hortimare and performs project administrative tasks. Background in HR, Sales & Marketing and Logistics.

2. (If applicable) In which way does your expertise contribute to the Dutch food system, and possibly also the food system across the border?

Hortimare is active in the breeding and propagation of seaweed. As a supplier of basic material, Hortimare stands at the root of seaweed cultivation by seaweed farmers. Hortimare is a much sought-after partner for (International) projects, both in its role as "seed supplier" and in the advanced knowledge gained by the Research & Development department in the field of genetics, the lifecycle of various seaweed species, seed technology and cultivation installations. Hortimare: "The global demand for food and industrial raw materials is growing fast and subsequently the pressure on land by extensive agriculture and exhausting raw materials will increase, causing ecological disasters and political instability."

3. What is your organization's vision for seaweed for the future?

Seaweed is the future of many industries. Our founder Job Schipper once started the company with the vision to make a difference in the ever-growing need for proteins for human consumption. In the meantime, many applications have been added, including the feed industry (as a supplement to cow feed for methane reduction and to promote animal health and reduction of antibiotic use), for the food industry as a supply of bulk batches for the use of alginates / binders as well as for replenishing essential nutrients in drinks and other super food products, for the pharmacy and cosmetics industry, for extracting ingredients and then using the residual product on biofuel. Another sustainable aspect is that seaweed cultivation has a positive effect on the bioremediation of the oceans. Because seaweed (and all micro and macro algae) absorbs CO₂, they can be seen as the forests of our oceans.

4. What are the current thresholds and difficult aspects for your seaweed organization (s)?

There are a number of aspects that require attention; our first priority is to deliver a uniform product to our customers with good predictability of seed germination and a guaranteed harvest. This is necessary for our customers so that they can scale up (without too many financial risks). This upscaling allows the seaweed farmers to supply the processing industry with the correct quantities, which in turn enables the industry to use the seaweed as end products as economically as possible. This requires mechanization of sowing and harvesting. The mechanization of the seaweed farms must match well with the material supplied by us. Coordination within the chain is not ideal at the moment, but steps have been taken in the right direction over the recent years. The main goal for Hortimare is the breeding of seaweed and the marketing of seaweed varieties. In addition, we are working hard on expanding the seaweed species to be supplied and Hortimare is investing in researching tissue culture techniques to reproduce and breed red seaweed; the life cycle of red seaweeds is more

complicated and both working towards a hybrid and getting to grips with the tissue culture technique requires a lot of time and money, as well as bringing in personnel and stakeholders with the right knowledge in this area.

5. What would your organization (s) need to overcome these barriers?

Sharing knowledge within projects with, for example, knowledge institutes is an important factor, which is one of the reasons why we actively participate in (subsidized) projects. Naturally, working together with all parties in the sector is very important and forming the right consortia ensures that we build and expand the seaweed industry together at the right pace. It is also still necessary to receive financial support at this stage of the organization. The seaweed industry itself is not self-propelling at this stage, unfortunately.

6. Follow up: could the government, business sector or research play a facilitating role in this?

Yes, the cooperation of all the aforementioned parties can ensure that this will succeed. We need each other. The government could offer a helping hand in thinking along with regard to regulations and licenses and taking the necessary steps, which also helps in transparency and making it easier for (starting) seaweed farmers. The business sector can accelerate these processes and broaden networks and partnerships, and the knowledge institutes are essential to share knowledge and formulate sound answers to practical issues and to substantiate them scientifically. In addition, the government (and perhaps also the business community) will be able to give a financial injection to be able to start the scale-up phase in time.

7. Does your organization have a strategy for international cooperation or international trade in seaweed?

We see exponential growth in international cooperation and trade in seaweed. Seaweed plays a role in more and more (international) projects and the player field is also expanding. Hortimare's strategy is that we participate as much as possible in projects and partnerships as long as the focus for Hortimare on breeding can continue to exist.

8. (If applicable) Is the Arabian Gulf region currently something your organization is interested in?

The Arabian Gulf region is of absolute interest to Hortimare, although we also look at ethical aspects of the working methods of the parties we deal with. In the recent past, initial contacts have also been made through the business community to set up collaborations in the Gulf. For the time being, this has not yet resulted in an active collaboration or project, but we would very much embrace the possibility.

9. Do you think seaweed cultivation is an important aspect of the interplay between food, water and energy? *Absolutely.*

10. A: If yes: In what way?

The way we treat the planet and therefore the oceans also determines our future. As long as we use the resources of our planet in a smart way and distribute the pressure on raw materials as much as possible, we will also keep it liveable for our children. Sustainability is highly regarded within Hortimare. Where we can, we will always make sustainable choices. At Hortimare, our goal is to make food for the inhabitants of our planet via seaweed, while leaving the ocean in its natural form as much as possible. We get a minimum amount of seaweed from the sea to serve our customers as much as possible. How much energy goes into cultivation should never be less the energy and value it yields. That would not be economical either.

11. Expo Dubai will take place in 2021, is this something your organization is interested in? *For sure*

12. If yes: In what way? *We would like to be visible / findable as an organization that can be approached for all kinds of seaweed-related projects and for the supply of seaweed starting material. We are interested in expanding our network in the Arab community because we know that there is serious interest in developing cultivation projects in the Middle East. Hortimare would like to be part of that.*

13. Do you have any further contacts that could be of value to engage in a conversation with? *Marco van Duijvenvoorde (Sea flavours) +31 6 34 84 34 67 - currently approached to establish food safety with regard to seaweed for the United Arab Emirates*

Appendix L: Interview - Adrie van der Werf (Dutch side)

Interview questions:

1. What is your Profession and field of expertise?

Adrie van der Werf is a senior scientist at Wageningen University and Research. Since recently, he started to access the field of Seaweed Biology, where he analyses the whole seaweed value chain together with private partners and the scientific community. Furthermore, he is the coordinator of a consortium of seaweed businesses, focused on seaweed projects in Saudi Arabia as a local protein supply for Cow feed.

2. (If applicable) In what way does your expertise contribute to the Food System in the Netherlands and possibly across the border as well?

This project started around 10 years ago, because we had somebody in our team who did not like the conventional agriculture. He constantly came up with absurd ideas, from some we thought: hey, this could work! That's why we went to Saudi Arabia and set up this project after a few visits. In the meantime, I have taken over his position, we share the character that we are both thinking outside of the box. A delegation from Saudi Arabia came to the Netherlands, with investors. After some hurdles, we got a project of 200M euro in Saudi Arabia, focused on animal food production. This has evolved because the country was first producing its own soy (5.000 hectares), but this cost too much ground water. Seaweed was a good solution. We are now researching if seaweed would reduce the methane emissions with the Proseaweed project of LNV and Wageningen and other partners.

3. What is your organization's vision for seaweed in the future?

Seaweed is only just emerging, land-based food production has seen thousands of years of co-evolution. People think that seaweed can be used very quickly by means of start-ups, but in my opinion, they are wrong.

