Interreg
North Sea Region
SalFar
European Regional Development Fund

EUROPEAN UNION

Inspiration Guide on Saline Farming

PHOTO *Stephen Valentine*

Inspiration Guide

This Inspiration Guide on Saline Farming was developed as part of the Interreg Vb North Sea Region project SalFar. It pulls together knowledge on saline farming from the farming community, farmers, farming advisors and other interested parties and summarises the lessons learned in the Salfar project.

Other reports and information about the SalFar project can be found here:

www.northsearegion.eu/salfar

Acknowledgements

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VLAAMSE LAND MAATSCHAPPIJ Vlaanderen is open ruimte

SAGRO Viden og vækst

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UNIVERSITY OF LINCOLN UNITED KINGDOM

UNIVERSITY OF GOTHENBURG

ILVO Flanders research institute for agriculture, fisheries and food

SPNA agroresearch

provincie groningen

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Introduction

This guide provides ideas, tools and practical information for farmers, food producers, and food processors. It is for those who want to start using saline crops and for anyone who wants to know more about saline farming. It presents knowledge gained by the SalFar project over five years by a multi-disciplinary team from The Netherlands, Belgium, Germany, Denmark, Sweden, Norway and The United Kingdom - the seven countries that make up the North Sea Region (NSR).

The information has come in a variety of ways: practically, by farmers and other producers growing crops in saline conditions; by scientists and technicians analysing the results of scientific experiments and by laboratory research. The potential for saline products has been explored by restaurateurs, chefs, cooks and food enthusiasts who have been experimenting - using the products - often in new and interesting ways. Knowledge partners outside the network have also been reached out to.

It is hoped this material will inspire, encourage and guide readers into exploring the possibilities inherent in saline farming, help them to apply it to their specific conditions and offer them some ideas for developing new market opportunities.

Background

Climate change is having an increasing effect on food production. Flooding of farmland near the sea is becoming more frequent and, in many places, groundwater is becoming more saline.

A shortage of freshwater resources is limiting agricultural activities and farmers in affected areas are having to re-sow their crops as a result of the effects of salt spray.

The expected increase of the world's human population combined with the effects of climate change: sea level rise, changing precipitation patterns and rising global temperatures together with a reduction in the amount of available arable land all threaten food security and will present considerable difficulties for efficient and sustainable food production in the near future.

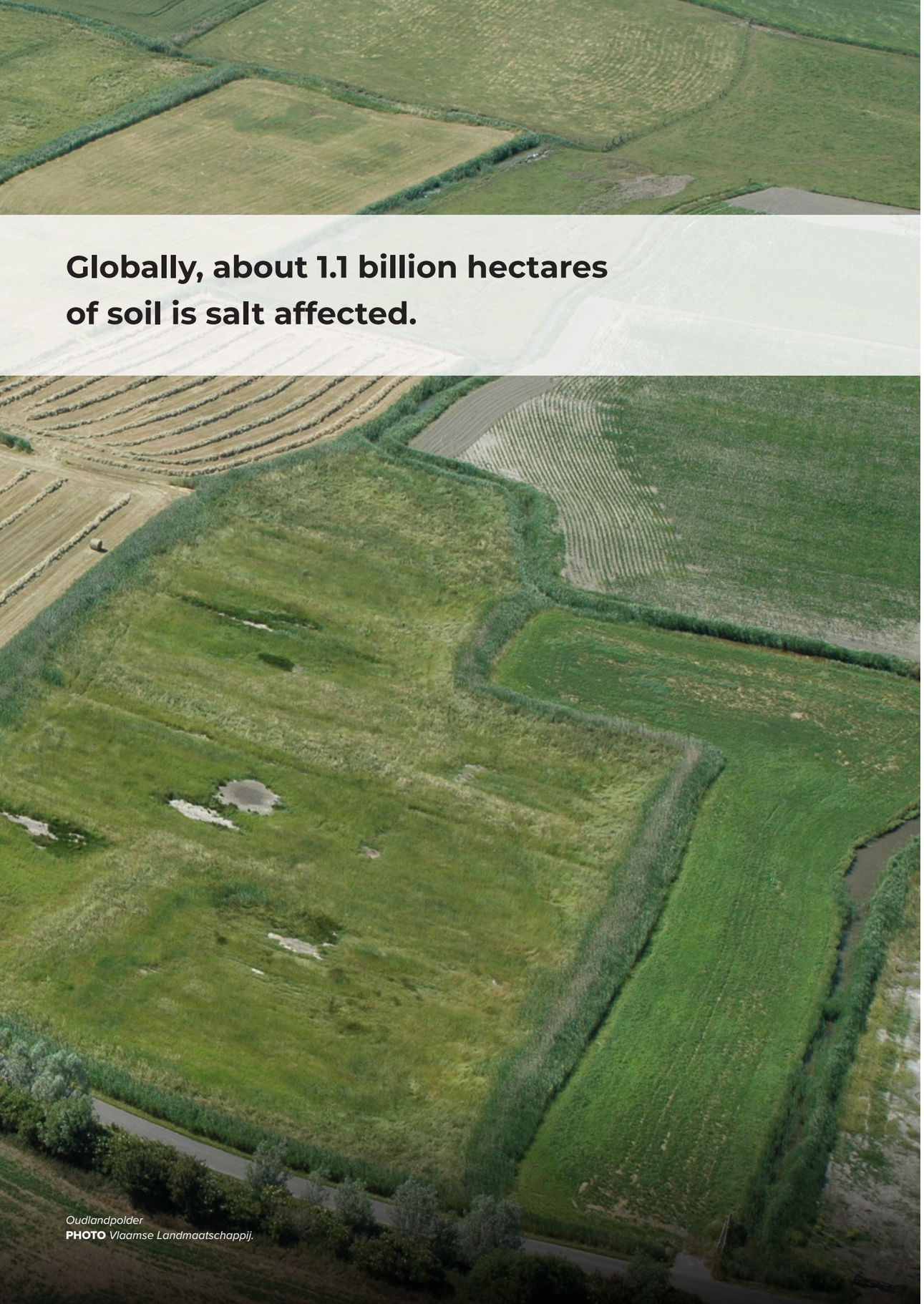
According to the United Nations Synthesis Report 2018 on Water and Sanitation, agriculture is using almost 70% of globally available freshwater. In the meantime, 800 million people lack access to basic water services and more than 2.1 billion do not have access to safe, managed drinking water. Pressure will continue to increase on the availability and distribution of fresh water, in response to this agriculture will have to adapt and adopt cultivation practices that minimise its use, make use of saline water and learn how to cultivate crops in saline conditions.

