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An International Research and Experimentation Center for Saline Agriculture in the Wadden Area

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The feasibility of setting up an International Research and Experimentation Center for Saline Agriculture in the Wadden area in the Netherlands

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Author
Karima el Bay BSc.
Student Number 1452134
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Environment and Resource Management
Vrije Universiteit Amsterdam

Supervisor
Prof.dr.ir. Pier Vellinga
2987 Department of Spatial Analysis and Decision Support
Faculty of Earth and Life Sciences
Vrije Universiteit Amsterdam

Preface

This study is a thesis for the master Environment and Resource Management of the Vrije Universiteit in Amsterdam and a feasibility study commissioned by the Waddenacademie in Leeuwarden. This study is conducted during an internship at the Waddenacademie and carried out in order to investigate the feasibility of setting up an International Research and Experimentation Center in the Wadden Region. First and foremost I would like to express my gratitude towards the academic supervisor Pier Vellinga for offering his professional guidance, reinsurance and constructive criticism. I would like to thank him for introducing me to this interesting subject and the trust he has put in me during the execution of this study. I would like to thank the second assessor for their assessment as well. In addition to that, I would like to thank the Waddenacademie for offering me the opportunity of an internship and would like to thank Sjerpy Moeyersoons-Joustra, for welcoming me at the office and facilitating me during the interviews. Hereby also my heartfelt gratitude towards all stakeholders interviewed, your input has been of great value for this study and I have enjoyed the many pleasant conversations.
Finally I would like to thank my loved ones, to begin with my parents, who sacrificed their own interests and needs in order to offer us the opportunities available in a foreign country. Finalizing my master studies with this report is a way of thanking you and appreciating all the chances you have been able to provide for us. You both are my leading examples! Hereby, I would also like to thank my partner Hicham, for challenging me on every aspect of my life and believing and convincing me to always aim for the highest possible. My dearest friend, Assmaa, for her unconditional support in good and (especially) bad times, I couldn't have done it without you. Also a big shout out to my dear friends, Ikram and Nawal for their incredible assistance. And finally, but most of all I would like to thank the Lord for all his blessings, but also for all the trials I had to endure in these last years. Despite the difficulties, I never lost hope since I believe that 'on no soul is placed a burden greater than it can bear (2:286)'.

Karima el Bay

Juli 2015

Executive Summary

This study shows that it is feasible to set up an International Research and Experimentation Center in the Wadden region based on a stakeholder analysis and a first indication of costs and benefits from a triple P perspective. The involved stakeholders from the provinces of Noord Holland, Groningen and Friesland, business and entrepreneur, knowledge institutes, agricultural organizations and nature conservation agency seem relatively open and positive towards the set-up of IREC, but differ in perspectives of how such an organizations should be financed and what the core activities need to be. To resolve this contrasting interest from business and research, ant to integrate science and development according to the transdiciplinairy approach, the organizational structure of IREC consists of a product development unit and a product marketing unit. Where the focus of the first lies on all elements of research and the latter focuses on integrating science and development, in order to achieve innovations in the field of saline agriculture. The product marketing unit works as an incubator in order to accelerate saline agricultural developments by setting up strategic collaborations. This division of tasks is also applied in the composition of the executive board, that shall consist of 2 persons, one with a scientific research background and the other with an experienced business profile.

Content

Introduction

Agriculture in the Netherlands has changed over the years. After the devastation of the second world war the main focus in agriculture was to re-establish the sector and restore the production. Research played a major role in the successful revival of agriculture, leading to a substantial growth of the production level of crops and livestock. The issues the agricultural sector had to face until the 1970s were relatively straightforward, it exclusively focused on increasing the production levels. However this gradually changed during the 1970s, the higher production levels leading to an extensive agricultural sector became a major driver of environmental degradation. Excessive and inefficient consumption of fresh water for agricultural practices, soil degradation and air pollution became environmental problems associated with agriculture. These changing conditions and perspective of the sector led to the demand of more sustainable agricultural development. The agricultural industry faced increasing environmental laws from both the national and European policy level. Land users had to deal with all kinds of new environmental and societal requirements for sustainable development. In addition to the new governmental regulations, they also had to deal with various stakeholders involved in the agricultural sector. Research focusing on solely the purpose of increasing production levels before the 1970s changed in finding and developing innovative theories for the various new challenges in the agricultural sector.

Contemporary agriculture is facing various environmental and societal challenges, from new strict environmental regulation to producing more crops on smaller acres of land for the increasing food demand. While the requirements that the farmers need to meet increase, the environmental situation of land and water is deteriorating. Land users are confronted with the loss of agricultural land, the scarcity of fresh water, the pollution of available water, degrading soil and the salinization of soil. This is only a minimal enumeration of the problems facing the agricultural sector. In the Netherlands one of the concerning issues affecting agriculture is the salinization of soil. Farming in the low-lying areas are confronted with brackish groundwater. Sea water from the North Sea mixes with fresh water from the rivers and ditches. The risk of saline water affecting agricultural land will aggravate in the future due to sea level rise and subsidence in coastal areas (Rijksoverheid, z.d.).

According to the Waddenacademie the increase of salinity worldwide is an inevitable fact (Waddenacademie, 2015). The Wadden area will also be affected by the expansion of salinity of the soil. Therefore they recommend an approach in which the increase of salinity in the future is accepted and is used as an starting point to explore the possibilities of how the Netherlands, and especially the Wadden area, can adapt to this situation. The Waddenacademie advises to investigate the possibilities of saline cultivation for the Netherlands and subsequently for other areas in the world facing salinization of water and soil (Appendix B).

In order to adapt and respond timely to the challenges of salinity, the Waddenacademie has requested to carry out a study in which the potential of setting up an International Research Center for saline cultivation in the Wadden area, is investigated.

This feasibility study is commissioned by the Waddenacademie and is carried out in the context of a thesis for the master Environment and Resource Management at the Vrije Universiteit in Amsterdam.

Research Question

The aim of this research project is to assess the feasibility of setting up an International Research and Experimentation Center (IREC) in the Wadden area in the Netherlands. This center will be set up with the aim to further develop the current knowledge on saline agriculture and to investigate the potential it has as an adaptation strategy to the increasing salinization problem of soil in the Wadden area and in other coastal or dry regions worldwide. This IREC will coordinate and facilitate projects in the area of saline agriculture in collaboration with science institutes and entrepreneurs. IREC serves as a platform, where development of saline cultivation is organized in order to further develop the methodology of testing and producing food and biomass in saline environments.

IREC will offer more scientific and practical expertise about saline agriculture and could explore and support the development of international markets for products and know how.

The defined mission and purpose of this study leads to the following research question:

RQ: What is the feasibility of setting up an International Research and Experimentation Center (IREC) in the Wadden area in the Netherlands?

To answer this effectively, the question will be addressed through the following sub questions:

1. What can we learn from public funded research and expertise centres specialized in agricultural or water related themes?
2. To what extent is the set-up of an International Research and Experimentation Center supported by the stakeholders?
3. What are the most important financing and governance criteria for the set-up of an International Research and Experimentation Center according to the stakeholders?
4. What is a suitable organizational structure for the International Research and Experimentation Center?
5. What are the potential social costs of setting up an IREC on saline cultivation in the Wadden Area?
6. What are the potential social benefits of setting up an IREC on saline cultivation in the Wadden area?

The main objective of this IREC is to study the opportunities of saline agriculture by establishing a cooperation between researchers, entrepreneurs, farmers and the local government. This IREC can serve as an expertise center of saline cultivation worldwide and contribute to more recent data and knowledge on the salt tolerance of crops and the cultivation of these crops.

This study derives from various saline projects from the Wageningen University Research Centre (WUR) and previous studies from among others, Arjen Vos (2011) and Zilt Perspectief (2015), which recommend further investigation in the potential of saline cultivation in the Wadden area. The Waddenfonds which is founded to invest in development in the Wadden area is interested in ideas or projects which could contribute to both the ecology as the economy in the region. Setting up an International Research and Experimentation center in the Wadden area can possible contribute to the aim to stimulate the economy in the region by development of the natural environment. This study is a scientific investigation in how to develop a strategy to facilitate, upscale and stimulate more research and practical implementation in the field of saline agriculture. The focus of the research will be on setting up a research center which will serve as an expertise center for saline cultivation and will contribute to the potential of food production in saline environments worldwide.

Reading guide

Investigating the feasibility of setting up this facility will be done by assessing different existing organizational and financial models used for setting up International Research and Experimentation Stations, in particular in the domain of the water and agricultural sector. The purpose of this comparative study is to learn from previous experiences of research centres which focus on specific agricultural or water related themes and which are funded by public investments. In order to make a good comparison and learn from the different types of organizations, three research centers will be examined. The comparison will consist of the following institutes: the largest non-profit agricultural research centre in Asia: IRRI, a Dutch Technological Top Institute for water technology: Wetsus and the International Centre for Biosaline Agriculture in Dubai: ICBA. This comparative study will help in developing a model for the establishment of an International Research and Experimentation Center (IREC) on Saline cultivation in the Wadden area.

1. Theoretical Framework

The theory of Transdisciplinarity is selected as the theoretical framework in which this research is conducted. This approach is chosen because it not only describes the importance of scientific research, but also underlines the importance of the integration of research and development.

1.1 Theory of Transdisciplinarity

Science is considered to be an important aspect of sustainable development, however strategic reports of Science Academies, Research organizations and Universities worldwide do not only emphasize the significance of science in sustainable development but also underline the urge of effective communication between science and society (Bouma, van Altvorst, Eweg, Smeets, & van Latesteijn, 2011). According to the International Council for Science (ICSU), International Science needs to be strengthened for the benefit of science. This means that science and development needs to be more integrated, to create a stronger link. The theory of integrating science into society evoked different responses. When viewing this

from societies perspective, the question arising is to what extent does society benefit from science. This is referred to as the 'Knowledge Paradox' (Bouma, 2010) , which indicates that too much research does not necessarily contribute to innovation and therefore not to societal development (Bouma et al., 2011). From the perspective of the scientific community, some members do not agree with this point of view, while other scientists consider this as an unspoken request for funding without a necessarily consent of society.

Integration of science and development is referred to as the transdisciplinairy approach (Bunders et al., 2010; Hessels & Lente, 2008). Full potential of this approach can be achieved when multiple stakeholders with often contrasting views seek for collaboration. To represent the major stakeholders in the transdisciplinairy approach, (Bouma, 2010) use the acronym KENGi. The K stands for Knowledge community, E for enterprises and business, N for NGO's and civil society organizations, G for government at different levels and i for system innovation (Bouma et al., 2011). All these partners need to work together to achieve system innovation (i). This approach is described as the horizontal paradigm, while the vertical paradigm is the traditional way of conducting research. The horizontal paradigm is not without risks. Involving partners with contrasting views and interests leads to the risk of losing the independent position of the scientific community (Bouma et al., 2011). The general idea is that the research community functions best when the intellect is able to develop freely without being controlled by influential stakeholders. The aim of the transdiciplinairy approach to strive for the collaboration of KENGi partners, raises concerns regarding the independent position of the scientific community.

Conducting research in the traditional way referred to as the vertical paradigm, seems not effective and sufficient enough to deal with complex environmental problems such as the global increasing salinity. In order to develop a strategy to cope timely with the challenges of salinization, the theory of a horizontal method of conducting research is adopted in this study. This approach supports the theory of involving plural stakeholders in developing solutions to complex issues. The establishment of an International Research and Experimentation Center in the Wadden area is pursued in order to organize and structure development around salinization with the various stakeholders in the Wadden region. Therefore, a comparative study is conducted to investigate the implementation of the transdiciplinairy approach in existing research centers in the field of agriculture or water related themes. The results of the comparative study provide an overview of best practices of these research centres which then in turn serves as a practical example to the establishment of IREC. In addition, a stakeholder analysis is carried out to gauge the views of the main stakeholders in the Wadden region and comprehend their vision on the preferable organizational structure of IREC.

2. Research Methodology

In order to investigate the feasibility of setting up an International Research and Experimentation Center three main research methods are used. The study begins with a literature study on salinization and saline cultivation worldwide. Information derived from this study will contribute to the discussion of costs and

benefits establishing an International Research and Experimentation Center in the Wadden Region. This discussion of costs and benefits enables us to address the second and third sub question. In addition, a comparative study will be conducted in which various organizational and financial models of existing research centers in the field of agriculture or the water sector will be compared. The purpose of the comparative study is to learn lessons and best practices from these research institutions. Information derived from this study will address the first sub question and will also provide insights in the most important financial and governance criteria for a successful research and experimentation station which contributes to answering the fourth sub question. These insights will also be tested for the specific case of IREC in the Wadden Region. Investigating the applicability and suitability of the essential financial and governance criteria for the case of IREC will be done through a stakeholder analysis. Questions will be asked on the subject of the economic and ecological potential of saline cultivation by setting up IREC and on the topic of the most preferable organizational and financial structure of IREC. Outcome of the interviews contribute to addressing and answering the fourth sub question on the most important financial and governance criteria for the International Research and Experimentation Center. The main relevant stakeholders will be interviewed in the region of the Wadden, including all three provinces: Friesland, Groningen and Noord Holland.

The literature study, comparative study and the stakeholder analysis will all provide data and information to answer sub question two and three, which will finally lead to the discussion of the total social costs and benefits for the establishment of the International Research and Experimentation Center for saline agrriculture in the Wadden area.

An overview of the methods used in this research is illustrated in figure 1.

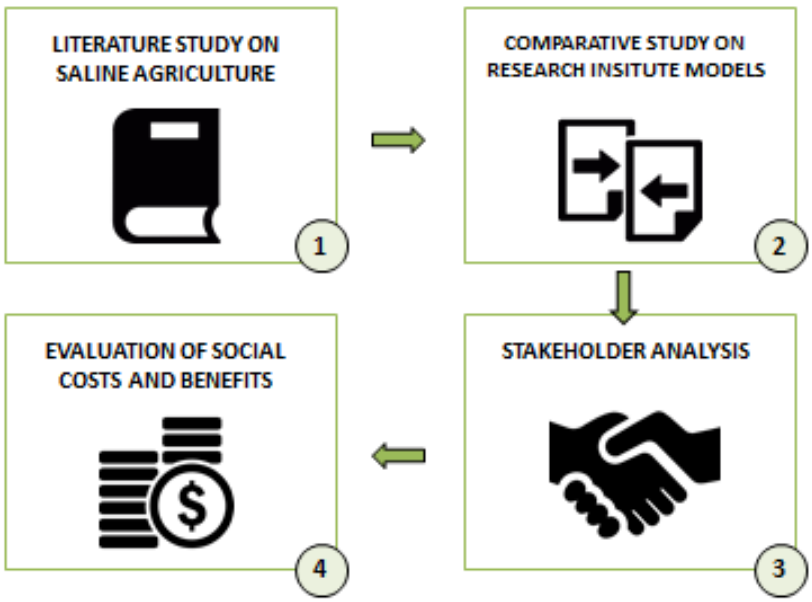


Figure 1: Total overview of the methodology used to evaluate the social costs and benefits of the establishment of IREC (own ill.)

3. Review of the state of the art

The agricultural sector in the Netherlands is one of the most important sectors for the Dutch economy. In 2010 the former cabinet Rutte 1 started with a top sector policy, including the Agri & Food sector, which accounts for nearly 10% of national income, 25% of export and 10% of employment in the Netherlands (CBS, 2014). The agricultural sector however is challenged by numerous environmental and animal welfare issues. Abundant research and literature is devoted to the topic of agriculture and its (future) challenges. However a lot of the findings and results in scientific research are not being implemented or translated to practical lessons to apply in the field (Bouma, 2010). This study therefore focuses not only on a better understanding of saline cultivation, but investigates the possibility in creating an opportunity in which the link between research and practical lessons is faster to bridge. Implementation of the lessons learned is essential to be able to act fast on the ever-changing conditions of agriculture. The results derived from this research can serve as a benchmark in comparative studies, which focus on the link between scientific research and the practical implementation.