4. Can you name some current hurdles and struggles of your organization in terms of seaweed production?

We are struggling to find the right stakeholders, the company who would take care of the harvesting machines for Saudi Arabia now want to focus more on their core business, because seaweed is starting up that is not yet one of them. A 50% contribution from the EU is requested for this project. Now here's the problem: the opportunistic behavior of starters, they don't have an investment fund. Since there is no existing market, it is difficult to find external financing. On the other hand, as soon as you have investment money together and you are going to grow, there are still buyers to be found. That is why we have added "cow nutrition", this party is very important because it is an important buyer of protein. Whether it is Soya or seaweed, if it works and sells. We are now conducting research to prove that it works.

5. What would be needed in your organization to overcome these hurdles?

In Europe and the Middle East, supply and demand are not yet balanced out, but there is already a balance in Asia. There is an established seaweed market in

Indonesia and China, which is sold all over the world, but is only possible because the production costs are so low. In Europe, you have to come up with a new idea to make it profitable, maybe in the middle of the ocean, on a very large scale. People say 75% of the Earth's surface is the sea, but you have to remember: what percent of that is suitable, and what are the costs involved?

6. Follow up: and in terms of research or government or business?

It sounds nice to grow this in the middle of the sea, but processing and making a product should then also be done at sea. There are also possibilities near the coast, but this is more complicated, because the sea also has all kinds of other social functions. If another interest (e.g. tourism, shipping or ecology) is more economical or desirable, then this must be considered. We also know little about pests and diseases, pesticides have helped us in the past, but nature suffered. We cannot make this mistake again with the sea. There is still a lot to explore, for science and the businesses.

7. What is your organization's strategy in terms of international cooperation on Seaweed? *We are cooperating with Saudi Arabia from the consortium, but I also have contacts with Asian seaweed producing countries for other projects.*

8. Is the Gulf region currently of interest to your organization?

Yes, especially Saudi Arabia.

9. Do you think seaweed cultivation is an important part of the water, energy and Food Nexus? *Yes, the storyline is relevant in 2 ways.*

A: If Yes: How?

In terms of Food security, it can be a direct food source. It contains protein, but will people also eat it? I won't be eating 100 grams of seaweed a day, that's for sure. You will have to enter a consumer acceptance process. There will be a group that likes it immediately and a group that says: never ever. How do you get the different groups on the seaweed? When you look at food production, there is an incredible gap between what you can expect from the earth and what we produce, and what we need to produce in 30 years. There is a seaweed extract, if you spray that on the crops, the production increase will be between 10 and 30%. We are now measuring this. Should we use seaweed to eat the protein immediately? Or should we ensure protein production by spraying seaweed extract over land based. I immediately received 2 tons from Wageningen to find this out. Seaweed can also be used in combination, via direct consumption, extract and animal feed. I do not believe in biomass, I did a project with reed fields, where we grew reed on a large scale. We couldn't find funding, and everyone pointed at each other. Province pointed to the farmers, who were responsible for the pollution. The farmers pointed to the "waterschap", which pointed to the province, etcetera. Then, we looked into Biomass, but we only received 20 euros per ton of dry matters, I don't think you get a revenue model like that. And the pharmaceutical industry is a good option, but then you have to meet enormous standards.

B: If no: Why?

10. The Expo Dubai is coming up, is this of interest for your organization?

Perhaps for the organization because this is an expo for the region, which also includes Saudi Arabia, but not for me personally.

A. If yes: And: What would you hope to gain from the participation? -

B. If No: Why?

I had been to an expo before, I had an invitation to speak. What struck me was that the expo was purely focused on business. This makes it very difficult to walk in and find a contact of value as a scientist. The interest is not in science, at least not directly, perhaps in a wrapped form. I think that also applies to other researchers, although it may be different for one of Wageningen's business developers who have more experience with this. As a scientist, I found it difficult to set up a joint project through such an expo.

11. In what way could your organization be contributing in the Expo Dubai?

A company of our consortium such as cow nutrition may go to the expo, but not for the seaweed. As a research institution, I would not be going to an expo, because of my own experience.

12. Do you have further contacts which could be of value for his research?

The other members of the consortium are no secret, if you're interested, I could give you a list.

Appendix M: Interview - Lena Hildmann (Dutch side and UAE side)

1. What is your Profession and field of expertise?
I'm Lena Hildmann, the country officer of the Netherlands at Bureau Internationale des Exposition.
2. (If applicable) In what way does your expertise contribute to the Food System in the Netherlands and possibly across the border as well?
The previous Expo in Milano was called "Food for the planet, energy for life". Furthermore, at the expo, we have many culinary experiences, showing the future of food. Visitors can get a taste of food, prepared with augmented reality and virtual reality. Furthermore, at a world expo, different cuisines can be mixed, food connects cultures and people. You also see country pavilions showing their own national food dishes.
3. What is your organization's vision for seaweed in the future?
It's certainly part of the innovative food and beverage scene and I know the Italian pavilion is showing micro-algae production. Furthermore, the expo is expecting at least 50% of the visitors to be Asian, these cultures understand seaweed is a good source of food. World Expo's and other smaller expo's have a long history with emerging industries. Although the seaweed industry is not self-propelling at this stage, history has shown us that the World expo is an excellent leap forwards to scale up.
4. Can you name some current hurdles and struggles of your organization in terms of seaweed production?
We do not produce seaweed, but I might be able to connect you to somebody at the Italian pavilion. Serving seaweed at the expo would need to comply with our Food Ethos, a set of values that we designed to give a push to culinary ethics. It would have to be sourced locally, be certified organic, have sustainable packaging and be affordable for the end customer. We have more requirements, but I think seaweed already fits these; like vegan destinations and dietary options.
5. What would be needed in your organization to overcome these hurdles?
There would have to be a local, organic seaweed producer that sells for an affordable price in sustainable packages.
6. Follow up: and in terms of research or government or business?
At country pavilions, these rules do not apply, I think, so a national government could collaborate with any seaweed supplier and the hospitality agency in the pavilion to serve seaweed if they'd like to.
7. What is your organization's strategy in terms of international cooperation on Seaweed?
There is a global need to fight climate change, although the consequences might affect every country differently. For a country like the Netherlands that is under sea level, climate change and sea level rise is concerning.
8. Is the Gulf region currently of interest to your organization? Yes

9. Do you think seaweed cultivation is an important part of the water, energy and Food Nexus? *I do not have a lot of knowledge about this nexus, but it sounds like it does.*
10. A: If Yes: How? *I don't know.*
B: If no: Why?
11. The Expo Dubai is coming up, is this of interest for your organization? *Yes*
12. A. If yes: In what way could your organization be contributing in the Expo Dubai?
And: What would you hope to gain from the participation? *We are organising it.*
B. If No: Why?