Rising sea levels are an important factor in increasing the salinisation of arable land and this is a growing challenge. Globally, about 1.1 billion hectares of soil is salt affected. To this, each day, worldwide, an area equivalent to 2,800 football pitches, 2,000 hectares of arable land is lost through salinisation.

Although today the salinisation of soils is not a significant problem in the North Sea Region (NSR) with the changing climatic conditions we are experiencing in the near future it will become one. By the time it does become a problem it will be too late to develop effective mitigation techniques.

In Europe, at trans-national, national, and local levels, agricultural policies are fiercely debated. Attention is focused on the quality of food and its provenance in relation to nature, climate change, animal welfare and landscape. Consumers are increasingly concerned about how their food is produced and where it is coming from. Meanwhile most farmers, suppliers and the majority of the food industry are still focused on the quantity of production. There are however an increasing number of farmers and producers who are exploring new, interesting, and innovative approaches that are compatible with the changing demands of society.

Farmers can often feel caught, whichever way they turn, between changing political ideas, the ever-changing demands of consumers increasingly stringent safety and quality requirements. They also face increasing costs and a continual downward pressure on prices. This document sets out to offer some ideas and information to encourage thinking about and the development of approaches and possibilities that may help.



Globally, about 1.1 billion hectares of soil is salt affected.

Oudlandpolder
PHOTO *Vlaamse Landmaatschappij.*

Saline Agriculture – a challenge and an opportunity

Challenge

In general, if farming continues in the traditional way, when salinity levels increase yields decrease. A first response is often to enhance the efficiency of fresh water use through buffering and smart drainage. This has immediate positive effects. But when salinity levels continue to rise this approach will become very costly and other strategies need to be considered.

Worldwide, various techniques to deal with saline soils continue to be explored, developed, and implemented. In countries around the North Sea various experiments are being continued by farmers and agricultural research centres. The SalFar project connects, farmers, field tests and laboratory research from all the North Sea Region countries. It provides a nursery for ideas and a place to explore the potential for growing and marketing food products grown in salt affected soils.

PHOTO *Stephen Valentine*

Saline crops

Research has shown that many crop varieties were once capable of dealing with moderately saline conditions. Sugar beet used to flourish in coastal salt marshes. However, through more than 100 years, plants have been bred to produce more and more sugar. A side effect of this selective breeding is that most of the current dominant commercial varieties have lost their salt tolerance.

SalFar has demonstrated that some existing crop varieties perform better than expected in moderately saline soils. A body of evidence for this has been built up over more than ten years of controlled experiments on the island of Texel in The Netherlands

Evidence is also beginning to emerge that crops grown on saline soils can have a different taste, often a little sweeter. This appears to be true for carrot, tomato, and other crop varieties. This phenomenon is gaining the interest of chefs and other food producers as enhanced or different flavours potentially offer marketing advantages for them and for crops grown under saline conditions.

Saline water is water that contains a high concentration of salts (mainly sodium chloride – table salt).

Water in the open sea has a salinity of around 7 teaspoons of salt per litre which equals 3.5% or 35,000 ppm.

A variety of tests have been, and continue to be, carried out. These include:

- a range of crops grown under saline soil conditions which were test marketed by an organisation of small-scale farmers in Denmark
- a group of farmers and entrepreneurs who have been working in collaboration with the University of Lincoln in the UK exploring the growth of halophytes[1] in salt affected soils
- Ökowerk Emden, Germany is providing an example of public education and the testing and marketing of saline grown food in co-operation with local people and restaurants
- on the island of Terschelling in The Netherlands an NGO-enterprise is, with the help of farmers, producing premium products for the restaurants and shops on the island
- at University of Gothenburg increased variation of gene expression is being explored with the aim of identifying wheat varieties that produce well under strong saline conditions.

The variety of experimental tests, products and marketing carried out by the participants in the SalFar project demonstrate that farmers, consumers, and policy makers are seriously interested in food produced from salt affected soils. Market analysis and practical experience suggests that consumers are willing to pay a premium for food produced in this way. Examples of products market tested include: potatoes, cabbages, carrots and tomatoes with a unique taste; salicornia added to potato chips and a pesto based on sea asters. It is not just the difference in taste or the appearance of an unusual product that generates interest. The novelty and the story of where, how, why and under what conditions the crops are grown and by whom is important in generating consumer appreciation, acceptance and willingness to purchase. Stakeholders and consumers are becoming aware that salinisation of soils is a worldwide problem aggravated by increasing freshwater scarcity, more persistent droughts, flooding, accelerated rates of sea level rise – the ongoing effects of a changing climate.

It is important to note that saline soils are different everywhere. The geology, hydrology and soil processes differ widely from one place to another. In some situations, flooding by sea water is the cause, in others it is underground seepage, irrigation or the interaction between rain and groundwater dynamics. Any approaches taken should acknowledge this and take into account the unique local hydrological and geological conditions. This specificity can also be applied to local marketing. Simply copying practices from one place to another will often not work. SalFar has demonstrated that an experiment in one place can provide a baseline of experience from which knowledge, information and inspiration can act as a foundation for the establishment of effective, locally determined practice elsewhere.

The results and findings from the SalFar network have inspired many others along the way including farmers, entrepreneurs and local, national and international governments and institutions. SalFar has triggered a cooperation between North Sea and Mediterranean countries and their farmers in their efforts to scale up the production of various salt tolerant crops including potatoes and quinoa. SalFar partners are members of two working groups set up by the Food and Agriculture Organization of the United Nations, FAO: the Global Framework on Water Scarcity in Agriculture, WASAG, and the International Network on Saline Affected Soils, INSAS.