This chapter introduces the state of the art of the central themes and concepts used in this study. The first paragraph will describe the issue of salinization and the related consequences to the agricultural sector. Paragraph two introduces the concept of saline cultivation and discusses the potential of this strategy according to previous studies.

3.1 Salinization

Considering all challenges the agricultural sector is facing worldwide, the increase of soil salinity is regarded to be the major stress (Ladeiro, 2012). Climate Change in combination with increased anthropogenic activities is affecting the salinity of soil worldwide (Oude Essink, van Baaren, & de Louw, 2010; Pitman & Läuchli, 2002). Worldwide 1,5 billion hectares of land is salinized, and increasing with 3 hectares every minute (Noordhoff, 2015). That is according to FAO's estimations over 6% of worlds land and approximately 20% of irrigated land (45 million hectares out of 230 million hectares) (2008). In Europe an estimated 1 to 1,5 million of hectares is affected by salinization, predominantly in the Mediterranean countries (Ladeiro, 2012). The degree of salinity stress varies in the different regions. In general, salinity is categorized into three different types: Low salinity (ECe 2-4 dS/m), moderate salinity (ECe 4-8 Ds/m) and high salinity (ECe > 8dS/m) (Rogers et al., 2005). Soil salinity is also categorized by the source causing the salinization, this can be either primary or secondary salinization. The first, also called natural salinization results of weathering of minerals and soil derived from saline parent rocks, while the latter is a consequence of anthropogenic activities, such as irrigation, intensive cropping or deforestation (Ashraf, Ozturk, & Athar, 2008). Salinity causes substantial agricultural losses, because most crops are sensitive to the high concentration of salts in the soil (Pitman & Läuchli, 2002). The main sources of estimated potential yield losses are drought (17%), high temperature (40%), low temperature (15%), salinity (20%) and other factors (8%) (Ashraf et al., 2008). These figures show us that salinity causes one fifth of the potential yield reduction, it is therefore seen as a great hazard for agriculture. Estimated financial costs of this yield losses are estimated to be $US 12 billion a year in the United States,

these costs will increase since the area of salinized land is expected to enlarge (Ghassemi, Jakeman, & Nix, 1995). Besides the great financial costs, the yield losses have severe consequences for the food security. While the food production under these circumstances will drop, the world's population will increase. The UN estimates a population growth of 9 billion in 2050, which will inevitably lead to a higher food demand. In order to meet this demand, it is urgent to develop and adopt strategies to recover the crop production.

Food insecurity will mainly affect a large population in rural areas in developing countries, in these often arid and semi-arid areas, the shortage of precipitation and the high evaporation causes salinization (de Vos, 2011). In the mild regions salinization is primarily caused by seepage of seawater into low-lying areas. In coastal areas like the Netherlands, seawater is extant as saline groundwater and is relatively close to the soil surface (de Vos, 2011). These areas commonly use fresh water from rivers and lakes to flush the land. However, this is not a sustainable strategy to combat the salinization of soil since the availability of fresh water decreases while the impact of brackish and salt water increases due to climate change, soil subsidence and increase of sea level (Velstra, Hoogmoed, & Groen, 2009). The expectation is that the salinization of arable land will increase in the Netherlands and will reach a total of 125.000 hectares, which corresponds with 6% of the total agricultural area In the Netherlands (de Kempenaer, Brandenburg, & van Hoof, 2007).

3.2 Saline Agriculture

The increasing population growth and the associated increasing food demand combined with the decreasing yield caused by salinization of soil, requires a vision and strategy beyond the conventional crop production and coping mechanisms. Since the demand of food increases faster than the crop production, politicians and researchers ever more emphasize the crucial need to improve alternative agricultural strategies (Galvani, 2007). In order to efficiently produce more food, it is essential to invest in better technology to enhance sustainable agriculture without destroying lands and natural resources. Various recent studies are investigating other alternatives for salinized soil than abandoning or flushing soil with fresh water since these options are extremely inefficient and expensive. A more useful and practical alternative is that of saline agriculture: cultivation of salt tolerant plants, which have the capacity to grow using land and water not suitable for traditional crops. This innovative strategy enhances land and water availability by using salted soils and salted water (Ladeiro, 2012). Scientific studies conduct new experiments on the salt tolerance of various crops, since the current data are outdated and all originate from the United States. The majority of studies is based on data often older than 50 or 60 years (de Vos, 2011). Studies carried out by a project of the Waddenfonds in the Netherlands have produced promising results on the salt tolerance of crops. The results proved that the tolerance of some crops is much higher than previously assumed. Most studies have been carried out in laboratories, and not yet in the actual salinized areas (Glenn & Brown, 1999). Studies that have been performed in salinized soil seemed to show great differences with results derived in laboratories. Experimenting with saline cultivation is still done on

very small scale in the Netherlands, but seems to be a very promising solution to this global problem. Saline cultivation is in addition to producing salt tolerant crops also simultaneously applicable as strategy to soil rehabilitation and landscape reintegration(Ladeiro, 2012)

Besides increasing the salt tolerance of existing crops, saline cultivation also comprises using alternative plant species such as halophytes to complement agricultural needs (Ladeiro, 2012 and (Shekhawat, Kumar, & Neumann, 2006). Halophytes are able to grow in areas with high temperatures and low water availability (Ladeiro, 2012). In order for halophytes to complement the agricultural need, it needs to be incorporated in the daily diet. So even though the production of halophytes is a potential option in coping with salinized soil and water, the consumer market is extremely small. Halophytes are nowadays mainly used in restaurants and are a relatively unknown product to the general public. For halophytes to succeed as irrigated crop and to provide and contribute to the increasing global food demand, it needs to meet four basic conditions. The first condition is the potential to achieve high yields, the second is that the requirement of irrigation should be within the scope of conventional crops and that it will not damage the soil, the third condition is that halophytes will substitute for conventional crop products (hence it needs to be incorporated in the daily diet) and the last requirement is that saline agriculture needs to be integrated in the existing agricultural infrastructure (Glenn & Brown, 1999).

A total of about 2600 halophytic species are known and only a few of these halophytes have been comprehensively studied for their potential in agriculture (Ladeiro, 2012). The potential of halophytes stretches further than merely the sole consumption of it. These high salt-resistant species can complement the daily diet, but can also be used as a source of genes to improve the salt tolerance of conventional crop species. Furthermore, large scale sustainable cultivation of halophytes can serve multiple purposes such as the stimulation of productive ecosystems, regreening degraded areas and providing a biological resource for oils, flavors, pharmaceuticals and fibers (Ladeiro, 2012).

Cultivation of halophytes can serve various purposes and contribute to solving some of the contemporary environmental issues. However, as stated before, only a few of halophytes have been studied extensively for their potential in agriculture and their ability to improve ecosystems.

Saline agriculture consists of both increasing the salt tolerance of conventional crops as the cultivation of halophytes. The following definition derived from a study of (Glenn & Brown, 1999) is used in this study: "Profitable and improved agricultural practices using saline land and saline irrigation water with the purpose to achieve better production through a sustainable and integrated use of genetic resources (plants, animals, fish, insects, and microorganisms) avoiding expensive soil recovery measures" (Ladeiro, 2012).

4. Comparative Study

This chapter introduces three research centers in the water and agricultural sector. The following research centers are included in this study: the International Center for Biosaline Agriculture (ICBA), the

International Rice and Research Institute (IRRI) and Wetsus. All institutes will be introduced with a short background profile, and will subsequently be compared on the basis of the financial and organizational model.

4.1 International Center for Biosaline Agriculture (ICBA)

Background

ICBA is the International Center for Biosaline Agriculture situated in Dubai, it is a non-profit international center for research and development in marginal environments. In the late 1980s and the early 1990s scientist around the world developed an interest in investigating the potential of using saline water for agricultural production. In light of this development the Islamic Development Bank (IDB) and the United Arab Emirates University stated that an R&D center should be established to promote saline agriculture in the Gulf region. From 1992 start-up operations begun to investigate the feasibility and the need for establishing a research center on saline agriculture. This feasibility study identified the major irrigation and salinity problems in the region, concluded that productive agriculture and greening projects with saline irrigation water was possible and recommended the establishment of a research center since adequate institutes for developing strategies for effective use of saline agriculture was not yet available. These findings led finally to the establishment of ICBA in 1999.

Organizational Structure

For an in-depth understanding of the organizational and financial structure of ICBA the annual report 2013 is used as main resource for this comparative study. Unless otherwise indicated, the information used in this paragraph is derived from the annual report (2013) of ICBA (Lawrence & Chandler, 2014).

ICBA focused initially on the issue of salinization and the usage of saline water for irrigating agriculture. Over the years, the scope of activities broadened and in 2013 the center developed a new strategy for 2013-2023. The new strategy identified three strategic outcomes targeting an increased food and nutritional security, more resilient environments and income, and an improved water security through the development of potential uses for wastewater and seawater (ICBA, 2013). The pursue of these three strategic outcomes led to the identification of four strategic objectives to be achieved in the coming years. Figure 2 shows the strategic outcomes and objectives for the next decade.

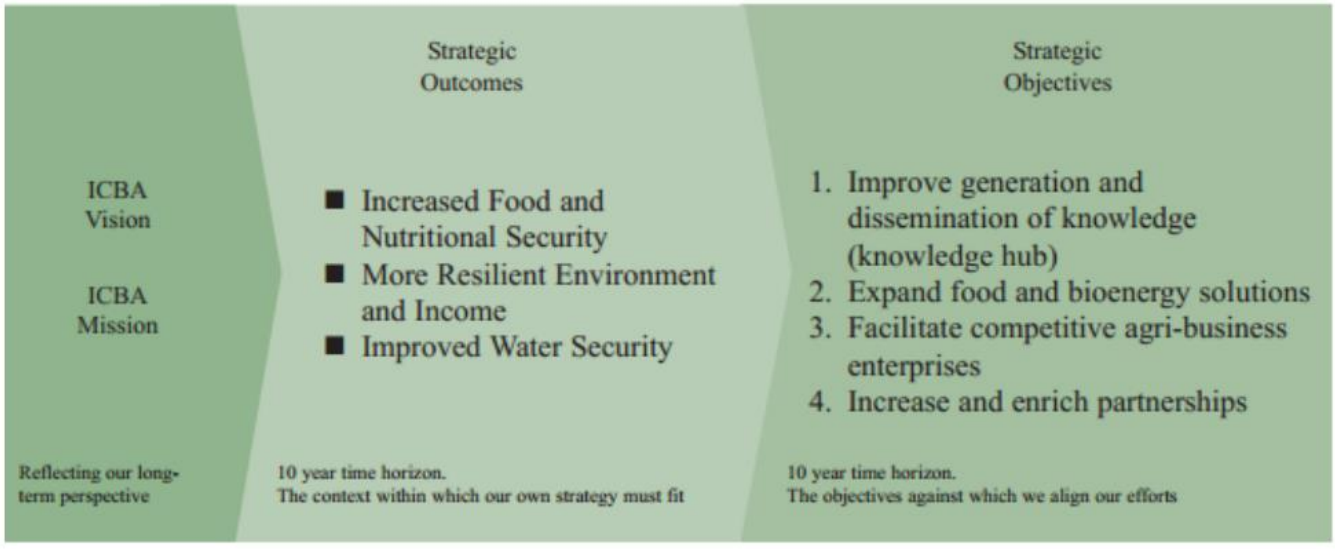


Figure 2:. Strategic Outcomes and Objectives of ICBA (ICBA, 2013)

In order to achieve these objectives and subsequently the outcomes, all research is organized around 5 innovation themes. An overview of the innovation is provided in table 1. ICBA decided with these targets and outcomes what goals they achieve to reach and in the new strategy they also decided on how to achieve these results, the enabling innovation (table 1). ICBA's business plan defines several detailed key objectives that need to be achieved within a specific period of time for every research innovation theme.

Table 1: ICBA strategic Directions based on 5 research innovation and 4 enabling innovations (Lawrence & Chandler, 2014)

Research Innovation	Enabling Innovation
Assessment of natural resources in saline and marginal environment	Strategic alliances and partnerships
Climate change impacts and management	Knowledge transfer
Crop productivity and diversification	Agri-business incubation
Aquaculture and bioenergy	Capacity development
Policies for resilience	

For the execution of the work plan, the implementation of the new strategy and in order to raise the required funds for ICBA, the organizational structure is based on three pillars. The activities are organized in an Research and Innovation department, a partnerships & knowledge management department and a corporate services department. All three departments are managed by a division director, which all are guided by the general director. The top level in the organization structure of ICBA is formed by the board of directors, who work closely with the general director. Figure 3 illustrates the complete organizational structure of ICBA.

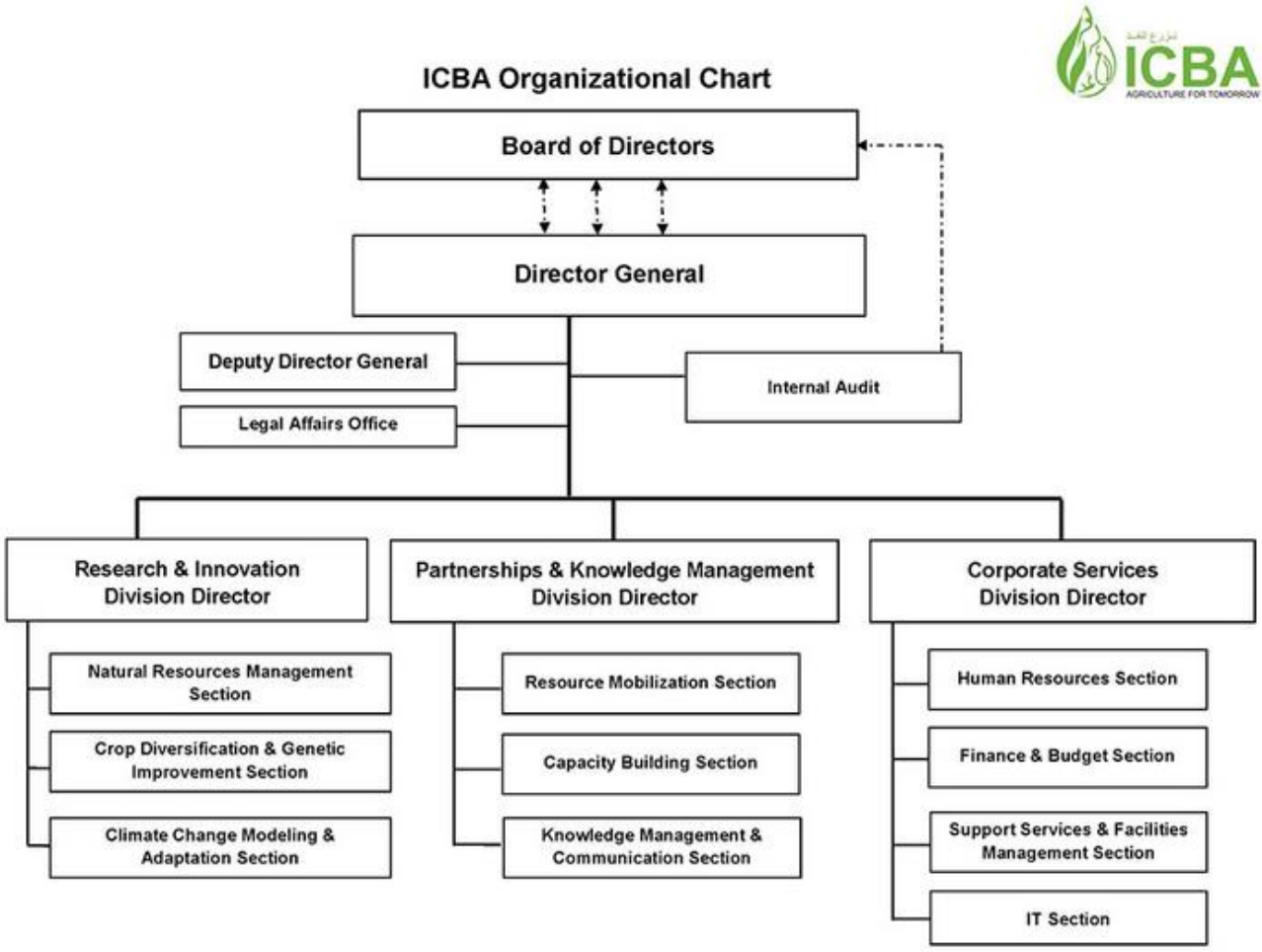


Figure 3: Organizational Chart ICBA (ICBA, 2015)