Appendix N: Interview – Hector Hugo Hernandez (UAE side)

1. What is your Profession and field of expertise?

I am a researcher, looking at technological possibilities within the frame of economic feasibility. Right now, I'm an assistant professor of chemical engineering at Khalida University of Science and Technology in the UAE, Abu Dhabi. Close to Abu Dhabi, there is Masdar city, a green district built to be climate neutral. Here I work together with Masdar on some seaweed projects and chemical engineering projects. I also often take my students there so they can see how it all works in practise.

2. In what way does your expertise contribute to the Food system in the UAE and possibly across the border as well?

I'm looking at tiny, tiny particles of seaweed for example, but also at desalination processes, wastewater uses, DNA analysis, extracting chemicals from wastewater, etcetera. I'm a researcher, but most of my "clients" are businesses. We have some funding for research from the government, but as the UAE is also very business-focused, there are many innovative entrepreneurs looking to optimize their (In my case, chemical) processes.

3. What is your organization's vision for future local food production in the UAE?

That's hard to tell, on one end, we are finding out ways to use the brine from desalination plants, for example for seaweed production. But at the other hand, climate conditions are getting more and more tough. I live here for 9 years now and it's incredible how fast it's getting warmer and the sea is getting saltier. When I just came here, you could swim, no problem. Now, your eyes are hurting, and your skin is all dried out from the salt water.

4. Can you name some current hurdles and struggles of your organization to increase local food production in the UAE?

We are struggling to find the right researchers, not everybody wants to live in the UAE, a lot has to come from abroad. But we are working on that, the UAE is investing in the youth and you can see more and more are getting interested in sustainability and food. Also, when we do research here, it's open doors for everybody, it's not just for us but for the world.

5. What would be needed in your organization to overcome these hurdles?

I think education is very important, but for the rest I do not know.

6. The Expo Dubai is coming up, is this of interest for your organization? Yes

7. A. If yes: How will you be involved in the Expo Dubai?

From Masdar, we are promoting the expo with sculptures, we have made 21 sculptures representing the Expo logo like a puzzle. It's spread across the Masdar terrain and visitors are encouraged to find all pieces.

B. If No: Why?

8. The Netherlands is working on showcasing the connection between water, food and energy for the World Expo in Dubai, does this connect to your work? Yes

9. A: If Yes: How?

As Masdar, we will be hosting the World future energy summit, which will be held next to the Expo.

B: If no: Why?

10. Is seaweed something that's currently of interest for your organization?

Yes

11. A. if yes, in which way? Do you work together with other organizations on this matter?

We are researching the different metabolites, energy production and food production. Mainly food production and cleaning of desalination brine nowadays, biofuel is hard since the oil price collapse.

B. If no, why? Have you heard if other organizations are interested in seaweed?

12. Do you have other contacts which could be of value?

(not needed, last interview is already planned)

Appendix O: Interview - Samar Kadri (UAE side)

1. What is your Profession and field of expertise?

I was born in Damascus, Syria, and studied the agricultural system in the middle east. I moved to Dubai to work on food security when the nation was still focusing majorly on tourism and construction.

2. In what way does your expertise contribute to the Food system in the UAE and possibly across the border as well?

When I moved from Syria to Dubai for agricultural diplomatic work, I thought to myself: what? Agriculture in a desert? What can they do? As you know, the UAE imports 90 – 95% of their food. We have built the Dutch horticultural cooperation over the years, together with companies and diplomatic work.

3. What is your vision for future local food production in the UAE?

At first, they were mainly focusing on tourism, but when I started, we were slowly starting to do the first experiments. The stronger focus on food production started when Saudi Arabia stopped exporting their locally produced food, as you know, they are part of the GCC countries, within that community they were the main exporters of wheat and potatoes. They stopped exporting the produce and dairy, because it was too water consuming. As the UAE, they cannot stop importing from abroad, but they want to become a food importing and exporting hub like the Netherlands. They want to increase the domestic produce as well. They are comparing themselves to the Netherlands, small country, but good logistical area.

4. Can you name some current hurdles and struggles of you (and your team) to increase local food production in the UAE?

In terms of climate, they are nothing like the Netherlands, so that's why we brought in the Dutch technology, like greenhouses. It's very different, because in the Netherlands you need a heating system, in UAE you need to cool. In the Netherlands you have a lot of water, in the UAE there is no fresh water. How can we save energy and water to produce food? They are looking for innovation and robotics to overcome this. In 2005, they created a food security office in the UAE. After that, the UAE created a ministry of food security, and just last year, they changed it to Food security and Water, because they see, water and food is very connected. So, in fact, I wrote recently an article about food security and the vision of the UAE, I can send it to you. The minister said, especially since Covid-19, it's a huge learning lesson. Here the economic crisis started in 2008, which resulted in many countries stopping food exports. The al ain university in the UAE wants to increase R&D and technology, mainly for the new generation and give awareness to like agriculture and to even cultivate at your own small garden. No, we cannot say they will be self-sufficient. The harsh climate conditions will be a major hurdle for them to cultivate standard crops, like beans, rice and wheat.

5. What would be needed in your organization to overcome these hurdles?

We are organising initiatives which make you think about food production knowhow, innovations, sustainability, cultivation etc. They are trying to produce food staples in the UAE, organised by Chinese people and it's working. They have the will, they have the intention, and they have money, to stimulate worldwide innovation in the food

sector. Recently I organized a webinar with the government of the UAE and Wageningen. They had a competition where multiple initiatives could be selected. 2 winners were chosen, one from the UAE and one Mexican. Recently, the UAE created the Abu Dhabi investment office, which launched about 1 billion dirham to expand the knowledge in 3 areas: seaweed, robotics and inventive ideas. Actually, there were many worldwide applicants and they will apply this mainly in greenhouses. So, that gives you a general idea. The next step of food security is not about supply, but also demand side, our behaviour (Food waste). Hospitality sector in UAE creates a lot of food waste. How to transfer the rest of the food waste and make soil out of it is an initiative. UAE has seen a 25% increase of import and export of food for the region, there is a kind of responsibility to make sure the region has the food sources. they want to mainly be external food trade hub; this is the main reason the UAE is food secure today. They have the ambition to be a Knowledge and technology hub, they are looking to decrease desertification. It's a challenge looking at the water use of produce and desertification.

The UAE wants to invest more in technology like NL that's why when we see seaweed, Masdar is doing a lot of research. They want to make biofuel and cosmetics, supplements and food. Many research is being done, it means stimulating the global research, its open doors for everybody. Masdar city uses an aquaponic system and at ICBA, international centre for bio saline agriculture, global research centre but cooperated with UAE university. There is also the Gharifa fund, which supports research, from which a part is seaweed and algae. The climate in UAE is very good for algae growing, because of our humidity and salty water its very good for algae. To transfer to energy, they need to get technology from abroad. I believe there is a centre for sustainable energy for agreement and cooperation with the Netherlands to create biofuel for expo2020 with algae. I don't know who is doing this. According to the minister, we have 3 S, sand, sun and sea. They say they did not discover this very well; they know the country is rich, but they need to discover.