1 A halophyte is 'a salt-tolerant plant that grows in soil or waters of high salinity, coming into contact with saline water through its roots or by salt spray, such as in the Waddensea, saline semi-deserts, marshes, and seashores'.

Salicornia growing in the intertidal zone on the east coast of Jutland, Denmark. **PHOTO** *Stephen Valentine.*

Soil, salinity and plant growth

Soil structure

A soil is a living ecosystem made up of a variety of materials of different shapes and sizes including inorganic stuff such as rock and mineral particles; decomposed organic matter from plant roots and other dead organic material; microorganisms, fungi, bacteria, invertebrates and voids containing gases and water. The structure of soil is dependent on the origin and distribution of inorganic particles such as clays and sand, climatic factors such as humidity and temperature, vegetation cover; the effects of time and management practice. An ideal soil structure is thus made up of a variety of materials of different shapes and sizes generating aggregates of different sizes (figure 1). Aggregates provide the ideal combination of large and small pores allowing plant root systems to flourish and to access water, gases and nutrients. They also allow the plant to be firmly held in position.

For a more detailed version of this chapter scan the QR code or click here.

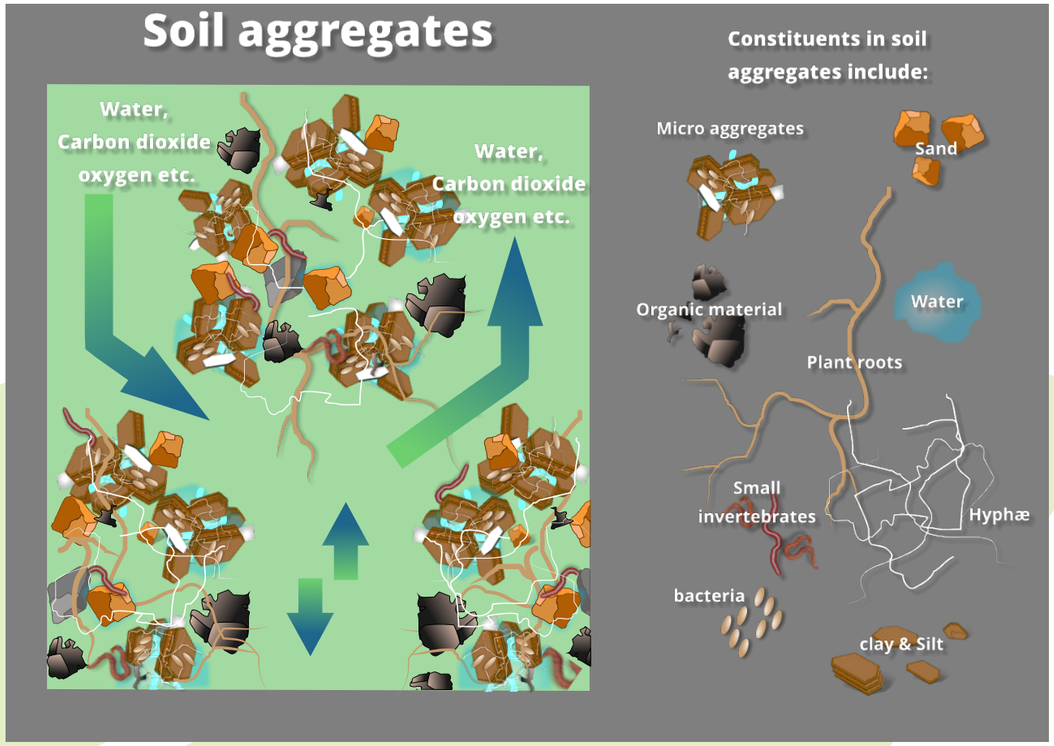


FIGURE 1

The figure illustrates how soil components are aggregated in a healthy soil ecosystem composed by inorganic minerals, living and dead biological material facilitating exchange of air and water.

The ability of a soil to absorb water, its infiltration capacity, is also a very important quality (figure 2). It affects the soil's ability to transport excess water and dissolved components such as nutrients, from the topsoil down to deeper layers. A good soil for crop cultivation will contain a variety of different sized pores. The small cracks or pores store water and dissolved nutrients making them available for plants to use long after rainfall has finished. The larger pores effectively transport excess water down to deeper layers and the underlying ground water. This prevents water saturation and the development of anoxic conditions in the topsoil. Water infiltration is high in sandy soils. Such soils are drought sensitive but also less sensitive to salinisation as accumulated salts will easily be leached out by rainwater. In both clay-rich and organic soils, those containing 20-30% organic material, the rate of water infiltration is low allowing accumulated salts to remain in the root zone for a much longer time.

The ability of soil to lift water from deeper layers, such as from ground water, is controlled by soil type and capillary forces. Capillary forces are stronger when the diameter of pores in the soil are small.

Sandy soils can be irrigated with brackish water if the crop will tolerate it. This is not recommended for organic or clay soils.

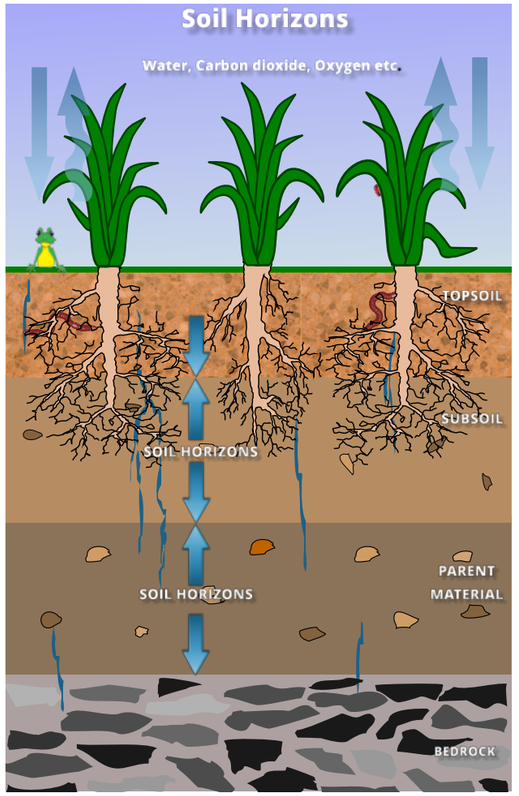


FIGURE 2

The figure illustrates how a soil profile consist of several horizons developed by the soil formation processes (climate, organisms, parent material, topography, time and anthropogenic activity).