Financial Structure

ICBA is financed through sponsorship, the three core donors are the Ministry of Environment and water of the United Arab Emirates, the Environment Agency of Abu Dhabi and the Islamic Development Bank. The Islamic Development Bank also arranged additional financial funding from the Arab Fund for Economic and social development and from the OPEC Fund for International Development. Funding for ICBA is complemented by aid from the following grant donors: the Arab bank for Economic Development in Africa (BADEA), the Australian Centre for International Agricultural Research (ACIAR), the Abu Dhabi Farmers Services Center (ADFSC), the International Fund for Agricultural Development (IFAD), the National Academy of Sciences, the United States Agency for International Development (USAID), MASDAR Institute of Technology and at last the Ajman Sewerage Company Ltd. Aside from financial aid, the municipality of Dubai also donated a hundred hectares of land to use for irrigation trials by ICBA. Along the financial contributors, ICBA has also arranged various partnerships with several parties such as the Arab League, the International Center for Agriculture in Dry Areas (ICARDA) and multiple universities in the United Arab Emirates and Uzbekistan as well as an university in the United States: the University of Montana.[1]

The International Centre for Biosaline Agriculture depends for its funding completely on sponsorship, ICBA is therefore not self-sustaining. In 2013 the annual report of ICBA states it has received a total of 9.553.158 USD in restricted and unrestricted grants. Subsequently the annual revenue of ICBA is complemented by 245.883 USD from interest and 10.753 from other income, which is not further specified in the report. In 2012 ICBA received a total amount of 8.4 million USD and in 2011 9.2 million. Based on the revenues of the last three years ICBA has an average income of 9.0 million USD annually. In 2013 the total expenses and losses equals over 9.5 million USD, in 2012 7.5 million USD and in 2011 7.1 million USD (annual report ICBA, 2012). The expenses and losses in 2013 increased with approximately 2 million USD in comparison with the previous 2 years. Due to this large difference, the losses and incomes of 2009 and 2010 are also consulted in order to estimate the average expenses and losses of such a research center. The annual report show a total amount of losses and expenses of approximately 6.8 million USD in 2010 and 6.1 million USD in 2009 (annual report ICBA, 2010). Over these 5 years the average total amount of losses and expenses is 7.4 million USD. The figures of 2013 and 2012 are shown in table 2.

Table 2: Profit and Loss Statement of ICBA in 2012 and 2013 (Lawrence & Chandler, 2014)

STATEMENT OF ACTIVITIES (USD)	2013	2012 (Restated)
GRANTS AND CONTRIBUTIONS		
Grants unrestricted	7,000,000	7,000,000
Grants restricted	2,553,158	1,244,986
Interest income	245,883	151,879
Other income	10,753	6,220
Total grants and contributions	**9,809,794**	**8,403,085**
EXPENSES AND LOSSES		
Salaries and Benefits	(5,554,119)	(4,881,832)
Operating Expenses	(3,985,061)	(2,652,330)
Total expenses and losses	**(9,539,180)**	**(7,534,162)**
SURPLUS FOR THE YEAR	270,614	868,923

[1] A total overview of financial contributors and partners of the International Center for Biosaline Agriculture is provided in Appendix A

4.2 International Rice and Research Institute (IRRI)

Background

The International Rice and Research Institute (IRRI) is non-profit research and educational institute specialized in rice science and is dedicated to use their rice knowledge to reduce poverty and hunger. They do so by improving the health and welfare of rice farmer and consumers and by protecting the environment where rice is cultivated for future generations (IRRI, n.d.). The institute was founded in 1960 and has its head quarter in the Philippines, but operates with 1400 staff members in 17 countries in Asia and Africa (figure 4). IRRI works with partners in these countries to develop advanced and more productive rice varieties that are better resistant to pests and are better in withstanding floods, droughts and other harmful consequences of climate change. The institute also works on developing improved methodologies for farmers, so they can manage their land both profitable as sustainable. Besides research, IRRI also provided training to 130 thousand students, researchers, farmers, professionals and others in the period of 1962 to 2014 (IRRI, n.d.)

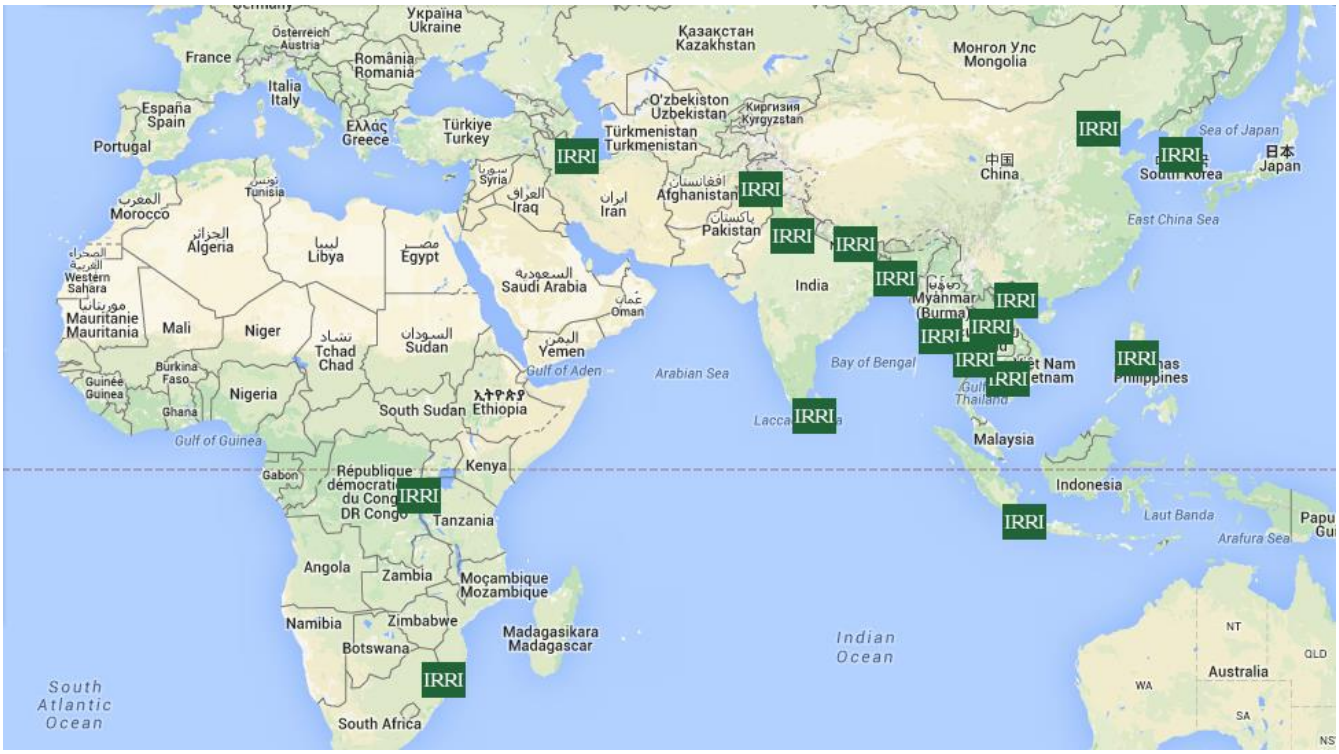


Figure 4: Location of the International Rice Research Institute (IRRI, n.d.)

Organizational Structure

IRRI organized its activities in organizational units and divisions in order to achieve a balance between discovery science on the one hand, and research for development on the other hand. For every unit clear objectives and management principles are defined. Every scientist participates in maximum 2 units. The programs are structured in units in order to provide in a longer-term platform for knowledge management and sharing. All programs are set up in the following three organizational units: Management Services, Research and Communication and Partnerships. Each of these pillars is led by a General Deputy Director, and consists of plural programs. The top level of IRRI is formed by a Board of Trustees and is linked with the Deputy Directors by the General Director. The Board of Trustees determines the research and policy

goals after input from partners, donors, end users (for example farmers) and the staff from IRRI (IRRI, n.d.) Figure 5 shows a total overview of the organizational structure of IRRI.

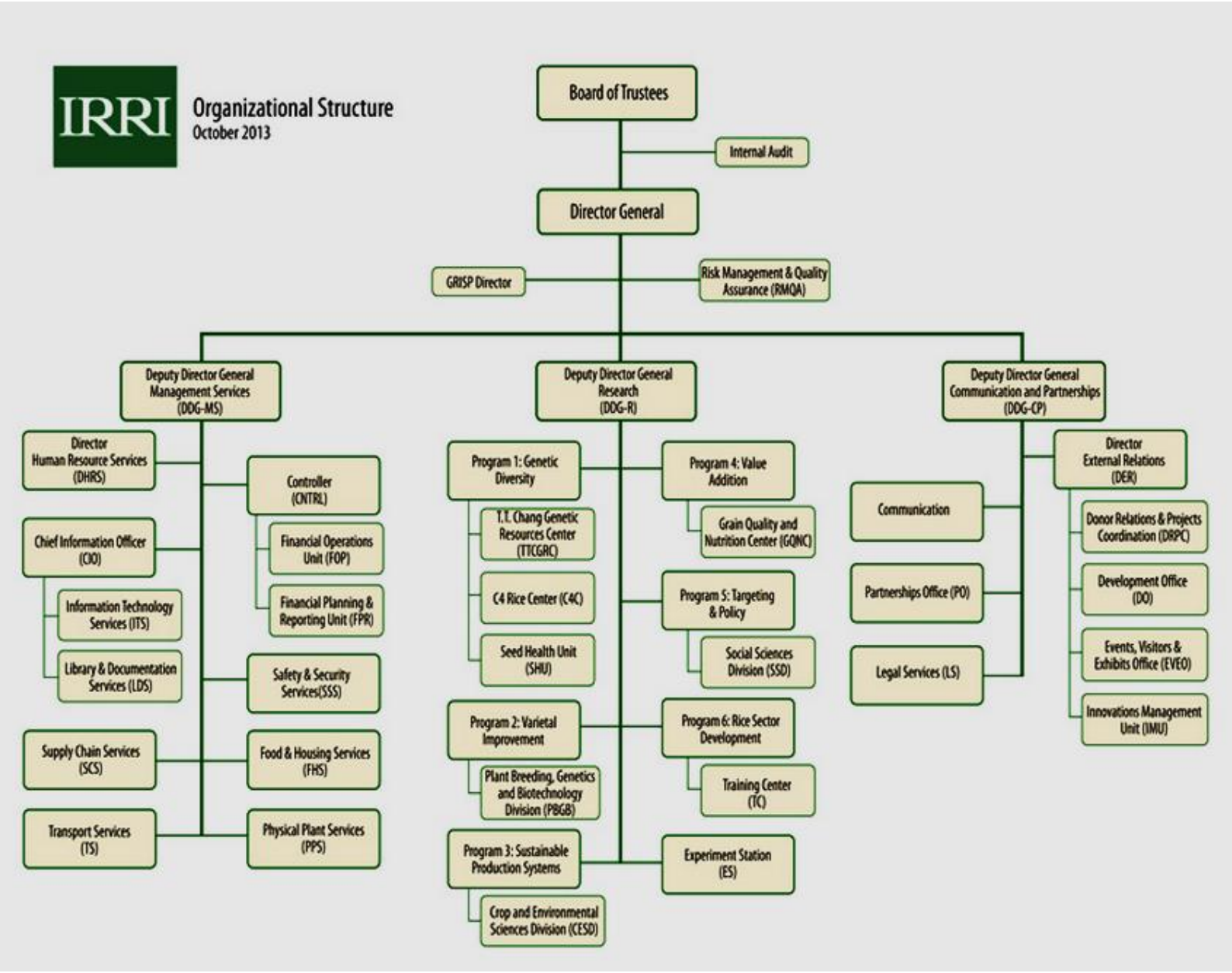


Figure 5: Organizational Chart IRRI (IRRI, n.d.)

Financial Structure

The financial data is derived from the annual report from IRRI of 2014, unless otherwise indicated.
IRRI is a nonprofit organization, funded by several international parties. The total revenue for 2014 was 99.19 million USD. This amount is provided by the CGIAR Fund (38.88 million), national governments of countries where IRRI is located (30.16 million), philanthropic foundations (15.73 million), CGIAR Centers and Programs (4.67 million), the private sector (4,01 million), international organizations (3,84 million) and universities (0.63 million). The relative distribution of funds is well represented by figure 6.

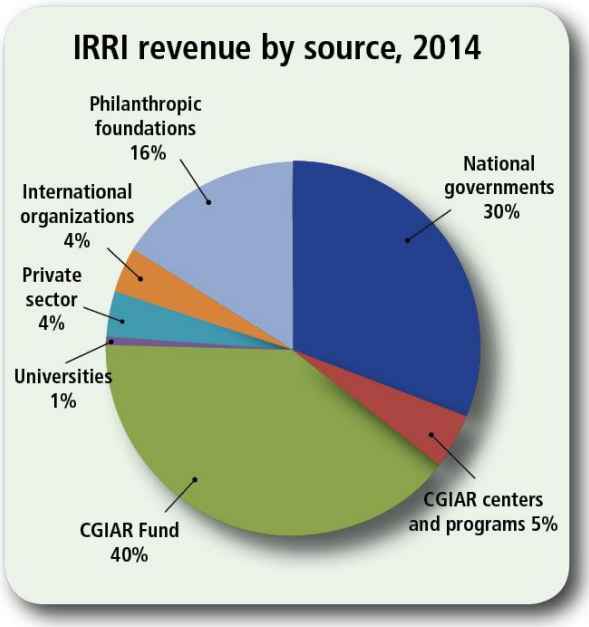


Figure 6: Distribution of funds in 2014 (IRRI, n.d.)

The total expenses and losses in 2014 is 100.259.000 USD. The largest expenses for IRRI are research costs which are equivalent to a total of approximately 69,7 million USD. The expenses exceed the revenue in 2014 and results in a deficit of more than 1 million USD. The specific data of the profit and loss balance of IRRI in 2014 is presented in table 3.

Table 3: Profit and Loss Balance of IRRI in 2014 (IRRI, 2015)

		2014			
	Note	Unrestricted	Restricted-CRPs	Restricted-Non-CRPs	Total
REVENUE AND GAINS					
Grants Revenue					
Windows 1 and 2		$ -	$38,875	$ -	$38,875
Window 3		608	25,369	980	26,957
Bilateral		572	27,343	4,170	32,085
Total Grant Revenue		1,180	91,587	5,150	97,917
Other revenue and gains	*4, 17*	1,270	-	-	1,270
Total Revenue and Gains		2,450	91,587	5,150	99,187
EXPENSES AND LOSSES					
Research Expenses		1,378	64,232	4,057	69,667
CGIAR Collaborator Expenses		-	18,568	-	18,568
Non CGIAR Collaborator Expenses		11	8,787	1,093	9,891
General and administration	*18*	2,133	-	-	2,133
Total Expenses and Losses		3,522	91,587	5,150	100,259
DEFICIT		($1,072)	$ -	$ -	($1,072)

4.3 Wetsus

Background

Wetsus, a centre of excellence for sustainable water technology, is a non-profit organization in the Netherlands. Wetsus organizes strategic cooperation to stimulate both profitable as sustainable water treatment technology. It acts as broker and facilitates collaboration between research institutes and companies in Europe, with the ambition to play a major role in contributing to the solution of global water problems.