6. The Expo Dubai is coming up, is this of interest for your organization?

I think the expo nexus story is good with seaweed, and if you want to integrate it, I think you should start now. I think it would be good to raise this issue at the expo team and promote the seaweed technology. They want to attract the youth; it might be a good target group for this. A programme (ACTIC Challenge) on food participation together with Wageningen university has started, where there was a very, very strict selection procedure; 1100 wanted to join but there will only be space for 12. R&D focus.

They want to know which food **can** be grown, which can be imported, and which can be **stored**. People started to buy a lot of food in the covid crisis, which created a lot of food waste unfortunately. It was a big mess, but the country handles it very well, it was amazing especially at the beginning people started to feel secure, also they did not raise the price. You can feel the crisis here really you see jobless people; hotels have been shut down; the economy is dependent on tourism. Residence permits are very hard and people cannot return home.

7. A. If yes: How will you be involved in the Expo Dubai?

There is a local group within the agricultural counsel, which focus on the Dubai Expo and the businesses matchmaking.

B. If No: Why?

8. The Netherlands is working on showcasing the connection between water, food and energy for the World Expo in Dubai, does this connect to your work?

Yes.

9. A: If Yes: How?

Our focus is also on water and in the UAE, there is lot of water research at ICBA. Crops grown using salt water. In Texel in the Netherlands, they grow crops with salty water and soil. In the UAE it's complicated because each area has its own salinity level. Water element and salinity is key, also brine water can be used. Technically very important closed system farms. 98% water reduce from 25% in hydroponic system and vertical farms. Hospitality sector is encouraged to use local production as well as people they keep a special space in supermarket shelves and want to keep it lower price, although the real cost is higher. The idea is to educate on fresh food and fresh from the farm. Also, smart food supply chain, also awareness of consumer and behaviour. We have a special committee for expo Dubai we have activity on dairy poultry (also with webinars organized now). Within expo as agricultural department we have activities to do there. Usually we'll receive a mission of 70 Dutch companies to go on a mission. Dutch Greenhouse Delta also came to the UAE and did a programme. We tried to support and facilitate them and many horticulture companies alike, also pure harvest. I am fascinated by it. Madar farm in the UAE is also a fascinating project, a huge project. There are more company projects but those are kept confidential. It has happened once where I have introduced a Dutch company, but they were only writing not listening not looking, when they finish, they just ask how much it pays. It takes time, competition I very high, every country comes with ideas, Dutch costs are high compared to China and India. We are expensive because of the quality. Being culturally sensitive and patient is very, very important.

B: If no: Why?

10. Is seaweed something that's currently of interest for your organization?

Yes

11. A. if yes, in which way? Do you work together with other organizations on this matter?

The UAE wants to invest more in technology like NL that's why when we see seaweed. There is also the Gharifa fund, which supports research, from which a part is seaweed and algae.

B. If no, why? Have you heard if other organizations are interested in seaweed?

12. Do you have other contacts which might be valuable for further contacts?

(- last interview)

Appendix P: Complete coding done for the Dutch perspective

Table 10, complete coding done for the Dutch perspective

Source	Text	Open coding	Axial Coding
Adrie van der Werf	In Europe, you have to come up with a new idea to make it profitable, maybe in the middle of the ocean, on a very large scale.	Need - business sector - new ideas	"Green" solutions
Petra Steenhoek	The way we treat the planet and therefore the oceans also determines our future. As long as we use the resources of our planet in a smart way and distribute the pressure on raw materials as much as possible, we will also keep it liveable for our children.	Need - business sector - balanced use of resources	"Green" solutions
Petra Steenhoek	The global demand for food and industrial raw materials is growing fast and subsequently the pressure on land by extensive agriculture and exhausting raw materials will increase, causing ecological disasters and political instability.	Need - Business sector - balanced use of resources	"Green" solutions
Lena Hildmann	There is a global need to fight climate change, although the consequences might affect every country differently. For a country like the Netherlands that is under sea level, climate change and sea level rise is concerning.	Need - Research sector - climate change	"Green" solutions
Jaap van Hal	to have a balanced consumption and offer of food, raw materials and energy.	Need - research sector - Balanced use of resources	"Green" solutions
Klaas Timmermans	For a country like the Netherlands that is under sea level, climate change and sea level rise is concerning,	Need - research sector - climate change	"Green" solutions
Jaap van Hal	Exchange practical knowledge in terms of seaweed production and thereby cooperating on a sustainable solution.	Need - research sector - sustainability	"Green" solutions
Klaas Timmermans	We have a climate problem, but the urgency is not necessarily felt by everyone, especially now fossil fuels are so cheap.	Need - research sector - sustainability	"Green" solutions
Klaas Timmermans	Since the market is mostly B2B, there should be a higher demand from the business side to go greener.	Need - research sector - sustainability	"Green" solutions
Jaap van Hal	specific innovation sectors, from which the Food transition is named E12	Need - research sector -food system innovations	"Green" solutions
Petra Steenhoek	We see exponential growth in international cooperation and trade in seaweed	Need - business sector - growing demand	Acceleration
Adrie van der Werf	Now here's the problem: the opportunistic behaviour of starters, they don't have an	Need - business sector -	Acceleration

	investment fund. Since there is no existing market, it is difficult to find external financing.	opportunistic behaviour	
Petra Steenhoek	The seaweed industry itself is not self-propelling at this stage, unfortunately.	Need - Business sector - start-up phase	Acceleration
Lena Hildmann	Although the seaweed industry is not self-propelling at this stage, history has shown us that the World expo is an excellent leap forwards to scale up.	Need - government - leap forwards	Acceleration
Niek de Regt	Seaweed businesses need to be developed in such a way that they have an international agenda, in order to be applicable for the Dubai Expo participation	Need - Government sector - start-up phase	Acceleration
Jaap van Hal	we would need somebody local that can get involved at the right tables and can give priority to the project.	Need - research sector - capacity	Acceleration
Jaap van Hal	Because of other priorities, there is more low hanging fruit available. We do not have enough capacity to serve everybody	Need - research sector - capacity	Acceleration
Jaap van Hal	with limited capacity, priorities have to be made	Need - research sector - limited capacity	Acceleration
Adrie van der Werf	We also know little about pests and diseases, pesticides have helped us in the past, but nature suffered. We cannot make this mistake again with the sea.	Need - research sector - research gaps	Acceleration
Adrie van der Werf	Seaweed is only just emerging, land-based food production has seen thousands of years of co-evolution. People think that seaweed can be used very quickly by means of start-ups, but in my opinion they are really wrong.	Need - research sector - startup phase	Acceleration
Klaas Timmermans	Seaweed is connecting water, energy and food, but a lot has to happen to facilitate this innovation.	Need - research sector - startup phase	Acceleration
Klaas Timmermans	Entrepreneurs have to be stimulated to apply this in a sustainable manner.	Need - Research sector - startup phase	Acceleration
Petra Steenhoek	The government could offer a helping hand in thinking along with regard to regulations and licenses and taking the necessary steps, which also helps in transparency and making it easier for (starting) seaweed farmers.	Need - business sector - policy	Acceleration
Adrie van der Werf	On the other hand, as soon as you have investment money together and you are going to grow, there are still buyers to be found	Need - business sector - buyers	Access to finance