Since capillary forces are stronger in smaller than in larger pores (figure 3), saline ground water can be lifted much higher in clay-rich than in sandy soils.

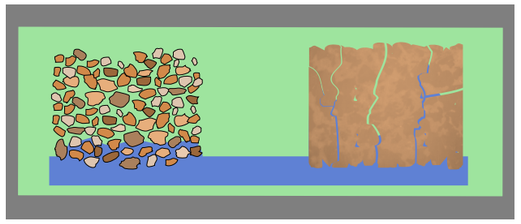


FIGURE 3

The figure illustrates how soil texture affects capillary forces in a column of sandy soil (left) and a clay rich soil (right). The thin cracks and pores in the clay soil provide better capillarity.

If salt water is either flushed over the land by flooding or lifted up from saline groundwater the soil structure can become permanently degraded, changing a well aggregated soil into a dense soil with few pores and with little or no water infiltration capacity (figure 4). This severely limits the space where plant roots can explore and offers few places where water can move freely, and nutrients can be made available to plants and soil living organisms. A damaged soil structure increases the risk of water saturation, soil erosion and release of the very potent climate gasses di nitrous oxide (N_2O) and methane (CH_4).

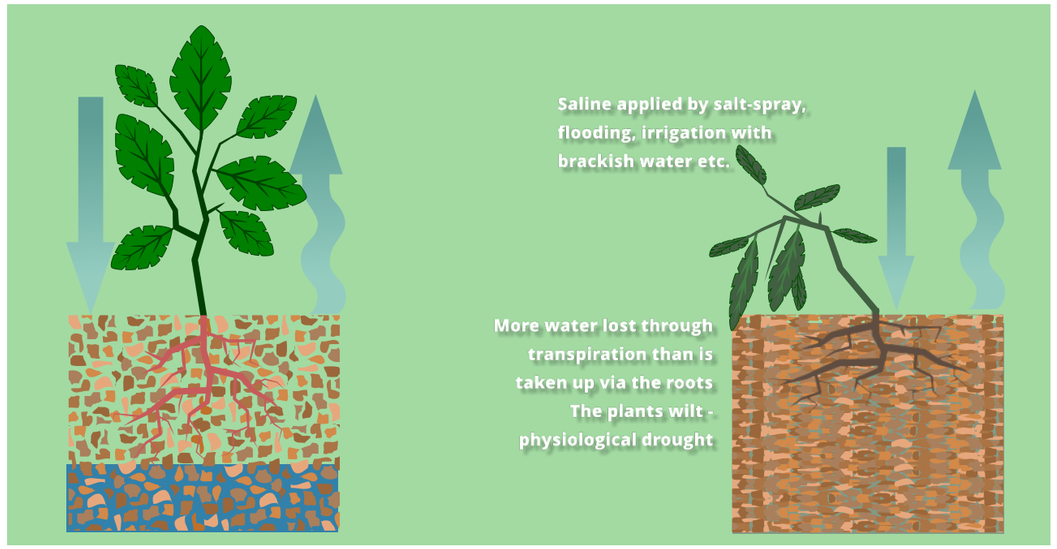


FIGURE 4

The figure illustrates on the left-hand side, a well aggregated soil composed by larger pores providing vertical leaching of excess surface water, and smaller pores retaining plant available water in micropores and aggregates. The right-hand side shows a collapsed clayey soil of poor and dense structure. The latter may result in anoxic conditions (no oxygen) with increased risk of CH_4 and N_2O emissions.

Salinity

Soil salinisation is defined as an excessive accumulation of water-soluble salts in soils, and the degree of salinisation can vary with the horizons[2] of a soil. In the North-Sea region, groundwater salinisation occurs in areas influenced by the sea. Brackish water with up to 1% salt content occurs in estuaries, typically where rivers are meeting the sea in a bay or a fjord. Some areas are also exposed to open sea water with 3.5% salinity. These soils are typically low-lying tidal flats, often not surrounded by dykes. In some places tidal water or storm events, aggravated by rising sea levels, can penetrate far inland via rivers. They can also break sea defences and flood low-lying land causing short or long-term salinisation effects whose severity may be affected by precipitation and soil type

Salinisation in arid soils occurs if the rate of water lost through evaporation is much higher than that of water received through precipitation (75% of minimum rainfall needed or less). Irrigation water, of even rainwater, contains some salts as dissolved ions and since salts cannot evaporate, they are left behind and accumulate on the topsoil crust.

In humid climates, any salt accumulated by road salting, by sea salt drift over land (aerosols) near the coast or by irrigation with brackish water will in most cases be temporary. It will be rapidly leached out of the topsoil during normal rainfall.

Finally, the application of fertilisers can lead to temporary and localised salinisation.

Salinity levels in water

Fresh water can contain up to 0.05% salt

Brackish water has 0.05–3% salt

Saline water has 3–5% salt

Brine has 5% - 26%-28% salt max

EC does not determine what material the dissolved solids are. It simply suggests that dissolved solids are present. However, if the sample is from soils that are known to be affected by saline water then there will be an increase in the amount, and it is reasonable to assume a substantial increase in predominantly, sodium and chlorine.

Measuring salinity in soils

The principle of measuring salinity in soils is quite simple. It is based on measuring electric conductivity (EC, dS/m) in the extracted water of a soil sample. The parameter can be determined directly in the extracted water using a handheld electrode. The results we get show, indirectly, the amount of dissolved material present in the sample, the Total Dissolved Solids or TDS. How? Pure water does not conduct electricity, but once other material is dissolved in it, this changes. As the amount of TDS in the water increases so does the ability of the water to conduct electricity. This can be measured and quantified. EC can therefore be an important, practical indicator of soil health.

Method of sampling

Scan the QR code or click the photo to see the video.