Organizational Structure

Wetsus is managed by an executive board, which is formed by a scientific director and director with a business related background. Each of the executives leads a management team. The supervisory board consist of 10 members, of which 4 are appointed by the company participants, 4 are selected by research institutes and 2 independent members, who fulfil the role of chair and vice-chair (Wetsus, 2015).

The scientific research agenda is outlined by the private and public water sector and carried out by leading research institutes in Europe. The involved companies are assembled in a research theme, which serve as intellectual property right (IPR) clusters, and all together they define the research program. Each research theme consists of 8 companies and 4 universities. The participating companies all pay an annual fee which gives them the right to define the agenda, but also a shared right of first refusal the research results (Wetsus, 2014).

In the cooperation model of Wetsus 3 types of participants are distinguished. The model exists of company, platform and know-how participants. For the first two organisations an annual fee is required to participate, the rates depend on the turnover of the organization. The company participant has the right to set the agenda and refuse the first research results. The platform participant does not have these rights, but gets a privileged position to access information and research results. The know how parties are participating research institutes. Research is mainly done by PhD students from all over Europe. The involved research institutes are responsible for all research projects performed by Wetsus(Wetsus, 2014).

Wetsus is operating in three main roles, besides the described research role, they also developed and operate a talent and education program. This program is setup to educate individuals and train them to fulfil the innovation goals the international water sector has. Furthermore they focus on the translation of laboratory inventions into actual and practical innovations applied in society, by organizing activities to support spin- offs and entrepreneurship. Figure 7 shows in which three domain the activities of Wetsus are organized.

Figure 7. Three main functions of Wetsus (Wetsus, 2014)

Financial Structure

Wetsus is funded by multiple parties, which provide for a total budget of 16 million euros per year until 2017. Funding is derived from regional, national and European government funds and from contributions from companies and universities. The 95 involved companies invest approximately 3.3 million euro per year. A total overview of program budget over the years and an overview of the results is provided in table 4. This table shows that Wetsus starts in the initial phase with a program budget of 7 million, which in the meanwhile has almost triplicated to 20.6 million in 2015. The contribution of companies increases less steep and accounts for an increase of 65% compared to a total increase of nearly 300%. Wetsus' network became larger as well, the number of participating companies doubled, with 53 in 2007 to 110 in 2015, and the number of knowledge institutes almost tripled, it increased from 6 in 2007 to 20 in 2015.

Unfortunately the annual report of Wetsus did not provide for an organizational chart of the organization.

Table 4. Wetsus overview performance indicators 2007 - 2020 (Wetsus, 2014)

Performance indicators Wetsus	2007 realized	2008 realized	2009 realized	2010 realized	2011 realized	2012 realized	2013 realized	2014 realized	2015	2016	2017	2020
Input												
Program budget (in mio €)	7.0	9.2	11.7	13.2	13.8	15.7	16	16	20.6	20.8	20.8	*20.8*
Contribution of the companies to the research programme (in mio €)	2.33	2.8	3.0	3.4	3.6	3.8	3.6	3.3	3.8	3.9	4.0	*4.0*
Overhead (%)	11	10	10	10	10	10	10	10	10	10	10	*10*
Talent program payed from TTI budget (%)	1	1	1	1	1	1	1	1	1	1	1	*1*
Network												
Number of participating companies	53	66	78	86	92	95	93	95	110	115	120	*120*
Number of participating research chairs	17	25	33	38	45	46	48	52	49	50	50	*50*
Number of public knowledge institutes	6	8	14	16	16	18	19	19	19	20	20	*20*
Percentage of SME (% of companies with turnover <100 mio €)	34	51	54	56	55	54	54	56	50	50	50	*50*
Number of foreign companies (cumulative)				13	17	17	22	27	31	35	35	*35*
Output												
Number of research projects (cumulative)	46	63	93	105	120	133	152	165	187	205	223	*275*
Number of research themes	14	16	19	22	24	25	25	23	25	25	25	*25*
Outflow of researchers to partners (cumulative)				20	22	34	42	58	78	88	98	*135*
Impact/Outcome												
Education												
Number of joint degree students / year		10	8	15	11	21	23	30	40	45	50	*50*
Number of MSc thesis students / year	21	46	37	71	61	80	76	72	70	70	75	*75*
Number of PhD Students (cumulative)				99	114	128	145	160	168	184	200	*250*
Number of talent events			10	20	19	19	16	20	35	40	45	*45*
Scientific												
Number of scientific papers in international journals (cumulative)	19	39	66	121	176	234	294	376	408	460	516	*690*
Numbers of papers in top 10% citations (cumulative)						45	67	80	61	69	77	*105*
Citation impact (overall)				very high	very high	very high	very high	very high			very high	*very high*
Valorization/entrepreneurship												
Number of spin-off companies (cumulative)	3	3	9	15	17	20	24	26	23	24	25	*30*
Number of patents (submitted, filed and granted) (cumulative)	13	22	32	39	53	61	64	67	73	77	80	*90*
Number of transferred patents (cumulative)	3	4	7	14	14	22	22	26	32	37	40	*45*
New technologies (cumulative)											20	*25*
Optimization existing technologies (cumulative)											15	*20*

4.5 Conclusions

This comparative study is done to provide for an answer on the question: what can we learn from public funded research centers specialized in agricultural or water related themes? Well ICBA and IRRI are for their funding both entirely dependent on funds from mainly the public sector. Wetsus derives the majority of their revenue from the public sector as well, but they also receive a substantial income from private companies. Almost a fourth of the total income comes from fees from participating companies. This shows us that public and private means can be combined for innovating developments in the agricultural or water sector. As for the organization, all institutes are non-profit organisations, and are mainly structured in the same manner, an executive board at the top level, followed by a general director and some supporting services. The main activities of the research centres are structured in 3 main departments or work fields. However Wetsus does not work with general directors, instead they have an executive board of two with each heir own management team. And in addition to the Executive Board, they also

have a supervisory board and an advisory board. The main difference between Wetsus and the other 2 organizations is the fact that Wetsus works closely with companies, which are represented by the supervisory board. These organizational types and the hierarchic organizational chart will be taken into account in the design for an organizational structure for IREC in chapter 6.

5. Stakeholder Analysis

A stakeholder analysis is performed in order to identify the individuals, groups and parties which will affect or be affected by the establishment of an International Research and Experimentation Center. A total of 15 stakeholders is identified, selected and interviewed through a semi structured questionnaire. These stakeholders are selected in order to represent a wide variety of sectors and perspectives. The following perspectives are represented in this study: the agricultural sector, the governance agencies, entrepreneurs in saline agriculture, the knowledge institutes, nature conservation agencies and the retail sector (including the seed breeding companies). An overview of all included perspectives and stakeholders interviewed is presented in figures eight and nine.

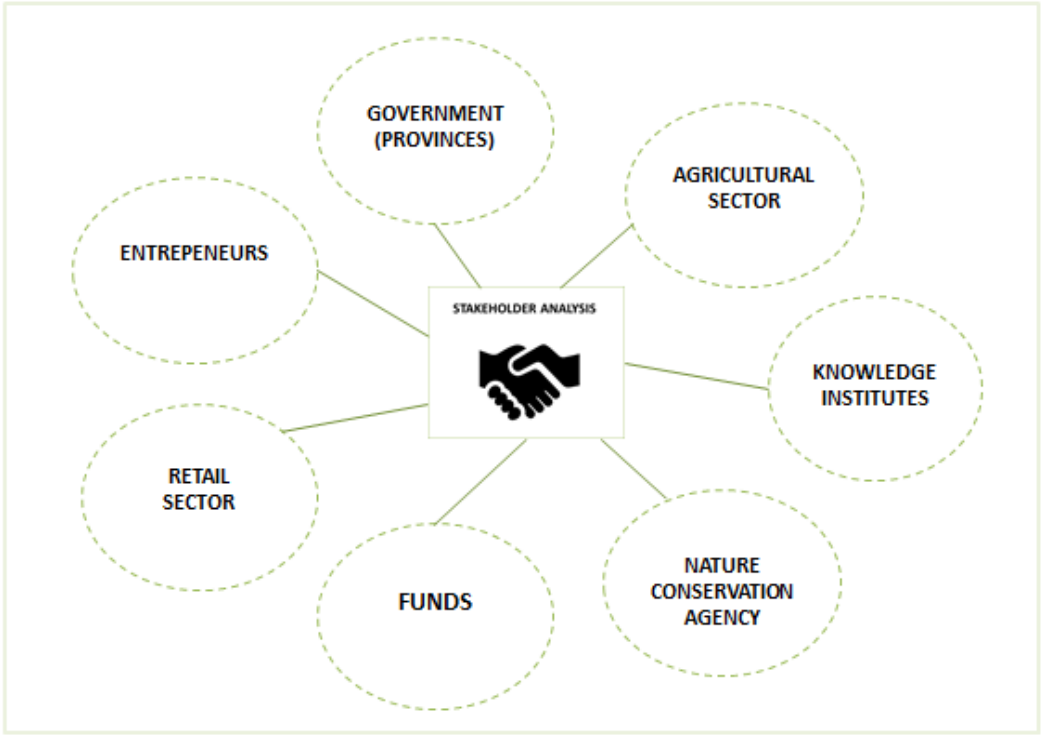


Figure 8. Overview of sectors consulted for this study (own ill.)

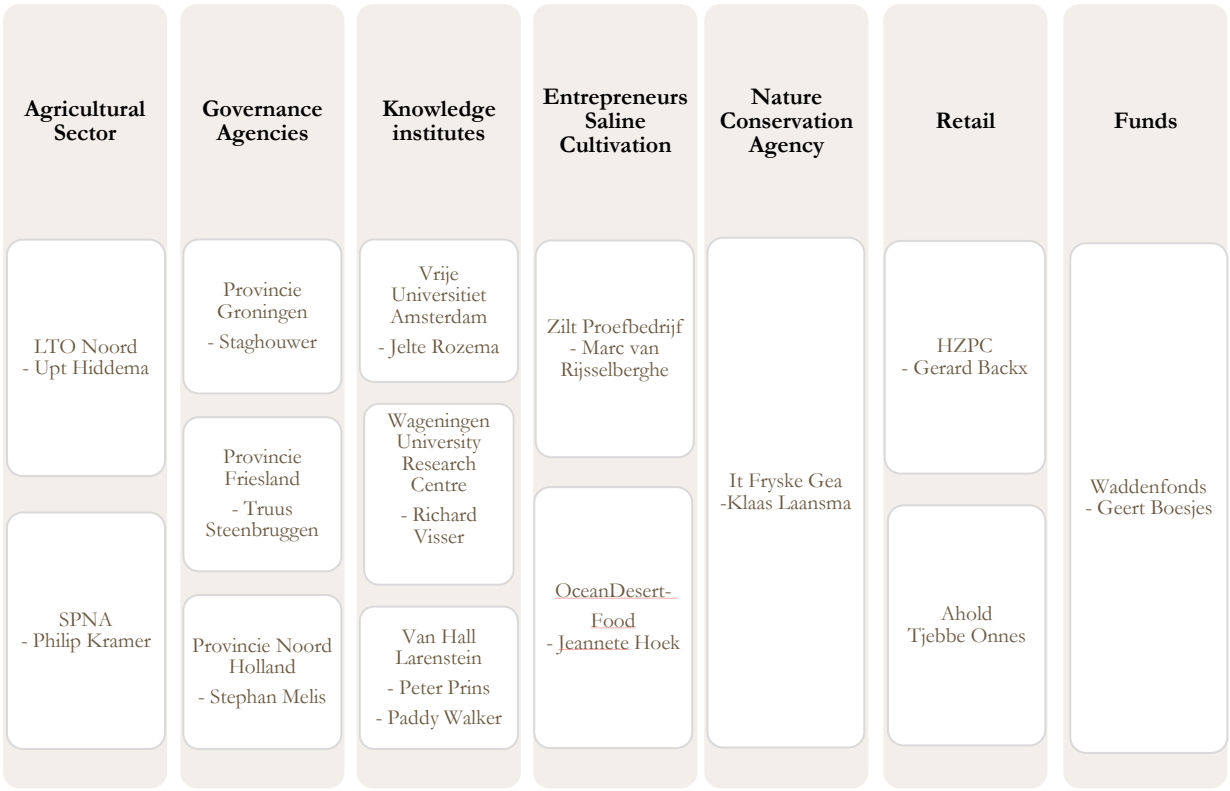


Figure 9. Overview of stakeholders interviewed for this study (own ill.)

The range of stakeholders involved in the exploration of the feasibility of setting up an International Research and Experimentation Center is necessarily broad as many different types of stakeholders are involved. In order to include all relevant sectors in the limited time frame for this study, 1 to 3 stakeholders have been selected to represent their specific group or domain. Therefore, the respondents selected to represent for example the agricultural sector are not individual farmers but farmer organizations that have a strong connection and a good overview of the perspectives of the majority of the farmers in the area. The perspective of the governance agencies is included by interviewing officials and deputies of agriculture in the provinces of North Holland, Groningen and Friesland. For the viewpoint of the knowledge institutes, the Wageningen University and Research Centre (WUR) is selected because of their specialization in Food and Food production, the Living Environment and Health, and Lifestyle and Livelihood. These core areas of the WUR align well with the issues that arise when setting up an International Research and Experimentation Centre. Besides the WUR, the Vrije Universiteit (VU) and Van Hall Larenstein (VHL) are also selected to represent the knowledge institutes. The VU is selected because of the expertise and the close involvement of professor Rozema and Arjen Vos (during his PHD) in the developments related to saline agriculture in Texel. VHL is chosen due to their education focusing on Delta areas and Resources, Animals and Business and Food and Dairy, which are all relevant themes connected to the central themes in this study. Furthermore, VHL has various lectureships concentrating on subjects such as: coast and sea and green living environments of cities (climate changes: risks and possibilities), all relevant lectureships related to this research. For this study, entrepreneurs already in the field of saline agriculture were also interviewed because of their experiences with saline businesses. It

Fryske Gea, a nature conservation agency in the area, is consulted because of their knowledge on the qualities and possibilities of the natural environment of the Wadden region. In order to investigate the market for saline products, Ahold the largest Dutch supermarket, is interviewed and also HZPC, as one of the world leaders in the marketing of (seed) potato varieties, is consulted. Finally, to investigate the possibilities for financing the set-up of IREC, funds had to be interviewed. The Waddenfonds is the sole fund included in this study because of their close involvement in the developments around saline agriculture in the Wadden area. Other funds indicated that they were not able to provide information on this subject due to the stage in which this study is carried out. Since this research is a feasibility study, in which the design of a research institute is still being developed based on the needs and viewpoints of relevant stakeholders, it is a premature phase to involve financial stakeholders. However, when this study is completed with a design for a research institute, financial institutes are willing to discuss the possibilities.

The questionnaire developed to interview the involved parties is structured in three segments: ecology, economic development and the financial and organizational structure. This chapter represents the results of the stakeholder interviews and will also be structured along the same components as in the questionnaire. Finally, the chapter concludes with an analysis on the results derived from the stakeholder interviews.

During the first three stakeholder analysis, professor Pier Vellinga accompanied me to the interviews. These interviews are a less structured along the questions of the interview, and have a relatively more open method of interviewing since Professor Vellinga is more experienced in interviewing techniques. The remaining interviews were conducted by myself at the office of the Waddenacademie or at the location of the stakeholders. In addition, there have been a number of telephone interviews, because stakeholders were not available in the period that the interviews were conducted, due to busy agenda's, holidays or obligations abroad. All interviews have been recorded, transcribed and included to this study in the appendices (Appendix D). The interviews are manually coded and processed per theme and per question.