Adrie van der Werf	People say 75% of the Earth's surface is the sea, but you have to remember: what percent of that is suitable, and what are the costs involved?	Need - business sector - costs involved	Access to Finance
Adrie van der Werf	Now here's the problem: the opportunistic behavior of starters, they don't have an investment fund. Since there is no existing market, it is difficult to find external financing.	Need - business sector - finance	Access to Finance
Petra Steenhoek	In addition, the government (and perhaps also the business community) will be able to give a financial injection to be able to start the scale-up phase in time.	Need - business sector - financial	Access to Finance
Petra Steenhoek	It is also still necessary to receive financial support at this stage of the organization.	Need - business sector - financial hurdles	Access to Finance
Adrie van der Werf	Then, we looked into Biomass, but we only received 20 euros per tonne of dry matters, I don't think you get a revenue model like that.	Need - business sector - revenue model	Access to Finance
Niek de Regt	Economic factors are the farmers which are dependent on livestock, for example 60% of the inhabitants in the mid-west. This produces huge meat-lobbies	Need - Government sector - economic hurdles	Access to Finance
Niek de Regt	We might say we've got the solution, but have stronger financial motives to continue business as usual, with climate consequences.	Need - Government sector - financial hurdles	Access to Finance
Klaas Timmermans	we know the technical feasibility, but what about the economic feasibility?	Need - research sector - economic hurdles	Access to Finance
Jaap van Hal	Financial instruments from a government point of view are rare, mildly speaking	Need - research sector - financial hurdles	Access to Finance
Jaap van Hal	government: more priority to implement these tools fast, which would also mean more financing instruments.	Need - research sector - financial hurdles	Access to Finance
Klaas Timmermans	We have a climate problem, but the urgency is not necessarily felt by everyone, especially now fossil fuels are so cheap.	Need - research sector - financial hurdles	Access to Finance
Klaas Timmermans	More investment and funding.	Need - research sector - financial hurdles	Access to Finance
Jaap van Hal	Scale, scale and scale. This is necessary to make seaweed and processing thereof profitable.	Need - research sector - profitability	Access to finance
Petra Steenhoek	Coordination within the chain is not ideal at the moment, but steps have been taken in the right direction over the recent years.	Need - Business sector - cooperation	Cooperation

Petra Steenhoek	Sharing knowledge within projects with, for example, knowledge institutes is an important factor, which is one of the reasons why we actively participate in (subsidized) projects.	Need - Business sector - cooperation	Cooperation
Petra Steenhoek	working together with all parties in the sector is very important and forming the right consortia ensures that we build and expand the seaweed industry together at the right pace.	Need - business sector - cooperation	Cooperation
Petra Steenhoek	Yes, the cooperation of all the aforementioned parties (Triple helix) can ensure that this will succeed. We need each other.	Need - business sector - cooperation	Cooperation
Petra Steenhoek	Hortimare's strategy is that we participate as much as possible in projects and partnerships as long as the focus for Hortimare on breeding can continue to exist.	Need - business sector - cooperation	Cooperation
Petra Steenhoek	We are interested in expanding our network in the Arab community because we know that there is serious interest in developing cultivation projects in the Middle East. Hortimare would like to be part of that.	Need - Business sector - international interest	Cooperation
Petra Steenhoek	and the knowledge institutes are essential to share knowledge and formulate sound answers to practical issues and to substantiate them scientifically.	Need - business sector - share knowledge	Cooperation
Adrie van der Werf	We are struggling to find the right stakeholders, the company who would take care of the harvesting machines for Saudi Arabia now want to focus more on their core business, because seaweed is starting up that is not yet one of them.	Need - business sector - stakeholders	Cooperation
Petra Steenhoek	We would like to be visible / findable as an organization that can be approached for all kinds of seaweed-related projects and for the supply of seaweed starting material.	Need - Business sector - visibility	Cooperation
Niek de Regt	It would be relevant for us if they could collectively enter the Dubai Expo.	Need - Government sector - cooperation	Cooperation
Niek de Regt	Although it can be a local solution for food shortages, it is still not high on the agenda in the UN.	Need - Government sector - put on agenda	Cooperation
Niek de Regt	The lobby of the food industry is huge, especially from countries that depend of meat production for their income.	Need - Government	Cooperation

		sector - solid support base	
Klaas Timmermans	Actually, it starts from the individual, broad support is needed from all sides to increase plant-based raw materials like seaweed.	Need - research sector - broad support	Cooperation
Adrie van der Werf	What struck me was that the expo was purely focused on business.	Need - research sector - business sector overrepresented	Cooperation
Adrie van der Werf	The sea also has all kinds of other social functions. If another interest (e.g. tourism, shipping or ecology) is more economical or desirable, then this must be taken into account.	Need - research sector - comparing different needs	Cooperation
Jaap van Hal	to let seaweed be part of the European policy, to address stakeholders together and share information amongst each other.	Need - research sector - cooperation	Cooperation
Jaap van Hal	Exchange practical knowledge in terms of seaweed production and thereby cooperating on a sustainable solution.	Need - research sector - cooperation	Cooperation
Jaap van Hal	Knowledge and broad support are needed	Need - research sector - knowledge and support	Cooperation
Jaap van Hal	A change in policy is necessary as the current work method is time consuming	Need - research sector - policy hurdles	Cooperation
Jaap van Hal	government: more priority to implement these tools fast, which would also mean more financing instruments.	Need - research sector - policy hurdles	Cooperation
Klaas Timmermans	CO2 emissions are still not being taxed, this price will have to be paid by the next generation	Need - research sector - policy hurdles	Cooperation
Petra Steenhoek	The Arabian Gulf region is of absolute interest to Hortimare, although we also look at ethical aspects of the working methods of the parties we deal with	Need - business sector - ethical aspects	Cultural sensitivity
Adrie van der Werf	You will have to enter a consumer acceptance process.	Need - business sector - consumer acceptance	Cultural sensitivity
Petra Steenhoek	In the recent past, initial contacts have also been made through the business community to set up collaborations in the Gulf. For the time being, this has not yet resulted in an active collaboration or project, but we would very much embrace the possibility.	Need - business sector - follow up	Cultural sensitivity