In this video, you will see how to take soil samples. This is the first step in the process to see if your land is affected by salt and if saline agriculture would be your solution.

2 Soil horizons: A soil horizon is a layer parallel to the soil surface whose physical, chemical and biological characteristics differ from the layers above and beneath

How do we extract the soil water sample? The methods differ. They are known as the “1:2 method” and the “saturated paste method”. The latter is perhaps more appropriate for laboratory use. The 1:2 method is easier in an everyday setting for farmers and others who wish to test the salinity of soils. Both methods are well illustrated in these videos:

Saturated paste method

In this video, you will see how to measure soil salinity using the saturated paste method.

A wide variety of Inexpensive EC meters are readily available from a variety of sources. although not necessarily 100% precise they are accurate enough to give practical and useful information.

1:2 method

In this video, you will see how to measure soil salinity using 1:2 method.

To determine salinity using the 1:2 method:

- collect a soil sample from the top 20 cm of the place in question
- spread the sample on a tray and air dry it either outside in the sun or in an oven
- pass the dried soil through a sieve
- mix 15mL of the sieved soil with 30mL of de-ionised water
- measure the EC in the resulting slurry.

Table 1: EC Values from both methods & the level of salinity of the soil

Classification/method	Saturated paste	1 : 2
	EC (dS/m)	
No salinity	0-2	
Low salinity	2-4	< 1
Moderate salinity	4-8	1-2
High salinity	8-16	2-3
Very high salinity	>16	>3

Deci siemens per metre (dS/m) or in micro siemens per centimetre (µS/cm). To convert from µS/cm to dS/m, simply divide the value by 1000 ((µS/cm)/1000 = dS/m) (The siemens in the International System of Units is the unit of measurement of electrical conductivity).

Many of the salt ions[3] are essential for maintaining healthy plant growth and a healthy soil ecosystem. But if the concentration becomes too high then both crop yields and nutrient availability will decrease. The activity of soil microorganisms can also be reduced, which may influence key soil processes such as respiration of soil organic material and nitrogen transformations. As the salinity of soil increases the ability of plants to take up water and nutrients reduces and it becomes difficult for plants, as well as earthworms and other soil invertebrates, to absorb water from the soil even if the soil is wet. More water is lost through transpiration than is taken in via the roots. This is also why plants wilt and appear stunted in saline soils -physiological drought. Some salt ions such as chlorine and boron can also have a direct toxic effect on plants.

[3]An ion is a particle, atom or molecule with a net electrical charge. This makes it able to attract or resist bonding with other components.

Table 2: Summary of saline irrigation options for sandy and clay soils

Dominant soil type	Soil salinity	Irrigation water	
		Fresh	Brackish
Sandy	Yes	Good possibilities	Good possibilities
	No	Conventional agriculture	Good possibilities
Clay	Yes	Tricky	Not recommended
	No	Conventional agriculture	Not recommended

Sandy soils can be irrigated with brackish water if the crop will tolerate it. This is not recommended for organic or clay soils.

PHOTO *Salt Farm Foundation*

Atlantic sea at the coast of Jægen, Norway.
PHOTO *Åsgeir R. Almås, NMBU.*

Saline crops, what to grow and how to grow them

Successful saline farming will need crops and plants that can withstand salt either from brackish groundwater, brackish irrigation water or salt spray from a nearby sea. The majority of the present-day plant varieties used in production systems have not been selected to withstand increased salinity. When exposed to water that contains a relatively high amount of salt it will potentially stress them and limit their yield. Is it possible to identify existing plant varieties able to cope with saline conditions or should we use plants that naturally occur and thrive on saline conditions such as halophytes?

The SalFar project has built up experience growing both different crops and different varieties of crops. A mix of halophytes and glycophytes[4] have been used. Halophytes include plants that prefer to grow under saline conditions. Only 2% of all terrestrial plants are salt tolerant halophytes.

The majority of plants used for food production, glycophytes, are generally, though not exclusively, salt intolerant. But through thousands of field trials, farmers and scientists of the SalFar project were able to identify varieties of crops (thus glycophytes), which are suitable for a future saline farming strategy. An important step on the way to strengthen food security and ensuring saline farming is not limited to the use of halophytes.

4 Plants which are usually not salt-tolerant and are damaged fairly easily by high salinity.

The following information is based on a variety of tests and experiments carried out in different places at different times. Not all have been performed in a strict scientific manner or been evaluated using statistical analyses to strengthen any conclusions made. Yield data from multiple years at the same location using the same experimental conditions will be needed to increase confidence in the results presented.

The test results - Glyophytes

Potatoes

Potatoes (Solanum tuberosum) are well known worldwide. They are an important food crop. A number of different potato varieties have been tested at various locations within the SalFar project.

The majority of the tests took place on the island of Texel in the Netherlands. Commercially grown varieties were predominantly used. Many are well-known both nationally and internationally. They include Maris Piper in the UK, Hassel in Norway and Red Scarlett in the Netherlands. Otherwise, selection was based on varieties that had the potential to be salt tolerant as used in the case study at Texel.

Controlling saline growing conditions

The saline concentrations used and the way the saline water was applied varied between the test sites. Irrigation at the test sites in Denmark and Norway used spraying techniques. In the United Kingdom and the Netherlands (Texel) drip irrigation was applied. On the Dutch island of Terschelling, the heavy sea clay was kept moist by adding brackish water via drip irrigation.

Spraying salt solution resulted in higher maximum salt concentrations (up to 25 dS/m). Those using drip irrigation kept their highest applied salt concentration lower. The soil types were diverse and ranged from very heavy sea clay via silty loam to light sandy soil. Despite the differences the results suggest that there are a number of potato varieties which can be considered for future saline farming.

Field tests in the United Kingdom show that brackish irrigation at around 6 dS/m had no major observable effect on yield. In Norway flushing with strong brackish water of 25 dS/m left the potatoes with no major impacts while spray application using 18.5 dS/m still showed good potential. Drip irrigation in sandy soil identified numerous varieties with good yield when exposed to 4 to 5 dS/m or more for a long time. Potatoes grown in sea clay had a tougher environment to contend with but given the circumstances there is hope for sustainable growth also in these conditions. Especially when the produce is to be supplied to local markets.