5.1 IREC and the ecology of the Wadden area

The first part of the questionnaire exists of 3 open questions on the establishment of an International Research and Experimentation Station and the ecological environment of the Wadden region. Respondents are questioned on their perspective of setting up IREC in the unique and valuable environment of the Wadden area which is part of the UNESCO World Heritage. Question 1 and 2 address what the impact is on the ecological environment, when setting up IREC, and thus developing saline agriculture in the Wadden region. Question 3 is about the potential of aquaculture in the Wadden area and whether the farming of aquatic organisms, such as shellfish and algae, should also be included as one of the focus areas of IREC.

All stakeholders have been asked the same questions, however the in-depth knowledge of the sectors on all three themes in the questionnaire varies. The questions related to promoting or harming the ecological

environment when developing more saline agriculture, was for most respondents difficult to answer. However Klaas Laansma from the nature conservation agency It Fryske Gea did provide for an extended explanation on the ecological properties of the area. Laansma states that the area along the coast line lacks brackish environments where salt and fresh water mix, brackish water appear naturally and form an important habitat for some species. Due to anthropogenic activities these areas reduced along the sea coast of the Wadden region. Thus from an ecological perspective more of these brackish environments are needed, because this promotes biodiversity. Fish species can easily migrate back and forth, which leads to spawning grounds along the reed in the ditches. He also states that besides the need for more brackish water areas, it also necessary to increase high tide refugee areas for birds both landward and sea ward. Laansma argues that saline agriculture could be combined with developing and promoting the ecological qualities of the Wadden region. This can be achieved by creating lakes with brackish water, which lead to the increase of brackish water areas and also of spawning grounds, and by creating fresh water lakes to establish fresh water lenses for agriculture and create high tide refugees areas and breeding grounds. This way the lakes can be combined with saline cultivation. Other respondents were cautious in answering the first 2 question on the ecological impact of saline cultivation. Respondents did make a clear distinction between saline cultivation land ward and sea ward. The representatives of the agricultural sector, Kramer from SPNA as Hiddema from LTO, both believe in opportunities for saline cultivation on the land side, but were more critical on the possibilities and the impact saline cultivation would have sea ward. While Kramer states one should not experiment on the sea side, because of its unique qualities, Hiddema says saline cultivation is possible sea ward as long as there are good regulations. Since saline cultivation is relatively new, it is not bound to rigid rules, so it can be organized in a way that harming the environment is prevented. His concern is not the possibilities of saline cultivation sea ward, but rather the market for saline products. Since it is and will be a niche market, there is no need for large scale production and therefore the harmful effects would be limited, says Hiddema. The 3 provinces all mentioned that it is absolutely not an option to deliberately accelerate the process of salinization by the inflow of brackish or salt water. Saline agriculture should only be allowed where soil and water is already salinized. As for the knowledge institutes, Visser of WUR was sceptical about agricultural production in the Wadden area, he makes a distinction between halophytes and large scale agricultural production. The halophytes could increase the biodiversity along the coast, but agricultural production is not appropriate for that region. Rozema (VU) and Walker (VHL) contrast this point of view, they state that it fits in the natural environment of the Wadden area. Walker's point of view corresponds with Laansma, as she as well points out the need for more brackish water and spawning grounds to enrich biodiversity along the coast. From this point of view, she argues that activities that link sea ward and land ward, leading to more brackish water, need to be stimulated. However she notes that anthropogenic activities need to be adjusted to the natural developments of the ecosystem, and that the scale of activities need to be suitable for the area. Activities can be developed on a larger scale near the ports for example and smaller in salt marshes. She concludes with the remark that saline agriculture can certainly result in ecological value creation, and that it might even reduce fishery in the Wadden sea. The point of view of Gerard Backx from HZPC matches

some arguments of Walker, Visser, Hiddema and Kramer. It matches that of Walker and Visser in that the impacts of saline agriculture depends on the scale of activities. And it corresponds with Hiddema and Kramer in the sense that sea ward agricultural production will change the ecosystem of the sea, however he highlights that it will change, but whether it is a negative change is still uncertain.

The final question in the ecology part relates to the inclusion of aquaculture. Respondents are asked if they think the International Research and Experimentation Center needs to include aquaculture as one of the focus domains and how they perceive the potential of aquaculture and the effect it could have on the Wadden Sea. Laansma from the nature conservation agency is positive about the potential of aquaculture, but when farming sea ward, one should consider what the effects are on the environment and the ecosystem. When a certain area is used for aquaculture, it should result in value creation in that specific area, but at the same time, value creation needs to be created elsewhere to recompense for the area used for aquaculture. The representatives of the agricultural sector, both said aquaculture belongs to fishery and is not their specialization. However, Kramer believes sufficient research is done on the subject of aquaculture and it seems promising so fishermen should be involved in the developments. His attitude towards including aquaculture is neutral in contrast to the response of Hiddema. He argues that aquaculture can be done anywhere else and is not specifically connected to the possibilities the Wadden area offers. When IREC includes aquaculture it should not be the first nor the second main priority, the only way aquaculture would be relevant is when a new generation is educated and interested in the subject of aquaculture, because the current farmers are not interested, says Hiddema. A more positive view on the potential of aquaculture is presented by Rozema, Walker, Prins, Boesjes and Staghouwer. They argue that aquaculture is a very potential opportunity for the Wadden area. Rozema states that aquaculture and saline agriculture (salt tolerant conventional crops and halophytes) can be combined very well, because the excrement of shellfish enrich the water, which than can be used for saline agriculture creating a closed loop. In a way he is amazed that the Wadden region did not develop its aquaculture at all, even though there is market for it. Consumers travel to the coastlines of France to eat shellfish, while the Wadden area could also provide in this need. Therefore, he considers aquaculture as the most promising and potential part of saline agriculture, as soon as this production line is developed, it will be easier to combine it with the cultivation of halophytes. Prins states that when the Netherlands is able to develop a sustainable system of aquaculture, it will also have international potential. The Dutch interdisciplinary way of working can lead to qualitative high valued products, which can very well compete with the low quality and unsustainable production of some of the Asian countries.

5.2 IREC and the economic development in the Wadden area

The second part of the questionnaire exists of 5 open questions related to the economic development the establishment of IREC will have on the region and internationally. The first question is whether the set-up of IREC could stimulate economic development in the Wadden area. According to Staghouwer, Melis, Hiddema, Walker, Hoek, Boesjes and Rozema the economic development depends on the cooperation

with other stakeholders. Staghouwer, Melis, Hiddema, Hoek and Boesjes highlight that the economic development depends on the farmers, entrepreneurs and the market. Since the current market for saline products is small and the developments related to saline agriculture are merely driven by researchers, Melis considers the economic development and potential to be very limited. Rozema, Prins and Walker state that economic development is possible, when IREC collaborates with organizations such as Wetsus, Imares, businesses and universities of applied sciences. Prins and Walker especially emphasize the cooperation with the universities of applied sciences and advise to develop a service in which businesses can request research at IREC which will then be conducted by students of these universities. This way students gain practical experience, while businesses have the opportunity to develop strategies for saline cultivation. Backx believes setting up a business always results in more activity and thus in employment, however he points out, as well as Kramer, that economic development is limited to ten to dozens of jobs. In contrast, Rijsselberghe and Boesjes, state that large scale economic development is subject to the progress of saline agriculture. Farmers and businesses will participate and collaborate, when developments show a proven concept in transition to the market and when an indication of the earnings is provided. Laansma conversely sees opportunities in leisure fishing and culinary activities with samphire and shellfish.

With question 2 and 3, respondents are asked about their opinion regarding the possible regional and international spin off of IREC. Ten out of fifteen stakeholders interviewed believe IREC will mainly lead to international spin off (Hiddema, Kramer, Staghouwer, Steenbruggen, Walker, Prins, Backx, Rijsselberghe, Hoek and Boesjes). They emphasize the role of the Netherlands as expert in the agricultural sector, in water technology and as one of the main export countries for crops. From this perspective they argue that the Netherlands is also competent to play an advanced role in saline agriculture and export the Dutch technology and knowhow to salinized areas worldwide. There is a great global demand for salt tolerant crops, hence a great opportunity for the Netherlands to develop an adaptation strategy. In contrast to most stakeholders, Melis is cautious in his statements regarding the international spin off of IREC. He doubts the possibilities of exporting saline crops and technological knowhow, because knowledge on saline cultivation is still in an early stage and other projects related to saline agriculture have not yet been proven to be successful. Furthermore, he points out that the Wadden area is relatively small compared to other research locations and that the salinity in the Netherlands is very limited compared to other countries. Visser is also critical on the possibilities to export knowledge and knowhow, however his point of view is based on the general problem of marketing research. The development of knowledge is crucial, however it takes time for research to arrive at a stage in which a product, in this case a crop, is fully developed and results in direct earnings. Hence, it is possible, but needs a lot of investment, both in time as in financial resources, says Visser. Rozema would agree with Visser, in a sense that he as well states that international spin off is difficult to achieve. His experience with saline cultivation abroad, is that it all seems to be quick and dirty, and does not meet the high standards of saline agriculture practices of the Salt Farm in Texel at all. Despite this advantageous position, there is still little use of the services and facilities provided, probably because of the high costs.

As for the regional impact of IREC, Backx and Hoek believe in small scale regional spin off. Hoek describes a situation of farmers and restaurants collaborating and stimulating more employment and tourism because of the culinary possibilities of the Wadden area. Walker also has confidence in the regional spin off of IREC, according to her this is mainly related to collaboration, research, discussion and sharing knowledge. Hence, fundamental and applied research at all levels.

Question 4 is related to the earnings from saline agriculture. The Waddenacademie specified earnings from exporting salt tolerant crops and technology, and from a consumer oriented modified cultivation. Respondents are asked how they would like to participate and consequently could benefit from the earnings from IREC.

LTO is a farmers organization, which means we represent the interest of farmers and therefore we always strive for more development and new technologies. To realize this objective we work closely with research institutes and often participate in the board of projects on behalf of the farmers in the region. By participating, we can co finance the projects through funds for agricultural development from the Ministry of Economic Affairs. Kramer, is also positive about participating and emphasizes that the cooperation can be organized in several ways. They can offer their expertise of conducting research and experiments, but also the possibility to facilities of SPNA, such as the laboratory or conference rooms.

The developments related to saline agriculture can be combined with the planned projects of the province of Groningen. These plans focus on dike reinforcement and on removing the strict line between fresh and salt water. This way the activities lead to more employment, which is considered to be a direct gain for the province says Staghouwer. The province of Noord Holland, emphasizes that the private companies need to be convinced to participate and not the government. If IREC focuses on further development and implementation of the existing knowledge and is driven by financially strong companies, the province is willing to support the initiative with 20-40% of funding, says Melis.

The representatives of the knowledge institutes are all willing to participate by conducting research, developing an export method for saline products, applying for patents on developed methodology and so on. Hence all activities related to conducting research. Walker highlights that students get an opportunity to gain fieldwork experience while businesses are offered the service to conduct research for relatively low costs. Furthermore, by cooperating with universities of applied science, certain funds, for example RAAK, become available, says Walker.

According to Rijsselberghe, entrepreneurs are best served by an institution that gathers all knowledge regarding saline agriculture and offers public accessibility to this information. He compares it with the Waddenacademie which offers knowledge related to the Wadden region. He states that entrepreneurs are willing to share within the boundaries of their own interests. Organizing and forming a platform in which knowledge is publically available, results in a stronger position compared to other institutes dealing with saline agriculture. Correspondingly, Hoek states she can offer the institute her expertise and experiences as

entrepreneur in the field of saline agriculture, and that she additionally would like to be supported in the marketing of her products.

It Fryske Gea offers their expertise in fundraising, but emphasizes mainly their role to support activities in which nature can sustainably contribute to the wellbeing of the society. Laansma says: we have a shared interest with the agricultural sector, in the sense that we both are benefitted by a well understanding of our environment and therefore we always strive for knowledge development.

For the Waddenfonds it is primarily important that the knowledge is in a pilot phase in which it can be implemented and tested on plural locations, or it is in the phase of marketing the output. In this case the Waddenfonds will surely contribute in enabling the establishment of IREC.

In contrast to the previous perspectives of the respondents, Backx states the possibility of HZPC to participate or contribute in IREC is relatively small. He argues that HZPC conducts its own research in testing the salt tolerance of potatoes, and that this is therefore private knowledge, which cannot be shared in a public institute. However, when fundamental research is conducted by public means, private companies are needed in marketing the products, since knowledge institutes are not adequate to produce readymade end products. In this phase HZPC is interested in cooperation.

For the last question on economic development, respondents are asked if they can identify a (research) institute that resulted in great economic development for the region and if they can explain what one should learn from this successful institute.

Breeding companies for potatoes have a strong positive influence on the developments in the region and subsequently did the Wageningen University and Research Center, says Hiddema. In order to contribute to development in the region IREC needs to seek cooperation with SPNA, PPO Lelystad, HLB, the Dairy Campus and Wetsus. Kramer mentions mainly the same institutions as Hiddema, and stresses that these research institutes have greatly contributed to the economic development of the region. Croppers have significantly benefitted from the research done by these institutes because these experiments are too risky for farmers to apply on their own land and this way they can benefit directly from the proven results provided by research institutes without taking any risk themselves.

The province of Noord Holland points out that the Seed Valley could contribute greatly in saline agricultural developments internationally.

Wetsus is mentioned by Rozema, Backs and Boesjes as on the one hand as a good organizational model where cooperation is established between government, businesses and knowledge institutes, and on the other hand mentioned as a great partner in the development of saline agriculture. SPNA and Salt Farm Texel are appointed as location to experiment and test the developed methods (Rozema and Boesjes).

The Center of Expertise Delta technology is, according to Walker, a better organizational model for IREC than Wetsus or Dairy Campus. The Center of Expertise works with a 50/50 model, which means 50% of funding is provided by the center itself and 50% by involved businesses.

Finally ICBA is also one of the institutes given as an organizational example for IREC by Hoek. This is an international center for biosaline agriculture in Dubai, which is included in the comparative study in this feasibility research.

5.3 The Financial and Organizational Model of IREC

In the last part of the interview respondents are asked what kind of financial organization they prefer for IREC and how the institute needs to be financed. The first questions elaborates on the collaboration IREC pursues, and stakeholders are asked how this collaboration needs to be organized in order for them to participate in this cooperation.

Hiddema explains that LTO usually works in consortium with 5 or 6 parties and that they participate as the representative institute for farmers. Well this method is also applicable on IREC, however I do emphasize that the activities must be market driven, that is the main condition says Hiddema. This is in line with the perspectives of Steenbruggen and Melis. As long as its market driven, they are willing to facilitate it. Steenbruggen adds that the institute needs to collaborate with the academy for agriculture. Furthermore, Rozema agrees with the condition that it should be market driven.

Most respondents also emphasize the importance of collaboration with other parties and stakeholders (Hiddema, Rozema, Prins, Walker, Hoek, Boesjes, Backx and Laansma). An enumeration is given of the following parties: breeding companies, business firms, farmers, water boards, knowledge institutes, provinces and Wetsus. According to Rozema, IREC should also provide researchers with the necessary support when they work abroad. He gives the example of difficult partners in China, researchers are not adequate to negotiate with these partners, and IREC could provide a service for mediation.

While most stakeholders adhere to the cooperation model, Visser is skeptical and says it is self-evident to strive for cooperation, but this is extremely difficult. Including plural knowledge institutes for example leads to competition between institutes, since they are all dependent on the same funding sources. It also results in competition between existing research institutes and IREC, a lot of research institutes are already conducting research in the field of saline agriculture so why should they abandon their research or transfer it to IREC. Besides the funding related issues, he also points out that the current proposed structure is more expensive since personnel of IREC also needs to be compensated for their work. In his view, the proposed structure in which parties cooperate in fundraising, seems too good to be true.

A key issue with regard to cooperating parties, is the tension between public and private interests (Rozema, Rijsselberghe, Backx and Visser). While Rijsselberghe explicitly warned for including businesses in the board, because their private interests contrast the public interests. Businesses are eager to control

the processes, says Rijsselberghe. In line with the perspective of Rijsselberghe, Backx says that companies should be included and that they then indeed want to steer the processes since they invest a great amount of their private means. Hiddema argues that it is completely comprehensible, that the party that invests should be the one to control. According to Backx, a cooperation is achievable when it is clearly indicated what belongs to public property (usually fundamental research) and what can be further developed and exploited by private companies. He mentions the Carbohydrate Competence Center (CCC) as a textbook example of, how cooperation between public and private parties is achievable.