Adrie van der Werf	In terms of Food security, it can be a direct food source. It contains protein, but will people also eat it?	Need - business sector - unknown food	Cultural sensitivity
Niek de Regt	Culture is very hard to overcome, but it can't be a reason not to do it. What is culture? What you eat is often cultural, but it can be changed.	Need - Government sector - cultural hurdles	Cultural sensitivity
Jaap van Hal	we would need somebody local that can get involved at the right tables and can give priority to the project.	Need - research sector - cultural hurdles	Cultural sensitivity
Klaas Timmermans	When the seaweed farmers came back from the trade mission, everybody was very enthusiastic, but in the end there was not much follow-up.	Need - research sector - expectations	Cultural sensitivity
Petra Steenhoek	Hortimare is a much sought-after partner for (International) projects, both in its role as "seed supplier" and in the advanced knowledge gained by the Research & Development department in the field of genetics, the lifecycle of various seaweed species, seed technology and cultivation installations.	Offer - Business sector - research and development	"Green" solution
Adrie van der Werf	This has evolved because the country was first producing its own soy (5.000 hectares), but this cost too much ground water. Seaweed was a good solution.	Offer - Business sector - improved water usage	"Green" solution
Niek de Regt	In this area, there are very practical things that can be pushed to a global scale, to go from intensive livestock to sustainable food production.	Offer - Government sector - practical solutions	"Green" solution
Niek de Regt	Dutch seaweed technology can serve practical solutions, seaweed is also very well known in Asia. Dutch seaweed is even exported to Japan, which I'm not a huge supporter of..	Offer - Government sector - practical solutions	"Green" solution
Niek de Regt	Negative Economic-social factors of meat compared to seaweed are less CO2 production, which contributes to global warming and the degradation of the nearby surroundings.	Offer - Government sector - ecosystem services	"Green" solution
Niek de Regt	I am sure that by focusing on more sustainable ways of income, the economic benefits will be greater in the long term.	Offer - Government sector - economically sustainable	"Green" solution
Jaap van Hal	We have had conversations with Masdar, a big UAE company looking for sustainable solutions.	Offer - research sector - offer	"Green" solution

		sustainable solutions	
Jaap van Hal	Exchange practical knowledge in terms of seaweed production and thereby cooperating on a sustainable solution.	Offer - research sector - cooperate on a sustainable solution	"Green" solution
Klaas Timmermans	in the future, these kind of solutions will become more relevant	Offer - research sector - future solutions	"Green" solution
Klaas Timmermans	It grows in salty water, which is relevant for the middle east and globally.	Offer - Research sector - salt water	"Green" solution
Petra Steenhoek	Another sustainable aspect is that seaweed cultivation has a positive effect on the bioremediation of the oceans.	Offer - Business sector - sustainable effect	"Green" solution
Niek de Regt	Seaweed connects positively to 80% of the SDG's (sustainable Cities, climate action, Sustainable consumption and production, Good health and wellbeing, Zero hunger, etc	Offer - Government sector - 80% of SDG's	"Green" solution
Niek de Regt	As said before, it also does not need any pesticides, which I is also a high benefit	Offer - Government sector - no pesticides	"Green" solution
Klaas Timmermans	An additional benefit of seaweed are the system-effects, having a positive effect on the fish population and nutrient levels.	Offer - research sector - System effects	"Green" solution
Petra Steenhoek	Our founder Job Schipper once started the company with the vision to make a difference in the ever-growing need for proteins for human consumption.	Offer - Business sector - protein consumption	"Green" solution
Petra Steenhoek	The business sector can accelerate these processes and broaden networks and partnerships	Offer - business sector - accelerate	Acceleration
Petra Steenhoek	Seaweed plays a role in more and more (international) projects and the player field is also expanding.	Offer - business sector - spreading internationally	Acceleration
Adrie van der Werf	After some hurdles, we got a project of 200M euro in Saudi Arabia , focused on animal food production.	Offer - Business sector - animal food production	Acceleration
Klaas Timmermans	There is a lot of interest and new initiatives are coming up	Offer - research sector - new initiatives	Acceleration
Adrie van der Werf	A 50% contribution from the EU is requested for this project.	Offer - business sector - financial support from the EU	Government collaboration

Niek de Regt	Looking at the nexus on the Expo, it would be very nice to promote seaweed businesses with an international agenda.	Offer - Government sector - promote seaweed businesses	Government collaboration
Klaas Timmermans	There is a demand from the middle east, which resulted in a trade mission with the Ministry of Foreign Affairs	Offer - research sector - trade mission	Government collaboration
Klaas Timmermans	Everything we produce is public as the government is our main "client", so somebody in the Emirates can use this knowledge freely.	Offer - research sector - knowledge sharing	Government collaboration
Adrie van der Werf	We are now researching if seaweed would reduce the methane emissions with the Proseaweed project of LNV and Wageningen and other partners.	Offer - research sector - Collaborating with LNV	Government collaboration
Petra Steenhoek	our first priority is to deliver a uniform product to our customers with good predictability of seed germination and a guaranteed harvest. This is necessary for our customers so that they can scale up (without too many financial risks). This upscaling allows the seaweed farmers to supply the processing industry with the correct quantities, which in turn enables the industry to use the seaweed as end products as economically as possible.	Offer - Business sector - predictability	Research and development
Petra Steenhoek	The main goal for Hortimare is the breeding of seaweed and the marketing of seaweed varieties.	Offer - Business sector - research and development	Research and development
Petra Steenhoek	In addition, we are working hard on expanding the seaweed species to be supplied and Hortimare is investing in researching tissue culture techniques to reproduce and breed red seaweed; the life cycle of red seaweeds is more complicated and both working towards a hybrid and getting to grips with the tissue culture technique requires a lot of time and money, as well as bringing in personnel and stakeholders with the right knowledge in this area.	Offer - Business sector - expanding cultivated species	Research and development
Jaap van Hal	The EU and the Paris agreement have identified specific innovation sectors, from which the Food transition is named E12	Offer – research sector - Food transition	Research & Development
Klaas Timmermans	I carry out research for the possibilities to use (among others) seaweed to produce high quality products (protein, carbohydrates, etc.)	Offer – research sector – high quality products	Research & Development

Klaas Timmermans	I have been approached by parties in the UAE the share knowledge and experience in terms of sustainable biofuel.	Offer – research sector – knowledge and experience	Research & Development
Petra Steenhoek	many applications have been added, including the feed industry (as a supplement to cow feed for methane reduction and to promote animal health and reduction of antibiotic use), for the food industry as a supply of bulk batches for the use of alginates / binders as well as for replenishing essential nutrients in drinks and other super food products, for the pharmacy and cosmetics industry, for extracting ingredients and then using the residual product on biofuel.	Offer - Business sector - wide array of applications	Wide array of applications
Adrie van der Werf	There is a seaweed extract, if you spray that on the crops, the production increase will be between 10 and 30%.	Offer - business sector - plant extract fertilizer	Wide array of applications
Adrie van der Werf	Seaweed can also be used in combination, via direct consumption, extract and animal feed. And the pharmaceutical industry is a good option, but then you have to meet enormous standards.	Offer - Business sector - direct consumption, extract, animal feed and pharmaceutical companies	Wide array of applications
Niek de Regt	I think seaweed is a solution for energy and food, but also for medicine.	Offer - government sector - wide array of applications	Wide array of applications
Jaap van Hal	There are also chances in the UAE for seaweed for sustainable protein and sustainable raw materials.	Offer - research sector - protein and raw materials	Wide array of applications
Klaas Timmermans	We are now researching seaweed as fish feed at NIOZ, as an alternative to (imported) soy.	Offer - Research sector - Fish feed	Wide array of applications
Klaas Timmermans	There are many varieties, ranging from 10-20% protein and carbs, which are pretty high percentages.	Offer - Research sector - Protein	Wide array of applications