Potato Research, Texel. **PHOTO** *Salt Farm Foundation*

Saline potato field. **PHOTO** *Stephen Valentine*

Scan the QR code or click the photo to see the video.

Potato Irrigation

In Norway flushing with strong brackish water of 25 dS/m left the potatoes with no major impacts while spray application using 18.5 dS/m still showed good potential.

Innovative Farmers Field Lab Saline Drip Irrigation in the Fens

This video illustrates how a group of potato growers in South Lincolnshire set up a trial of irrigation in 2019 with water at different levels of salinity, applied by drip and boom. This video also includes the trials results presentation.

Table 3: Potato varieties cultivated under different saline condition using various soil & practices

Location	South Lincolnshire, UK	Jæren, Norway	Sejerø, Denmark	Terschelling, The Netherlands	Texel, The Netherlands
Growth period	April to September	March/April to September	May-Junue to October	April to September/October	4 month, Q2- Q3
Soil management	Conventional bed system, drip irrigation installed	Ploughing, mechanical stone collection, potato trench and hill preparation for sowing	Ploughing - harrowing	Cultivator, sow bed preparing	Yes
Soil type	Silt loam	Sandy soil	Sandy humic	Sea clay (heavy)	Sandy soil
Fertilizer practice	Basal Dressing (NPK)	Farmyard manure (cow), additional applications of commercial NS-fertilisers	Manure	Compost	Soil elixir, fertisaline (leaf fertilizer)
Crop rotation	Potatoes-wheat-peas-sugar beet	Grass in 5-year rotation with potatoes. 3 grass + 1 potato	Yes	Yes. 1:3	Yes
Salt concentration used	Ca 1.5 dS/m, 3.1 dS/m, 6.25 dS/m (diluted from ditch water)	Control, fresh water.25 dS/m either 4 or 7 weeks after planting; or a combined version	0 to ca 18.7 dS/m	Between 4.2-10.2 dS/m depending on the water source	0-12 dS/m
Irrigation management	Drip irrigation for all saline treatments. 950 ppm overhead irrigation treatment for comparison	Tractor spraying, 1000 l tank, boom irrigation through nozzles (and rain)	Spray	Keeping soil moist;adding water when needed via drip irrigation.	Drip irrigation
Field variables measured	Tuber yield, haulm vigour, common scab soil exchangeable Na percentage, soil penetration resistance	No soil parameter. Only dry matter yield so far.	Electric conductivity	Soil sample analysed	Soil sample analysed
Observation	No significant impacts of brackish irrigation to potato yields	No significant impacts of flushes of brackish irrigation to potato yield	Metro with good potential, Bintje less good.	Rain and drought influence salinity of the available irrigation water	Most cultivars had an average of 90% yield at 4-5 dS/m, but for some it was above 7 dS/m.

Beets

Beets (Beta vulgaris) are commercially significant crops containing important nutrients. They are considered to have the potential to tolerate high salinity.
Sugar beets (Beta vulgaris spp. vulgaris convar. vulgaris var. Altissima) are important for the production of sucrose. The crop has a very high energy value.
Red beets (Beta vulgaris spp. vulgaris Conditiva group) contain important nutrients including vitamin B9 (folate), vitamin C, manganese and potassium as well as being high in fibre. The crop is said to have several health benefits.

In field tests at Texel two varieties of sugar beets were tested and designated ‘Standard’ and ‘Tolerant’ as they are not commercially available. The seeds were obtained from a commercial seed company. Different lines of sugar beets were tested to identify gene and gene combinations that might be of use in saline conditions.
The two red beets were selected based on their potential to be strongly salt tolerant. Seaweed, (sea lettuce, Ulva lactica) was used as dried fertiliser to observe if it could promote better growth on saline soil for the red beet variety Egyptische platronde.

All the beets were grown on sandy soil and were given a range of different salt concentrations. The salt solutions were applied via a drip irrigation.
It was estimated that one variety of sugar beet could still produce a 90% yield at 12-14 dS/m. There was no major difference in tolerance between the two lines. A slight difference in the sugar content was observed, varying between 15 to 21 %.
For red beets a 90% yield at saline levels of 11-14 dS/m was found.

The reported data are very encouraging. Beets appear to be very strong candidates for future saline farming. It has been suggested that sugar beets should be considered a true halophyte as the crop seems to thrive well in saline conditions.
The addition of seaweed did not seem to have a significant effect in this test. This could be due to heavy leakage of nutrients from the seaweed as a consequence of the high drip irrigation frequency washing out nutrients which are supposed to stimulate growth of the red beet. More tests are needed to explore the effects of seaweed as fertiliser for promoting red beet growth.

Table 4: Sugar beets and red beets cultivated under different saline conditions using various soil & practices

Plant/variety	Sugar beets; one standard, one tolerant	Red beets; Egyptische plat – ronde, Gioccia
Location	Texel, the Netherlands	
Growth period	May to October	May to August
Soil management	Yes	
Soil type	Sandy soil	
Cover drop used	No	Seaweed (Egyptische platronde)
Fertiliser practice	20 t/ha compost, 12 t/ha manure and 1 t/ha Orgevit and Monterra Malt	
Salt concentration used	0.6, 4, 8, 12, 16, 20 and 32 dS/m	
Irrigation management	Irrigation with saline water from early June to end of experiment	
Field variables measured	Salinity measurements pore water and soil samples	
Observation	90% yield at 12-14 dS/m, estimated to give 90 tons/ha, sugar content 15-21%.	90% yield at 11-14 dS/m.

Brassica

Brassica include broccholi, brussels sprouts, cabbage, cauliflower, kale or kohlrabi. These contain antioxidants, fibre, minerals and vitamins which make a significant contribution to a healthy diet.

Brussels sprouts (Brassica oleracea var. gemmifera) This crop was tested at a research farm in the United Kingdom using sandy clay loam. Irrigation with an overhead gun provided saline solutions up to 12 dS/m. Final crop biomass was measured and no major negative impacts were observed at the higher saline levels applied. The salt in the soil was not increased. After winter rainfall the levels were the same as before the application of the brackish irrigation.