The second question relates to how IREC should be organized, respondents are asked how they perceive the idea of using an organizational model, which consists of a central research facility and several decentralized local test fields.

Hiddema: central approach is the way. Having plural decentralized test fields allows for experimenting on different types of soils. One should first investigate the option to use the current experiment stations. When none of these locations possess the type of soil needed, research can still be done by the researchers of experiment station on parcels in the region. These researchers are experienced in doing this type of research and should be involved. Experiments are not appropriate to perform on valuable agricultural land, besides farmers are not used to do this type of work. These test fields can be located along the whole coast from Zeeland to Groningen. Experiment stations sea ward are less suitable because of the unique landscape and world heritage. This might be done for halophytes, but since these products are intended for a niche market, the scale will be small and will therefore not harm the environment.

Kramer, Boesjes, Staghouwer, Prins, Walker and Backx believe it is necessary to have plural test locations, both regional as international. They argue that it is required because of the various types of soils and crops related to saline agriculture and if aquaculture is included as one of the focus areas of IREC it is inevitable to incorporate multiple test sites. Staghouwer responded on this question with the remark, that the province offers 40 hectares of land in Groningen to be used for saline agriculture.

In contrary, the representatives of Noord Holland and Friesland were slightly more skeptical, as Steenbruggen regards this organizational model as a top down approach and Melis emphasized once again that it is above all important that the institute is initiated by entrepreneurs and businesses.

Visser believes that there is no need for another research institute. More important is the next step, when research is concluded and needs to be implemented in practice. This institute could contribute far more when it focuses on research which is already (being) conducted and needs to be taken a step further, it might need some additional research, but is close to the phase of implementing and marketing. Therefore I would not even call it a research institute, but rather a Translational Research Institute for saline agriculture, says Visser.

According to Rozema, it is possible to form a board with experienced people who have the necessary knowhow. However it will be difficult to establish cooperation with business partners. Entrepreneurs willing to invest in experiments and projects are currently rare and their financial contribution is relatively small. An example given by Rozema, is that of the Shellfish experiment in Texel, in which Andre Seinen participates and invest his own capital in the project. Cooperation of the provinces will also be difficult according to Rozema. However he argues that saline agriculture is potential, but questions whether the governance agencies will recognize its potential as it is not directly observable yet.

Rijsselberghe emphasizes the need for the right people in the board, companies should not have a position in the board. The board should exist of independent people who can transcend individual interest. These people should have a good reputation and understand the significance of the area, says Rijsselberghe. He mentions independent people such as King Willem Alexander, Herman Wijffels, Marjan Minnesma and Pier Vellinga as potential candidates to fulfill this role. Businesses, entrepreneurs and others will be involved in the other layers of the organization. Laansma agrees with Rijsselberghe and says the board should exist of strong and conceptual thinkers with no strong political or commercial ties, but able to understand the political framework and the importance of involving the right (political) stakeholders.

With the third question stakeholders are asked what they consider to be the most appropriate financial structure in striving for more positive developments in saline agriculture.

According to Hiddema the most effective financial structure is the 50/50 model, which means an equal division in public and private funds. In his experience, the government is more likely to collaborate when businesses invest for at least 50% in projects. Kramer suggests that IREC should mainly be financed with public means, especially in the first phase. He estimates that a public contribution of 80 – 85% is needed to establish IREC and that funding should be derived from the Waddenfonds, the provinces, the national government and European funds. The remaining funding depends on the type of research that is conducted, some may be fully funded by companies while others are financed by a combination of public and private means.

Representatives of the provinces are cautious in their statements about the financial structure. Steenbruggen says that if entrepreneurs need more space to develop their activities, they can do so in cooperation with the academy for agriculture. Melis also emphasizes the role of entrepreneurs and he states that if IREC is initiated by these stakeholders, the province of Noord Holland is willing to discuss the possibilities. Furthermore, he points out that if projects in saline agriculture fulfill the conditions, they are eligible for subsidy from the Waddenfonds,.

Visser argues that IREC will inevitably dependent on public means, because it cannot and should not be financed exclusively with private means. However the government has shown to be the most unpredictable partner by now, funding is usually provided for one year and for the next year funding is

uncertain. Consequently, planning for multiannual research projects is extremely difficult. Rozema also mentions the fact that operating on exclusively private means is not (yet) possible. Therefore he would like to see that current projects will get more support from an institution like IREC. As for Backx, Walker and Prins their point of views correspond with Kramer, in the sense that they, as well, believe IREC needs to be financed mainly by public funds and they also mention the possibility of international funds. Consequently they state that while funding in the first phase will mainly exist of public funds they would prefer a gradual shift over the years to private means.

Rijsselberghe is interested in a method in which funding of projects would be simplified by IREC. This way he is willing to invest for 50% in a project, when the remaining funding is arranged by IREC. As well as Kramer, Backx, Walker and Prins, Hoek argues that funding should be merely from public funds, such as the Waddenfonds, but also the European fund for climate change related themes. The division of public versus private funding is set at 60-80% public and 40-20% private, says Hoek.

Boesjes explains that the Waddenfonds is willing to contribute when research is in a pilot stage and is ready to be carried out. The Waddenfonds states that it is not interested in financing research facilities other than the Waddenacademie. As for funding he argues that the availability of private means will be limited and that public funding to set up IREC can be derived from the Ministry of Economic Affairs and from Brussels.

The last question of the interview focuses on which lessons can be derived from the organizational structure of other research centers in the area of agriculture or water related themes.

Kramer says that most research centers are probably organized in the same way as SPNA and that this model could also be used for setting up IREC. They have a management team, a couple of researchers performing the experiment and some supporting staff. Not all research is performed by SPNA, some is outsourced to Van Hall Larenstein for example, so it is important to work closely with other institutes.

During the interview Steenbruggen mainly highlighted the plans to set-up an agricultural academy. The establishment of IREC should, in her opinion, be connected with the current development of the agricultural academy. However she doe emphasize that this is her personal opinion and that if farmers and entrepreneurs strive for more development in the area of saline agriculture, they should pursue this and seek cooperation with Zeeland. Melis mentions Zeeland as well, he explains that the project Zeeuwse Tong had a good organizational structure, due to the combination of knowledge development and input of businesses. Another appropriate structure is that of Greenport, where all stakeholders in the horticulture are organized in order to secure a strong position and prioritize its main activities.

Wetsus' operational model is the same as Plantum says Visser, but he believes that this model is not the most appropriate one for IREC. He rather advises to find a structure in which all three types of saline agriculture are represented and allows to organize it in a way that highlights the areas one should focus on

in order to achieve results that contribute to multiple targets. In other words determine strategic focus areas. Walker considers the Rijke Waddenzee Programma to be a good example of how an organization was able to organize and fulfill an important role in Waddenzee developments. They were able to facilitate numerous activities due to a collective of commissioners, consisting of representatives of provinces, the Ministery of Economic Affairs and several other parties. While they focus on facilitating research, they outsource the execution and implementation of activities to the Department of Public Works of the Ministry of Infrastructure and Environment.

The Carbohydrate Competence Center (CCC) is mentioned by Backx as an appropriate organizational model for IREC. This Center is a cooperation between public and private parties, which consists of 19 companies and 6 universities. They have joined forces to generate and develop high quality knowledge in the field of carbohydrates in order to stimulate innovation and contribute to a healthier and more sustainable society.

5.4 Conclusions

In general the perspectives related to saline agriculture in the valuable agricultural and natural environment of the Wadden region were predominantly positive and sometimes supplemented with a critical note to avoid large scale industrial activities as these will damage the environment. Aside from this warning, stakeholders believed that with an appropriate scale of activities and the right regulations, saline agriculture could be implemented in the region. The representatives of the agricultural sector are also open to developing saline cultivation, as long as experimentation is done in test fields and not on the farmers' agricultural land. Hence, the agricultural sector is not as negative as presumed by the government representative of Friesland. As for aquaculture, that is particularly perceived as a very attractive option to explore by Laansma and Walker (Appendices D13 and D7) , due to the fact that brackish water will improve the natural environment and increase the biodiversity in the region.

From the economic part the most important conclusions derived from the outcomes of the stakeholder analysis are related to cooperating with existing institutes and the prerequisite that the set-up of IREC should be market driven. For the province of Noord Holland that is a condition that needs to be met in order to receive subsidies from the province. By cooperating with organizations such as LTO and Van Hall Larenstein, it is possible to apply for certain funds and subsidies. Hence, cooperation is important to exploit existing institutes to their full potential and for the possibility of co-funding. As for the spinoff, the emphasis lies on international spinoff explained from the perspective of the Dutch knowledge based economy and the current expertise in agriculture and water technology. Regional spinoff is considered to be limited.

The third sub question refers to what the most important financing and governance criteria area for the set-up of an International Research and Experimentation Center according to the stakeholders. This corresponds with the first three questions of the financial and organizational part of the interview and are

discussed in detail in the previous paragraph. The perspectives vary but are summarized in the following conclusions. A frequently mentioned issues in the organizational & financial part of the interview is the conflicting interests between businesses and research institutes. This consequently leads to another regularly discussed problem, namely how the institute should be financed. In general businesses benefit in the last phases of a value chain, therefore they have no interest in participating or funding projects in the research stage. On the contrary, the government representatives argue that to receive subsidies the institute needs to be initiated by businesses and that they should contribute to the funding of the institute. The organizational model of a central institute with plural local test locations is considered to be an appropriate model for IREC by most of the stakeholders interviewed. Various funding options are proposed, some believe funding needs to be shared between public and private investment, while others are skeptical about the contributions of businesses in this stage and plea for total investments from public funding or close to total funding.

Based on these outcomes of the stakeholder analysis we can conclude that aside from the different perspectives of how the organization should be organized or funded, the stakeholders interviewed support the establishment of IREC in the Wadden region. These conclusions form an answer on the second sub question related to stakeholder support for the establishment of IREC.

6. Organizational Design and Discussion of Costs and Benefits of IREC

This chapter will present an ex-ante discussion of the costs and benefits of setting up IREC. In order to indicate the costs to assess the feasibility of setting up an International Research and Experimentation Center, an organization model needs to be designed first to comprehend which costs need to be included. Appraisal of the costs and benefits is based on a qualitative description of the combination of 2 organizational prototypes: the Traditional Research Center and the Incubator. The main purpose of setting up an institute is to accelerate the developments and innovations regarding saline agriculture in order to cope with the challenges of climate change and to benefit from the commercial production of saline products and knowhow. Since government representatives have emphasized the importance of economic payoff from nation's academic research, the incubator is selected as an additional strategy for the more traditional structured research center.

In the next paragraph an extensive description of the institute will be specified, and will provide a design for the organizational structure of IREC. The description will lead to the core elements the institute exists of and based on this information the following paragraph presents a discussion of the costs establishing IREC, from an economic, social and environmental perspective. In the subsequent paragraph the benefits will as well be presented in a triple P manner. Once the costs and benefits have been identified of the designed organizational structure of the International Research and Experimentation Center the chapter will be concluded with a total overview of the costs and benefits to indicate whether the establishment of IREC is a sound and potential investment for the Wadden region.

6.1 Organizational design of IREC

The following paragraph will discuss a suitable organization for IREC in depth and answers the fourth sub question of a suitable organizational structure for the International Research and Experimentation Center. The incubator is selected as additional organization model for IREC, because government, universities and businesses recognize that new high potential activities are essential to the Dutch economy in order to achieve and retain a competitive position in the world (www.dutchincubator.nl). An incubator is internationally defined as: an organization that sets up an (incubation) process to enable accelerated growth of high- quality start-ups into successful businesses by offering an integrated package of services such as workspace, services, culture, coaching, networking, (access to) funding etcetera. (DIA, z.d.).

According to this definition the incubator needs to offer entrepreneurs some services in order for them to establish and further develop their businesses. A number of needs are indicated by the stakeholders during the interviews, this will be included in the package the incubator should provide. One of the most important and frequently mentioned urge is that of the funding of projects, therefore the incubator needs to provide fundraising from public or private parties. Another repeatedly discussed issue is the lack of capability in the marketing of products, thus the incubator also needs to be able to support the businesses in marketing activities. A third essential matter is that of Intellectual Property Right of innovations and products, thus a legal affairs department is also required. Input of the stakeholder analysis and the institutes discussed in the comparative study are used to develop an organizational structure for the set-up of the desired institute (figure 11).

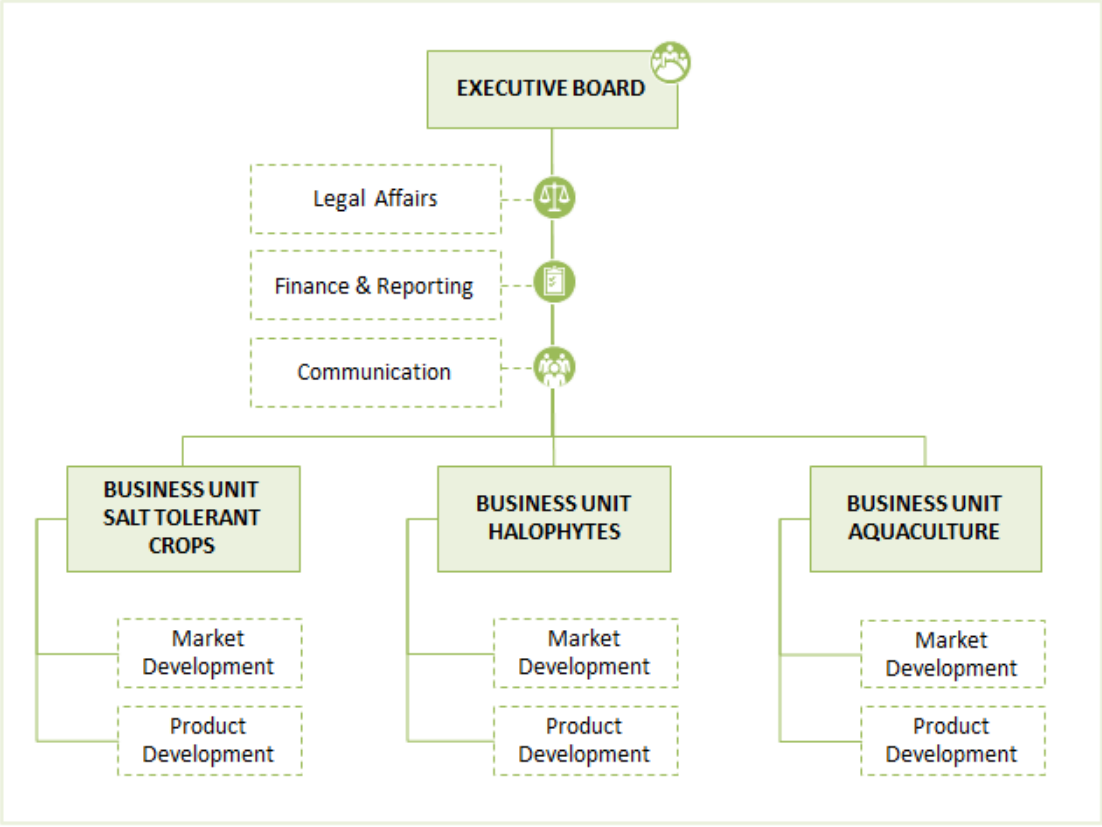


Figure 11. Organizational Chart IREC (own ill.)