Appendix Q: Complete coding done for the UAE perspective

Table 11, complete coding done for the UAE perspective

Source	Text	Open coding	Axial Coding
Robert Baldwin	macro algae could be cultivated without making big ecosystem changes	Offer - business - Ecosystem	"Green" solution
Samar Kadri	We are organising initiatives which make you think about food production knowhow, innovations, sustainability, cultivation etc	Offer - government - thinktank initiatives	""Green solution"
Robert Baldwin	This crisis might give us an opportunity to build back greener, but I am critical if this will truly happen	Offer - business - Ecosystem	"Green" solution
Hector Hugo Hernandez	Close to Abu Dhabi, there is Masdar city, a green district built to be climate neutral.	Offer - research - green district	"Green" solution
Erik Smidt	Proteins from seaweed compared to meat, use significantly less water. There is enough salt water in the UAE.	Offer - Government - Low freshwater usage	"Green" solution
Hector Hugo Hernandez	We have some funding for research from the government, but as the UAE is also very business-focused, there are many innovative entrepreneurs looking to optimize their (In my case, chemical) processes.	Offer - research - business focused	Business deals
Robert Baldwin	they are very forward looking and influence these innovations. This strong government push helped us to	Offer - business - Government push	Business deals

	overcome the hurdles of the starting phase.		
Erik Smidt	deals were closed very quickly, Omar, Samar and I were there too, we were already familiar, so that might have helped.	Offer - Government - Business deals	Business deals
Robert Baldwin	The Dubai Expo could be a connecting factor for researchers and innovators all over the world	Offer - Business - connecting factor	Cooperation
Robert Baldwin	the government, Etihad airways, Boeing, and Safran we are working towards seaweed cultivation to have an environmentally sustainable fish production and create biofuel with the algae biomass created.	Offer - Business - seaweed consortium	Cooperation
Erik Smidt	They are preparing to collectively access the Gulf market with seaweed researchers from Wageningen University, Dutch businesses and they want to collaborate with the UAE side.	Offer - Government - collaborate with UAE	Cooperation
Erik Smidt	There is a consortium, led by my predecessor, he is currently leading it as an entrepreneur	Offer - Government - consortium	Cooperation
Erik Smidt	deals were closed very quickly, Omar, Samar and I were there too, we were already familiar, so that might have helped.	Need - Government - Familiar people	Cultural sensitivity

Erik Smidt	The Netherlands has helped with the processing (e.g. seaweed burgers), to make it more palatable for the Western market.	Need- Government - Palatability	Cultural sensitivity
Erik Smidt	There are some small hurdles, mainly import problems, for example Halal certification	Need - Government - Halal certification	Cultural sensitivity
Hector Hugo Hernandez	the UAE is investing in the youth and you can see more and more are getting interested in sustainability and food.	Need - Research - youth interests	Cultural sensitivity
Erik Smidt	In the emirates they are willing to invest money, but they want to see an investment back, not necessarily in money, but in (long-term) involvement.	Need - Government - Long-term involvement	Cultural sensitivity
Samar Kadri	It has happened more than once where I have introduced a Dutch company, but they were only writing not listening not looking, when they finish they just ask how much does it pay. It takes time, competition is very high, every country comes with ideas, Dutch costs are high compared to China and India. We are expensive because of the quality. Being culturally sensitive and patient is very, very important.	Need - Government - It takes time	Cultural sensitivity

Erik Smidt	By seeing each other once or twice and possibly eat together, you show you're not just there for a project, but you have a more long-term view.	Need - Government - Showing you have a long term view	Cultural sensitivity
Robert Baldwin	At the end of the day, when oil is 10 dollars a barrel, seaweed won't even be a choice in terms of biofuel.	Need - Business - a competitive price	A solution to problems felt by the COVID-19 crisis
Samar Kadri	You can feel the crisis here, really, you see jobless people, hotels have been shut down, the economy is dependent on tourism. Residence permits are very hard and people cannot return home.	Need Government – dependence on tourism	A solution to problems felt by the COVID-19 crisis
Robert Baldwin	The government has to involve and provide incentives, otherwise the economy will draw back the innovation to fossil fuel in my opinion.	Need - Business - government incentives	A solution to problems felt by the COVID-19 crisis
Robert Baldwin	linked with food production without creating an environmental disaster	Need - Business - Environmental food production	Food security
Erik Smidt	what the Emirati's focus on is food security, which means	Need - Government - Food security	Food security

	to produce more themselves and draw up long-term contracts for imports.		
Erik Smidt	If the world still needs to be fed in 30 years' time, more local production will have to be done, so the Netherlands cannot feed the world, but we can transfer the knowledge.	Need - Government - Food security	Food security
Samar Kadri	In 2005, they created a food security office in the UAE. After that, the UAE created a ministry of food security, and just last year, they changed it to Food security and Water, because they see, water and food is very connected.	Need - Government – Food security	Food security
Erik Smidt	Where I do see hurdles for the UAE itself is their mentality, they think they can be self-sufficient very soon, but I doubt that	Need - Government - Self sufficiency	Food security
Erik Smidt	If the world still needs to be fed in 30 years' time, more local production will have to be done, so the Netherlands cannot feed the world, but we can transfer the knowledge.	Need - Government - Food production knowledge	Knowledge and technology
Samar Kadri	They have the ambition to be a Knowledge and technology hub, they are looking to decrease desertification. It's a challenge looking at	Need - Government – be a knowledge and technology hub	Knowledge and technology

	the water use of produce and desertification.		
Hector Hugo Hernandez	We are struggling to find the right researchers, not everybody wants to live in the UAE, a lot has to come from abroad.	Need - Research - researchers	Knowledge and technology
Hector Hugo Hernandez	on one end, we are finding out ways to use the brine from desalination plants, for example for seaweed production. But at the other hand, climate conditions are getting more and more tough. I live here for 9 years now and it's incredible how fast it's getting warmer and the sea is getting saltier.	Need- Research - Fast changing climate conditions	Knowledge and technology
Robert Baldwin	Wageningen is the leader in the world as well as some other universities in the US, but Europe is at the forefront	Need - Business - Europe at the forefront of research	Knowledge and technology
Erik Smidt	Currently, eggs are incubated in the Netherlands for 1 to 2 days, then transported to the UAE and then incubated there, using Dutch machines.	Need - Government - Technology and starting material	Knowledge and technology
Robert Baldwin	if the seaweed project has made a lot of progress it (the Dubai Expo) would be a wonderful way to show this off.	Offer - Business - showing progress of UAE projects	Show