Cauliflower (Brassica oleracea var. botrytis), white cabbage (Brassica oleracea var. capitate) and kohlrabi (Brassica oleracea Gongylodes group) were planted at Texel using sandy soil and a drip irrigation system. The results show a 90 % yield at 3.3 dS/m for cauliflower, 4.5 dS/m for kohlrabi and 6.5 dS/m for white cabbage. This indicates that Brassica are highly suitable for saline farming.

Carrots

Carrots (Daucus carota) are also a well-known vegetable crop in the moderate climate of the North Sea Region. Filled with beta-carotene, which gives the orange colour to the vegetable, the root also contains useful ingredients such as fibre, antioxidants, vitamin D and vitamin K1.

Four different carrot varieties were tested at Texel using sandy soil and a drip irrigation system to maintain a range of different salt concentrations in the soil from 0.6 dS/m up to 32 dS/m. The plants were first germinated and grown for about four weeks prior to the salt treatment being applied in June. The four varieties all had only a 10% yield reduction at soil salinity levels equal to a minimum of 4.4 dS/m. The best variety (Danvers), reached 90% yield at 7.2 dS/m. The second-best variety (Nantes) produced only a 10% yield reduction at 6.5 dS/m. This indicates that carrots should be seriously considered for future saline farming. There are more varieties available to be tested for their level of salt tolerance.

Onions

Onions (Allium cepa) are high in antioxidants and sulphur-containing compounds offering significant health benefits and are grown all over Europe and worldwide. In the United Kingdom onions were used in field tests on sandy clay loam (former pasture) with overhead irrigation of brackish water diluted from sea water to reach 4, 8 or 12 dS/m. Fresh water was used as a control.
No significant impacts by the brackish irrigation to onion biomass were observed. This indicates that it is possible to replace fresh water with brackish water during periods of drought to maintain onion growth.

Table 5: Brassica crops cultivated under different saline conditions using various soils & practices

Plant/variety	Brussels sprouts	Cauliflower (Herfstreuzen)	White cabbage (Langedijker Bewaar)	Kohlrabi (Blue Dehli)
Location	University of Lincoln Research Farm. UK	Texel, the Netherlands	Texel, the Netherlands	Texel, the Netherlands
Growth period	May to September	May to August	May to September	May to August
Soil management	Plots drilled into former grassland	Yes		
Soil type	Sandy clay loam	Sandy soil		
Fertiliser practice	Basal NPK (16:16:16)	20 t/ha compost, 12 t/ha manure and 1 t/ha Orgevit and Monterra Malt		
Salt Concentration used	Freshwater, 4, 8 and 12 dS/m	0.6, 4, 8, 12, 16, 20 and 32 dS/m		
Irrigation management	Via overhead gun	with saline water from June until end of experiment		
Field variables measured	Final crop biomass, soil salinity	Salinity measurements, pore water, and soil samples		
Observation	No significant impacts of brackish irrigation to crop biomass. Soil salts return to ambient levels after winter rainfall	90% yield at 3.3 ds/m	90% yield at 6.5 ds/m	90% yield at 4.5 ds/m

Table 6: Different carrot varieties cultivated under the same saline conditions soil practies

Plant/variety	Danvers	Nantes	St Valery	Napoli
Location	Texel, the Netherlands			
Growth period	May to September			
Soil management	Yes			
Soil type	Sandy soil			
Fertiliser practice	20 t/ha compost, 12 t/ha manure and 1 t/ha Orgevit and Monterra Malt			
Salt concentration used	0.6, 4, 8, 12, 16, 20 and 32 dS/m			
Irrigation management	Irrigation with saline water from June until end of experiment			
Field variables	Salinity measurements, pore water, and soil samples			
Observation	90% yield at 7.2 dS/m	90% yield at 6.4 dS/m	90% yield at 4.5 dS/m	90% yield at 4.4 dS/m

Wheat at Texel. **PHOTO** *Henrik Aronsson, University of Gothenburg*

Wheat

Wheat (Triticum aestivum) is one the world leading crops and an important energy source. Worldwide it contributes, to approximately 20% of total human food production. Several components found within wheat grain have a high nutritional value. These include carbohydrates and protein as well as vitamin B, fibre, and phytochemicals.

Using the setup at Texel (sandy soil, salt concentrations ranging from 0.6 to 32 dS/m, drip irrigation with salt applied after about four weeks after planting) a moderately salt tolerant Bangladeshi wheat variety called BARI Gom-25 was cultivated together with several other varieties derived from the same parent line. It was observed that some of these lines, initially developed for Bangladeshi conditions, provided higher yields than the control BARI Gom-25 grown in this more moderate northern European climatic zone. Indications point to good prospects for the possibility of enhancing wheat production on salinized land. However, use of existing European wheat varieties is needed for further analysis to determine in more detail if identified promising lines have greater salt tolerance than other existing European varieties.

Pastures and grass varieties

Europe's cultivated land includes large areas of pasture used for animal grazing. Pastures provide very important forage resources for livestock. Field tests have been performed in Norway to collect data on the ability of grasses to sustain their fast-growing and high-yielding properties under salt stress conditions. Three different perennial grasses were tested: timothy (Phleum pratense), ryegrass (Lolium) and meadow fescue (Festuca pratensis).

The field conditions included sandy soil, balanced fertilisation, and brackish irrigation using spray from a tractor. Fresh water irrigation was applied to a control group of grasses three times during the test period. Another group of grasses had a one-time application of brackish water with a salinity level of 25 dS/m and two additional irrigations with fresh water. A third group of grasses was irrigated with brackish water (25 dS/m) three times during the experimental time frame. The protocol used aimed to mimic episodes of flooding by sea water up to three times a year. The irrigations were equal to 30 mm precipitation to ensure complete humidification to rooting depth. The data collected indicates that growth and biomass of the grasses were still enough to be considered acceptable for grazing and hay production despite the saline treatment.