The organization needs an executive board, who bears the final responsibility and is in charge of the overall management of the institute. This board is supported by a legal affairs department, a financing and reporting department and a communication department. These 4 functions focus mainly on the general tasks an organization has. The following level in the organization chart is that of the deputy directors at the head of every production line of saline agriculture. Since the development stages of the 3 saline production lines vary, it leads to different required skills for each. Therefore, the organization is structured along these 3 production lines. All three deputy directors will lead a team consisting of personnel divided over 2 departments, namely the market development section and the product development section. The product development team will predominantly focus on research and everything that is needed to work towards new innovations. When taking into account the value chain of innovation (figure 9), the product development team will focus on the first four stages: Understand the need, Formulate an idea, Create a concept and Develop a solution. In order to create innovations and solutions that are interesting for the market, and thus not only for research purposes, there needs to be a good understanding of the need. That is the first and most important step, therefore the product development unit needs to cooperate closely in this first phase with the market development team. As for the formulation of an idea and the creation of the concept, those will be the tasks for the product development team, they will investigate and conduct research in how a certain issue can be resolved. After the research is done by this team, it should meet again with the market development team to further develop and refine the concept that is developed by the research team. The subsequent phases of solution production and solution delivery are the core activities of the market development team. The division of Product Development is based on the activities of a traditional research institute, while the Market Development unit resembles the package of services provided by an incubator.

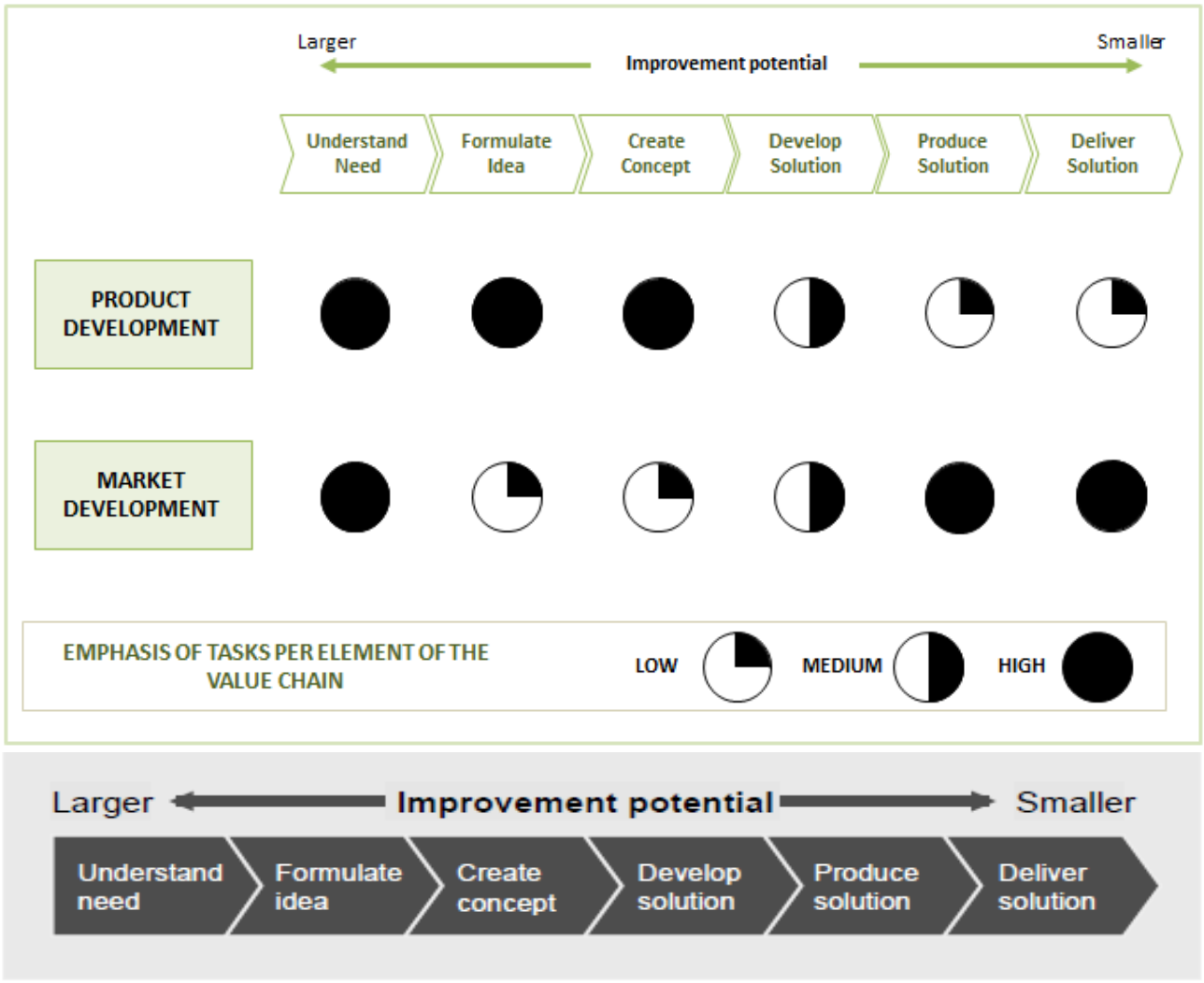


Figure 12: Process from need to delivered solution (Sehested & Sonneberg, 2011)

The outcome of the stakeholder analysis, showed that the organizational model of one main central institute with several decentralized test locations is considered to be an appropriate set up of IREC by 14 of the 15 stakeholders interviewed. Subsequently all stakeholders advised that IREC should collaborate with the existing research institutes, test locations and businesses. Furthermore the interviews with Rozema, Rijsselberghe and Melis revealed that the current situation of some projects related to aquaculture seem to deal with (financial) difficulties, and that the existing test locations are not yet operating at full capacity. Based on these three outcomes of the stakeholder analysis, the tasks of the teams responsible for product development and market development will be fulfilled by existing institutes.

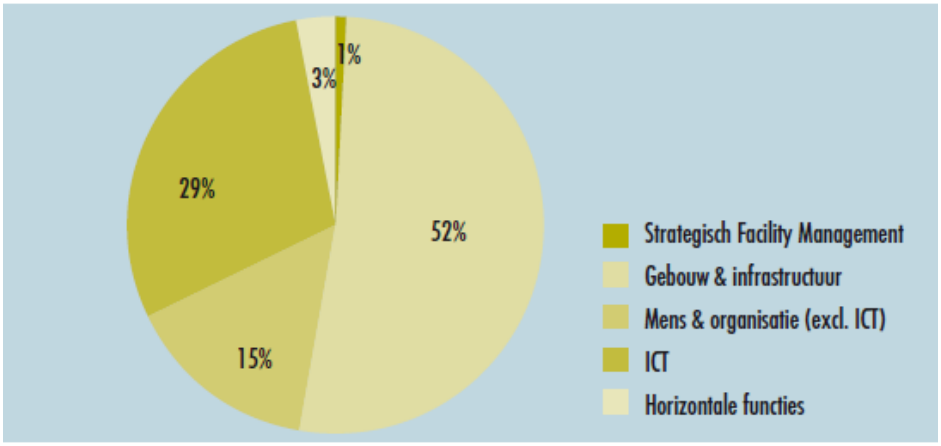
The organizational structure of IREC is led by an executive board (figure 8), which will consist of 2 directors, one for the research (product development) related tasks and one for the marketing development tasks (market development). Both are needed because IREC combines fundamental and applied research with high skilled business activities. This composition is derived from the executive board of Wetsus and they as well combine research and business activities. The supporting departments of Legal Affairs, Finance & Reporting and Communication will in the initial phase be fulfilled by one person per domain. Finally the three saline agriculture production lines will have one deputy manager, who needs to be both skilled business wise and possess the necessary substantive knowledge about saline agriculture or aquaculture. As explained before, the tasks related to market and product development will be carried out

by existing parties. The main role of the deputy managers is to have an overview of all relevant stakeholders and institutes in order to assemble collaborations for all projects related to saline agriculture in the region and beyond and to coordinate and monitor these. With this organizational structure a total of 8 people will be employed by IREC on a daily basis.

6.2 Costs of setting up IREC

These paragraph will provide an answer on the fifth sub question of the potential social costs of setting up IREC. A first indication of the costs will be based on the upfront investment required for the establishment of IREC and the operational costs during the first 5 years. The upfront investment costs are start-up costs that incur before any income or revenues can be generated. Before IREC can actually be established a preparation phase is needed in which a team will perform market research, search for an appropriate location, involve stakeholders, arrange fundraising and recruit and select potential candidates for the fulfilment of the vacancies within IREC. The assumption is made that the preparation work needs to be done by at least 2 fulltime employees in a period of 6 months. Income of an employee of a private company is 35.000 per year in the age of 25 to 65 (CBS, 2015). Thus the expenses for the preparation team are 35.000 for both employees during a time period of 6 months. As soon as this team rounds up the preparatory work, expenses are needed to purchase assets such as inventory, property, computers etcetera, these are one-time costs which also incur up front. The second category of costs are the operational costs, these costs are annual costs incurred during the continuous process during the entire time span the institute operates. For the indication of the operational costs, the median workplace costs in office buildings is used. The workplace costs are composed of costs for housing (rent), general office services and means, ICT, external services and facility management. The figures are adopted from the NFC Index, this organization publishes on annual basis a report with key figures on the median cost per workstation of facilities in Dutch offices. These figures are based on a set of European standards (NEN – EN 15221) for facility management that replace the Dutch standards. According to NFC Index, these workstation costs account for a total of €9.256 per fulltime employee (2014). In the design of the organizational structure 7 people will work on a daily basis at the office, this means a sum of €66.941 annually. Since a lot of the activities is outsourced and IREC strives for collaboration with the various organizations, an addition of 6 workplaces per production line unit are also taken into account. These workstations are available for students, entrepreneurs or other involved parties. The NFC Index indicated the costs for a workplace account for €8.786 (2014). With a total of 18 additional flexible workplaces, the costs amount €158.148 per year. Due to the usage of NFC Index figures for workstation expenses, the one-time costs to purchase assets such as inventory and computers are not included as additional costs since these are already merged in the calculation of workstation expenses. The division of the costs included to calculate the NFC Index figures is shown in figure 11.

Figure 2. Median workplace costs in 2014, divided into the main components according to European Standards (NEN-EN 152221) (NCF, 2015)



The operational costs will also include personnel costs, it is assumed that all employees work on a fulltime basis. To estimate the salaries of the staff, figures of the CBS (2015) are used. The most recent data is from 2013, and the average income of an executive in the age of 40 to 65 is estimated at 65.300 annual. Income of an employee of a private company is 35.000 per year in the age of 25 to 65 (CBS, 2015). Note that the data provided by CBS (2015) are very general and not specified per domain or education level, which results in lower estimation of personnel costs. Therefore a second source is consulted, which provides information on salaries per profession. Even though this information is less reliable than figures of CBS, it is recommended to use a higher estimation of costs in budgeting, to prevent shortages in the financial plan. Hence the data for personnel costs will be derived from Berenschot (2015), the salaries are calculated with data from- among others- Centraal Plan Bureau and Centraal Bureau voor de Statistiek. The values of the maximum salaries are taken into account, these scores are calculated as the average of the 10% highest paid per profession. The maximum salary of a CEO of a medium-sized organisation is €300.000 and of a professor is €120.500. The maximum salary of a manager Research and Development (€119.000 per year) is considered to resemble the function of the three business unit managers of IREC. A legal advisor has a maximum annual salary of €99.000, an account manager has a maximum salary of €87.000 and for the supporting communication activities the maximum salary of an executive secretary- which accounts for €63.500- is included (Berenschot, 2015). However these salaries are gross incomes, therefore an additional amount is calculated to indicate the employer cost. This amount includes of a vacation bonus, costs for employee insurance and an income dependent contribution for health insurance. Since the organizational design of IREC resembles that of an incubator, the rates applicable in the intermediary services sector is selected. All costs are shown in table 5.

Tabel 5. Overview of Investment and Operational Costs for IREC per year (own ill.)

Description		Price per unit (Bruto)	Price per unit (Costs Employer)	Number of units	Total in Euros
Preparation Costs Upfront	Fulltime employees preparing for set up IREC	€17.500	€21.902	2	€ 43.805
Operational Costs & Capital Costs	Operational Costs per fulltime office employee per year	€9.563	----------	7	€ 66.941
Operational Costs & Capital Costs	Operational costs per office work place per year	€8.786	----------	9	€ 79.074
Operational Costs	Personnel Costs Executive Board (Businessman)	€300.000	€332.272	1	€ 332.272
Operational Costs	Personnel Costs Executive Board (professor)	€120.500	€138.403	1	€ 138.403
Operational Costs	Personnel Costs Deputy Chiefs	€ 119.000	€136.783	3	€ 410.349
Operational Costs	Personnel Costs Legal Advisor	€99.000	€115.192	1	€ 115.192
Operational Costs	Personnel Costs Finance & Reporting	€87.000	€102.232	1	€ 102.232
Operational Costs	Personnel Costs Communication	€63.500	€76.843	1	€ 76.843
Total Costs Year 1					**€ 1.365.111**
Annual total costs Year 2 to 5					**€ 1.321.306**

The total costs of IREC on an annual basis are €1.321.306 and in the first year €1.365.111 due to the upfront investment costs for the preparation phase. The total investment over a time period of 5 years is €6.650.335, this investment will result in employment of a team with 8 members, that will focus fulltime on supporting and accelerating the developments related to saline agriculture in the region and beyond. This investment also allows for 18 external partners to use the workstations IREC offers.

The triple bottom line is an accounting framework with the three divisions of People, Planet and Profit. This framework is introduced by John Elkington (1997) and is nowadays used as a method to apply full cost accounting instead of a unilateral assessment with a sole focus on economic profit or loss. However the measurement of the environmental and social aspects appears to challenging to apply in practice (Slaper & Hall, 2011). Due to the time constraints to conduct this research the environmental and social costs are stated and described, but do not have a monetary value or any other measurement for value appreciation.

Environmental costs of setting up IREC and subsequently further develop saline agriculture may depreciate the unique environmental nature of the Wadden region, which is part of the UNESCO World Heritage. According to –amongst others - Visser and Backx the industrialization and the associated infrastructure needed to develop commercial exploitation of saline products shall result in destruction of the environmental qualities of the Wadden area. Another environmental cost mentioned by 2 of the 3 government representatives, Steenbruggen and Melis, is the cost of accelerating the salinization of soil through passage of saline water in areas where salinity does not occur. This is perceived as damaging natural valuable environment. Social costs are related to the organizational design of IREC, Visser pointed out that IREC should not be yet another research center who competes with the existing research centers and experiment stations. Aside from the issue of possible competition no other social costs are associated with the establishment of IREC.

6.3 Benefits of setting up IREC

This paragraph elaborates on the possible benefits resulting from the establishment of IREC. In order to consider and evaluate the benefits in a careful manner, they will be presented from an economic, environmental and social perspective, also referred to as the triple P approach. Throughout this study several benefits of setting up IREC and supporting the developments related to saline agriculture are featured both in the literature study as in the stakeholder analysis. One of the most important benefits associated with saline agriculture is contributing to the increasing food demand worldwide. Especially in countries where this demand is the highest, the consequences of salinization are also the severest. Dry regions as Africa experience great difficulties with the salinization of soil, agricultural land is abandoned due to the gravity of high salinized soil. Developing salt tolerant crops contribute to every aspect of the triple P concept. It contributes to the provision of food (people) and leads to the reuse of abandoned agricultural land, and thus prevention of accelerating anthropogenic salinization by relocating to other zones for agricultural cultivation (planet). Furthermore, the development of salt tolerant crops also offer a high economically potential opportunity for both the Netherlands as export country- of for example seed potatoes- , as for the farmers abroad suffering from salinized soil and scarcity of fresh water who are now able to provide in their livelihoods again. As for regional economic benefits, the organizational design of IREC allows for professional support of start-ups and entrepreneurs. Currently, entrepreneurship seems to be challenging according to some of the stakeholders interviewed, due to the lack of assistance in marketing of products and access to funding (Hoek and Rijsselberghe). Entrepreneurship is also related to social benefits. Prins, Walker and Kramer emphasized that the establishment of IREC could contribute to educational purposes, offering students from the knowledge institutes in the region an opportunity to gain practical experiences. According to Walker this also leads to chances for businesses to carry out research at lower costs. Prins and Kramer, believe in educating a new generation of entrepreneurs that feel a strong connection with the region due to its unique characteristics. This leads to both social and economic benefits, since young high potentials do not emigrate to the urban areas, but seize the opportunity to profit from this innovative and enterprising movement. All stakeholders interviewed believe the

Netherlands has a strong and valued position in both the agricultural sector as in water technology, thus the prospect of the Netherlands fulfilling a pioneering role in saline agriculture is scored from possible to very likely. This opportunity would lead to high qualified employment through research and the export of knowledge and expertise (profit). The development of agriculture and in particular aquaculture could improve the environmental quality of the region, according to Laansma and Walker. They argue that this could lead to more brackish water and subsequently to more breeding and spawning grounds which improve the biodiversity in the region (planet). Finally the establishment of IREC and thus saline agricultural developments can contribute to health by providing a new source of valuable minerals and proteins from aquaculture, say Rozema and Onnes. These regional products will attract tourism through culinary activities (social and profit).