Lena Hildmann	Furthermore, at a world expo, different cuisines can be mixed, food connects cultures and people. You also see country pavilions showing their own national food dishes.	Offer - Government - showing national food	Show
Samar Kadri	I think the expo nexus story is good with seaweed, and if you want to integrate it, I think you should start now. I think it would be good to raise this issue at the expo team and promote the seaweed technology. They want to attract the youth, it might be a good target group for this.	Offer - Government – promote seaweed technology	Show
Lena Hildmann	It's certainly part of the innovative food and beverage scene and I know the Italian pavilion is showing micro-algae production	Offer - Government - Italian pavillion	Show
Erik Smidt	We encourage companies to participate in strategic fairs.	Offer - Government - strategic fair participation	Show
Lena Hildmann	Serving seaweed at the expo would need to comply with our Food Ethos, a set of values that we designed to give a push to culinary ethics. It would have to be sourced locally, be certified organic, have sustainable packaging and be affordable for the end customer.	Need - Government - food ethos	Show

Appendix R: Overview of interview partners

Dutch side

Government and intergovernmental bodies.	Business and investment	Research
Niek de Regt (Ministry of Foreign Affairs & former United Nations diplomat)	Petra Steenhoek (Hortimare)	Jaap van Hal (TNO)
Lena Hildmann (Dutch country representative of the BIE)	Adrie van der Werf	Klaas Timmermans (NIOZ)

UAE side

Government and intergovernmental bodies.	Business and investment	Research
Erik Smidt (Agricultural counsellor for the gulf region)	Hector Hugo Hernandez (Masdar)	Robert Baldwin (Masdar)
Samar Kadri (Agricultural counsellor for Dubai)		
Lena Hildmann (Dutch country representative of the BIE)		

Appendix S: The report writing checklist

<p>Checklist Report Writing 2018</p> <p>Name: _____ Group: _____</p> <p><i>The assessment criteria marked with a * are 'killing points'. If the assessor has ticked more than five of them, you must improve the report on all insufficient parts. No killing points are allowed in the thesis/report.</i></p> <p>1. Use of English</p> <ul style="list-style-type: none"><input type="checkbox"/> Contains no more than three grammatical, spelling and typing errors per thousand words; the report is then rejected*.<input type="checkbox"/> Has an active writing style*<input type="checkbox"/> Is professional, formal and objective*<input type="checkbox"/> Is coherent (referral and linking words)*<input type="checkbox"/> Contains correct punctuation*<input type="checkbox"/> Does not contain the personal pronouns 'I/me/me, you/you/you, you, you, we/we/us' *<input type="checkbox"/> Is attuned to the chosen target group*<input type="checkbox"/> Has a uniform style* <p>2. The organisation</p> <ul style="list-style-type: none"><input type="checkbox"/> The report has a logical structure<input type="checkbox"/> Each chapter has a logical paragraph structure<input type="checkbox"/> Each chapter has an introduction (except ch.1) <p>3. The report/ thesis</p> <ul style="list-style-type: none"><input type="checkbox"/> Is free of plagiarism*<input type="checkbox"/> The pages are numbered*<input type="checkbox"/> Has a uniform format <p>4. The cover</p> <ul style="list-style-type: none"><input type="checkbox"/> Displays the title<input type="checkbox"/> Author(s) is/are mentioned <p>5. The title page</p> <ul style="list-style-type: none"><input type="checkbox"/> Title is specific*<input type="checkbox"/> Author(s) is/are mentioned in alphabetical order*<input type="checkbox"/> Date and place of publication are mentioned*<input type="checkbox"/> The sponsor/client of the report is mentioned* <p>6. The preface:</p> <ul style="list-style-type: none"><input type="checkbox"/> Contains personal reason for writing<input type="checkbox"/> Contains acknowledgement ("I" form permitted in the preface) <p>7. Table of contents:</p> <ul style="list-style-type: none"><input type="checkbox"/> All parts of the report are numbered*<input type="checkbox"/> The summary and appendices are included<input type="checkbox"/> Table of contents is clear/structured<input type="checkbox"/> Page numbers are consistent <p>8. The summary:</p> <ul style="list-style-type: none"><input type="checkbox"/> Is a concise version of the entire report<input type="checkbox"/> Contains the conclusions<input type="checkbox"/> Includes suggestions for further research<input type="checkbox"/> Does not contain personal opinions<input type="checkbox"/> Directly after the table of contents	 <p>9. The introduction:</p> <ul style="list-style-type: none"><input type="checkbox"/> Is chapter 1*<input type="checkbox"/> Describes the context, problem demarcation and justification*<input type="checkbox"/> Provides content relevant background information*<input type="checkbox"/> Contains the problem definition/research question*<input type="checkbox"/> Includes the objective(s) of the research<input type="checkbox"/> Contains a report <p>10. Material and method</p> <ul style="list-style-type: none"><input type="checkbox"/> Describes the research method used<input type="checkbox"/> Justifies the choice of the research method used<input type="checkbox"/> Matches/is in line with the problem definition/research question*<input type="checkbox"/> Describes the research variables/units<input type="checkbox"/> Describes the method of data analysis <p>11. The (construction of the) core</p> <ul style="list-style-type: none"><input type="checkbox"/> The chapters and the (sub)sections with a maximum of three levels are numbered *<input type="checkbox"/> Chapters and (sub) paragraphs have a fitting title<input type="checkbox"/> A chapter covers at least one page<input type="checkbox"/> New chapters start on a new page<input type="checkbox"/> Sentences are typed in sequence, without hard return within the paragraph<input type="checkbox"/> Figures are numbered and have a fitting title, which is put below the figure.*<input type="checkbox"/> Tables are numbered and have a fitting title, which is put above the table*<input type="checkbox"/> Tables and figures can be understood independently<input type="checkbox"/> Figures and tables are referred to in the text*<input type="checkbox"/> Each appendix is specifically referred to in the content<input type="checkbox"/> The text can also be understood without references <p>12. The discussion of results</p> <ul style="list-style-type: none"><input type="checkbox"/> Includes the interpretation(s) of the results<input type="checkbox"/> Contains a comparison with relevant literature<input type="checkbox"/> Contains a review of relevant sources<input type="checkbox"/> Valid argumentation is provided<input type="checkbox"/> Contains a critical evaluation of own findings <p>13. The conclusions and recommendations</p> <ul style="list-style-type: none"><input type="checkbox"/> Contains answer(s) to the research question<input type="checkbox"/> are based on relevant facts and / or discussion<input type="checkbox"/> Does not contain any discussion or information that does not appear elsewhere in the report text* <p>14. References</p> <ul style="list-style-type: none"><input type="checkbox"/> References in the text are in accordance with APA standards*<input type="checkbox"/> The source list conforms to APA standards * <p>15. The Annexes</p> <ul style="list-style-type: none"><input type="checkbox"/> Are all numbered<input type="checkbox"/> Each annex has an appropriate title<input type="checkbox"/> Do not contain the author's own analyses<input type="checkbox"/> Are clearly structured/displayed
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Figure 10, The report writing checklist