Table 6. Overview of Benefits from a triple P perspective (own ill.)

Benefits of Setting up according Triple P principle			
	People	Planet	Profit
Development and Production of salt tolerant crops	Food Provision	Reuse of salinized soil	Export of salt tolerant cops
	Poor farmers can provide in likelihood by reuse salinized soil	Decrease of scarce fresh water usage	Export of knowledge & Knowhow on salt tolerant crops
		Decrease of land use change (relocating to new location)	
		Decrease of anthropogenic salinization of soil	
Set up IREC	Practical experience students		Supporting Entrepreneurs and Start ups
	Educate new generation of entrepreneurs		Research carried out at lower fares
			high qualified employment through research
			export of knowledge and expertise on saline agiculture

6.4 Conclusions

The organizational structure designed as a combination of an incubator and research center allows for acceleration of saline agricultural developments. Assembling a team with employees of both a research related background and a more business oriented profile provides a total package with skills united in IREC will result in a stronger position to involve stakeholders from different sectors. While this would be an important advantage over the more traditional research centers or the sole business of an incubator, it is also the greatest challenge for the model. Cooperation between the two is essential for its success. If they are able to work together within IREC they will be able to make a major contribution in involving other stakeholders to accelerate the developments related to saline agriculture. When the costs are taken into account to set up IREC and are compared with the related potential benefits it could achieve in all three domains of People, Profit, Planet it is a prospective opportunity to further investigate. This investment allows a skilled team with both research and business related backgrounds to work on a fulltime basis on saline agricultural developments. They will acquire knowledge on all research, methodologies and innovation developed worldwide and all parties active in this domain. This results in possibilities to establish strategic (international) collaborations and become a key player in the domain of saline agriculture.

7. Discussion

The transdisciplinairy approach is used as theoretical framework in which this study is conducted. This approach is selected because it emphasizes the importance of scientific research, and takes this a step further to the integration of research and development. This theory of integrating science in society is extremely difficult. Especially in a case where development is linked to a wicked environmental problem and affects a wide variety of stakeholders. In the case of saline agriculture it does not only represent the interest of the farmer or the entrepreneur, but it could literally change lives for a large part of the world population. However the development of life changing innovations are not achieved by a single player or over one night. It takes years of research, projects, investments and strong involvement of parties to achieve the desired results. Stakeholders interviewed were willing to explore the potential of saline agriculture, but seem to lack the ability to do so, for financial reasons or lack of supporting services. Current saline agriculture entrepreneurs form a small group of entrepreneurs who have to endure the difficulties along the path themselves and just a few will be able to run a successful business in the end. Apart from them being succesfull or not, they for innovation, a widely supported and sought solution to a certain problem. Along the value chain the tasks of involved parties can be divided, important to note is that all steps of the chain need to be linked. Therefore conducting research is not finalized with the production of a report solely. This stage calls for another momentum to meet with stakeholders in order to define the next steps to integrate science in development and achieve valuable innovations for society. Close collaboration along the entire value chain will lead to faster development than the current vertical paradigm of conducting research. The gap lies in the integration of research results in development. This

is a phase where none of the stakeholders feels it belongs to their area and field of activities. This is a step too far for research institutes, but a step too early for businesses to be involved. Is this the domain of government institutes one can wonder. In my belief this gap can only be bridged by taking a step further by research institutes and taking a step back from businesses. The government should facilitate in this aim of co-operation and linking the first and the last phases of an innovation chain.

Conclusions

This study is written in the theoretical framework of the transdiciplinairy approach. This study served as a case to test this theory in practice. While most stakeholders believe in the value of collaboration of different parties in the aim to strive for more developments and research, it seemed to be difficult to achieve. In the comparative study, 3 research institutes were compared, of which IRRI and ICBA belonged to the more traditional way of conducting research. Research was done by knowledge institutes and funded by public means. Wetsus appeared to be structured differently, working close with companies and giving them an administrative role within the organization, leads to a more hybrid model. Which corresponds with the transdisciplinairy theory, that states that a more horizontal paradigm is needed for development purposes. In response to the need for integration of science in society and the related development of innovation, a more hybrid model is suggested for the organizational design of IREC. It combines the core activities of knowledge institutes, namely research, with the later stages following from research, the market development tasks. Striving for wide collaboration among different stakeholders begins with IREC itself than. The aim of IREC is to stimulate more research and developments related to saline agriculture, with the inclusion of type of incubator, developments can be accelerated since the strengths of incubators lies in knowledge about the entire market of a certain product or service. Linking partners in a strategic manner allows for a faster path from knowledge to innovation. A first indication of the costs and benefits are presented in the study, based on the wide variety of benefits for society (people), environment (planet) and business (profit), it seems a sound invest to take advantage of the opportunity to set up an institute with a time that solely focuses on the development of saline agriculture, on a fulltime basis. This investment allows the Netherlands to acquire yet another pioneers role in agriculture and water related development.

Hence in order to answer the main research question of this study on the feasibility of setting up an international research and experimentation centre, it can be concluded that this is feasible. The feasibility of this institute lies in overcoming the debate on public versus private means and finding a way to collaborate with each other in order to achieve the desired developments. This study suggest an organizational design were both extremes are combined along the entire value chain. alone will not bring a long changes and innovations. Nor will research institutes focusing on the sole activity of doing research itself. In order to deal with complex environmental problems such as the increasing salinization of soil worldwide an collaborative approach is needed. Multinational corporations, governments and knowledge

institutes are needed to bring along change. But as it seemed from the stakeholder analysis the theory of the transdisciplinary approach and the related collaborations sound very promising, but are in practice very difficult to achieve. Therefore parties need to be brought together in an early stage to first understand the shared need. That is the basis

Recommendations

This study has provided a first indication of the costs, however these were not specific enough to make a sound calculation of the investments needed to set up an International Research Center. Therefore it is recommended to conduct a specific cost benefit analysis for the proposed organizational design in this study. Additional a study is recommended to assess the benefits related to saline agriculture, with an emphasis on the specification of benefits for the region of the Wadden area and beyond, structured along the people, profit, planet paradigm. Also an indication of long term and short term benefits should be included in the study.

As for the wider context in which this study is conducted, a study with cases of best practices in the integration of science in society by the implementation of the horizontal paradigm, would be valuable of a scientific viewpoint as well as from a societal perspective.

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Appendices

Appendix A - Financial contributors and Partners ICBA in 2013

Core donors:

- United Arab Emirates Ministry of Environment and Water (MoEW)
- Environmental Agency of Abu Dhabi (EAD)
- Islamic Development Bank (IDB)

Grant donors:

- Ajman Sewerage (Private) Company Ltd.
- Arab Bank for Economic Development in Africa (BADEA)
- Arab Fund for Economic and Social Development (AFESD)
- Australian Centre for International Agricultural Research (ACIAR)
- Abu Dhabi Farmers Services Center (ADFSC)
- International Fund for Agricultural Development (IFAD)
- MASDAR Institute of Technology
- National Academy of Sciences
- OPEC Fund for International Development
- Swedish International Development Cooperation Agency (Sida)
- United States Agency for International Development (USAID)

Partners:

- Abu Dhabi Farmers Services Center (ADFSC)
- Abu Dhabi Food Control Authority (ADFCA)
- Arab Water Council (AWC)
- Arab League
- Center of Waste Management, Abu Dhabi
- International Center for Agriculture in Dry Areas (ICARDA)
- International Crops Research Institute for the Semi- Arid tropics (ICRISAT)
- International Water Management Institute (IWMI)
- Masdar/Boeing, UAE
- Ministry of Agriculture and Fisheries, Oman
- NARS IN Jordan, Kazakhstan, Iraq, Pakistan, Palestine, Oman, Syria, Tajikistan, Tunisia, UAE, Uzbekistan, Senegal, Burkina Faso, Gambia, Mauritania, Niger, Nigeria
- NASA Goddard Space Flight Center National
- Institute for Agrobiological Science, Japan
- United Nations Development Program (UNDP)
- UAE Municipalities: Abu Dhabi, Dubai, Sharjah
- Universities: BITS-Dubai Campus, UAE University, Al-Ain University, King Abdullah
- University of Science and Technology, Department of Applied Ecology National University of Uzbekistan, Academy of Sciences of Uzbekistan, Nevada University, University of Montana
- United States Department of Agriculture -Agricultural Research Service

Appendix B – Advice of the Waddenacademie on Saline Cultivation

waddenacademie

Advies

Aan: Waddenfonds
Van: Waddenacademie
Datum: maart 2015
Betreft: Zilte teelten

1. Inleiding

Het Waddenfonds heeft de Waddenacademie gevraagd advies uit te brengen ten aanzien van het thema zilte teelten. De feitelijke adviesaanvraag luidde als volgt:

'Naast het veiligstellen van de beschikbaarheid van zoet water is ook het benutten van zilte teelten van belang. Op het punt van zilte teelten lopen de meningen nog sterk uiteen. Een goede analyse van de stand van zaken en de perspectieven in economische en ecologische zin is dringend gewenst.'

De Waddenacademie heeft op 26 januari 2015 een besloten workshop over zilte teelten gehouden, waar met een breed scala aan deskundigen gezamenlijk werd onderzocht of er een toekomst is voor zilte landbouw in het Waddengebied. Daarbij werd ook gekeken naar de mogelijkheden van schelpdierenteelt en teelt van wieren.

Tijdens de workshop werd vastgesteld dat de wereldwijde toename van de verzilting een gegeven is. De invalshoek voor het nu voorliggende advies is dan ook om verzilting als uitgangspunt te nemen voor de verkenning van mogelijkheden hoe Nederland, en in het bijzonder het Waddengebied, zich hierop kan voorbereiden en hoe mogelijke kansen op het gebied van zilte teelten tijdig kunnen worden benut, in eigen land maar ook op de wereldmarkt.

Deze invalshoek mag als een zekere doorbraak worden beschouwd aangezien tot voor kort er in Nederland weerstand bestond tegen het serieus aan de slag gaan het verkennen van en experimenteren met zilte teelten. Natuurlijk kunnen in Nederland met zoetwater management de verziltingsproblemen nog vrij lange tijd worden bestreden, maar dat zal steeds duurder worden, terwijl er tegelijkertijd in Nederland en elders in de wereld interessante kansen ontstaan om meer te doen met zilte teelten.

Tijdens de workshop op 26 januari 2015 werd ook duidelijk dat de kansen voor zilte teelten in toenemende mate worden onderkend. Dit geldt voor ondernemers, maar ook voor organisaties die tot voor kort de negatieve gevolgen van de verzilting benadrukten, zoals waterschappen en landbouworganisaties. Ook de natuurbeheerders en de natuurbeschermingsorganisaties zijn in de afgelopen jaren meer en meer geïnteresseerd geraakt in zilte teelten en wat de stimulering daarvan kan betekenen voor natuurbeheer.

Het nu voorliggende advies is gebaseerd op een analyse van de wetenschappelijke literatuur op het gebied van de zilte teelten en een brede consulatie van deskundigen uit kringen van kennisinstituten, maatschappelijke organisaties en overheden.
Het advies heeft de instemming van alle deelnemers aan de workshop, en er kan derhalve worden gesproken van een breed gedragen advies van de Waddenacademie.

Appendix C – Questionnaire

STAKEHOLDER ANALYSIS

Interview - Setting up an International Research and Experimentation Centre specialized in Saline Agriculture in the Wadden area in the Netherlands

Date:

Name:

Organization:

Position:

At request of the Wadden academy a feasibility study is carried out for setting up an International Research and Experimentation Centre in the Wadden area in the Netherlands. The Waddenfonds has requested the Wadden academy to advise on the theme of salt water cultivation; they acknowledge that the availability of fresh water needs to be secured, but also state that it is important to exploit the possibilities of saline cultivation. However on the latter statement the societal views and opinions are diverged. In order to explore the economic and ecological potential of saline cultivation the Waddenacademy carried out an analysis on the situation of saline cultivation in the Wadden area and brought out an advise with recommendations. Based on these recommendations I will further explore the opportunities by conducting a feasibility study on setting up an International Research and Experimentation Center in the Wadden area. This study is executed in collaboration with professor Pier Vellinga of the Waddenacademy and will result in a graduation thesis for the master Environment and Resource Management of the Vrije Universiteit.

Part of this feasibility study is a stakeholder analysis in which relevant stakeholders in the area will be interviewed. Therefore I would like to interview you on your point of view regarding saline cultivation in the Wadden area and the possibility of setting up this International Research and Experimentation Center.

The questions are set up in 3 categories: **ecology, economic development** and **financial and organizational structure.**

Ecology:

1. How can more research and experimentation of saline cultivation promote the ecological qualities of the Wadden area?

2. What are the possible (negative) consequences for the ecological qualities when setting up an International Research and Experimentation center (IREC) in the Wadden area?
3. Should the International Research and Experimentation center also focus on saline aquaculture in the coastal areas? What is the potential of activities of shellfish farming , fish farming, algae , etc. on the landside of the dike, and could these activities contribute to reduce negative effects on the Wadden Sea?

Economic development:

1. How can the set-up of an International Research and experimentation center stimulate economic development in the area?
2. What is your opinion about the possible regional spinoff of the set-up of an International Research and Experimentation center in the Wadden area?
3. What is your opinion of the possible international spinoff of the set-up of an International Research and Experimentation center in the Wadden area?
4. According to the advice of the Wadden academy the earnings in saline cultivation will be based on the one hand on the export of salt tolerant crops and the export of technology (water management and agronomy) and on the other hand in the consumer -oriented modified cultivation in the Wadden Sea. How can your organization contribute and benefit from these expected earnings of saline cultivation?
5. What can we learn from similar public funded research and expertise centers specialized in agricultural or water related themes? For example Wetsus or Dairy Campus? How did this effect economic development in the region and in the Netherlands.

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Financial and organizational model:

1. The International Research and Experimentation Center will be a collaboration between various organizations, governance agencies and research institutes. How should this collaboration be organized in order to be of interest for your organization and to participate in this collaboration?
2. A possible set up of the International Research and Experimentation Center will consist of a central research facility and several decentralized and local test fields. What is your opinion regarding this organizational structure?
3. How should this IREC be financed to guarantee an efficient and effective structure to achieve and maximize positive results of saline agriculture?

4. What can we learn from the organizational structure of similar public funded research and expertise centers specialized in agricultural or water related themes? For example Wetsus or Dairy Campus?

Appendix D - Stakeholder Interviews

The literal transcription of the interviews is available for scientific purposes at the Waddenacademie and the Vrije Universiteit in Amsterdam.

Huis voor de Wadden
Ruiterskwartier 121a
8911 BS Leeuwarden
info@waddenacademie.nl
+31 (0) 58 233 9030

VU Main Building
De Boelelaan 1105
1081 HV Amsterdam
T (central): 020 59 89898
F (central): 020 59 89899