Potato Irrigation. **PHOTO** *Iain Gould*

Table 7: Different pastures cultivated under the same saline conditions and soil practices

Plant/variety	Timothy (60% Grinstad)	Tygrass (10% Calibra & 10% Figgio)	Meadow fescue (20% Minto)
Location	Jæren, Norway		
Growth period	March/April to September. Permanent grass cover during time of trial		
Soil management	Compaction between each harvest.		
Enhanced flushing/leaching	No. Seasonal rain will flush and leach the sea salts.		
Soil type	Sandy soil		
Gypsum used	No. pH controlled by regular liming.		
Fertiliser practice	Balanced fertilisation: Farmyard manure (cow), additional applications of commercial NS-fertilisers		
Crop rotation	Grass in 5-year rotation with potatoes. 3 grass + 1 potato		
Salt concentration used	Three treatments: 1, 3 x 0 dS/m; 2, 1 x 25 ds + 2 x 0 ds/m; 3, 3 x 25 dS/m		
Irrigation management	Tractor spraying, 1000 l tank, boom irrigation through nozzles(and rain)		
Field variables measured	Soil bulk density, water holding capacity, air capacity.EC, pH, Tot C and Tot N in soil, Cation Exchange CapacityH2O extraction of base cations and P (pore water)Ammonium Lactate (Exchangeable) base cations and P		
Observations	Acceptable yield despite increased saline irrigation		

Halophytes

Halophytes are a group of plants that give good levels of growth in the presence of salt. At Ökowerk Emden, Germany, tests were done with several halophytes using greenhouses, poly-tunnels and plant beds. Those with the best observable outcome with regard to yield during the tests were glasswort (Salicornia Europeae), Oyster plant (Mertensia maritima), Heartleaf (Mesembryanthemum cordifolium), and Karkalla (Carpobrotus rossii).

Native soil (clay) was used with a layer of at least 10 cm of sand for most plants. In addition, for glasswort alluvial mud was added. The salt entered the system using spray irrigation applied daily from the top. Salinity levels of approximately 15 dS/m were used. The four halophytes had good observable biomass and growth while being treated with high levels of salt.

In addition, several other halophytes were also tested not only for their biomass but also for their taste. Halophytes are not just salt tolerant, they are salt-loving plants which would not be able to survive in freshwater. They are found in their natural habitat in the Waddensea of the North Sea region, as well as along the lagoons of the Mediterranean Sea and many other places worldwide where salt is present Many of them have the potential to add value in food production and processing. They contain a wide variety of special features for aroma and taste, as well as polyphenols well-known for their contribution to a healthy diet (“Superfood”)
Growth conditions are not always optimal for large crop production. These plots can still be important to produce crops for local markets including restaurants with, for example, a special profile using nearby produced food.

Crambe maritima. **PHOTO** *Ökowerk Emden*

On the Dutch island of Terschelling different crops are grown on such a plot close to the Waddensea, just behind the dyke. Examples of tested crops are sea lavenders (Limonium), sea aster or seashore aster (Tripolium pannonicum), sea banana or beach banana (Carpobrotus rossii), samphire (Crithmum maritimum), and common glasswort (Salicornia europea).

Table 8: Different halophytes cultivated under the same saline conditions & soil practices

Plant/variety	Grosswort *(Salicornia Europeae, both annual and perennial)*	Oyster plant *(Mertensia maritima)*	Heart-leaf *(Mesembryanth emum cordifolium)*	Karkalla *(Carpobrotus rossii)*
Location	Ökowerken, Emden, Germany			
Growth period	Plants are grown in a greenhouse. Most plants grow at least from April/May to September			
Soil management	The soil for Salicornia species contains alluvial mud that is exchanged every two years.Complete exchange of soil after 4 years.			
Crop rotation	The position of the different plants is changed annually.			
Salt concentration used	Irrigation water contains approx. 10 g of salt per litre of water (1% salt), equals to ca 15 dS/m. Plants are treated with salt once a week. Soil salinity was not determined.			
Irrigation managementl	Irrigation system for spray watering from the top daily.			
Field variables measured	Taste, amount of plant material, plant phenotype, seed production.			
Observation	These four halophytes showed good biomass production at these high salt levels.			

These crops were cultivated using sea clay, a rather heavy and compact soil. This soil is rich in salt and by adding water when needed it has been possible to maintain a soil structure useful for plant growth. The salinity of the soil has been observed to vary between 4.2-10.2 dS/m depending on the water source used and weather conditions at the time of measuring the salinity (rain or dry condition prior to measurements). The results give a good picture of the normal soil conditions in sea clay at this kind of location.

All plants tested were observed to survive in the growing conditions and produced plant material useful for local markets although in small quantities. An additional benefit is that the results demonstrate that food, grown under saline conditions, can be produced from areas which are not easily cultivated. The plots show to the public that saline conditions can be overcome. Finally, the apparent modification of taste of some of the crops may offer added value in the marketplace.

Seeds used in this report were obtained from different sources including seed companies, other plant growers/colleagues, own resources, farmers, farmers’ cooperatives, researchers and via contacts. In general, finding seeds for salt tolerant and resilient crops is not a problem once you decide which crop or plant you want to grow. The challenge is to find out what to grow in a specific area with a specific soil type! For example, at the Waddensea islands like Terschelling the soil structure is different from most other places in this report. However, experience shows that there is a diversity of plants which can commonly be considered for growing under saline conditions, whether in saline soil due to water seepage, through aerosols from the sea, flooding or brackish irrigation due to lack of fresh water in a hot and dry summer.

Salt tolerant plants do have different mechanisms to survive saline growth conditions. Some do not accumulate salt; others adjust in such a way that they reduce cell damage. There are still many unknowns, and many questions remain to be answered. For instance that growth conditions in salt-affected areas are not always optimal for large scale crop production. But in times of freshwater scarcity or to regain already degraded farmland growing some of the fore-mentioned crops should be considered, whether glycophytes or halophytes. Particularly when there is an interest from local communities, farmers and entrepreneurs who would like to try something different.

Field tests at different locations and under various conditions will be continued after the end of the project and the SalFar knowledge platform regularly updated with the latest results to be shared.
www.northsearegion.eu/salfar/online-resource-centre/

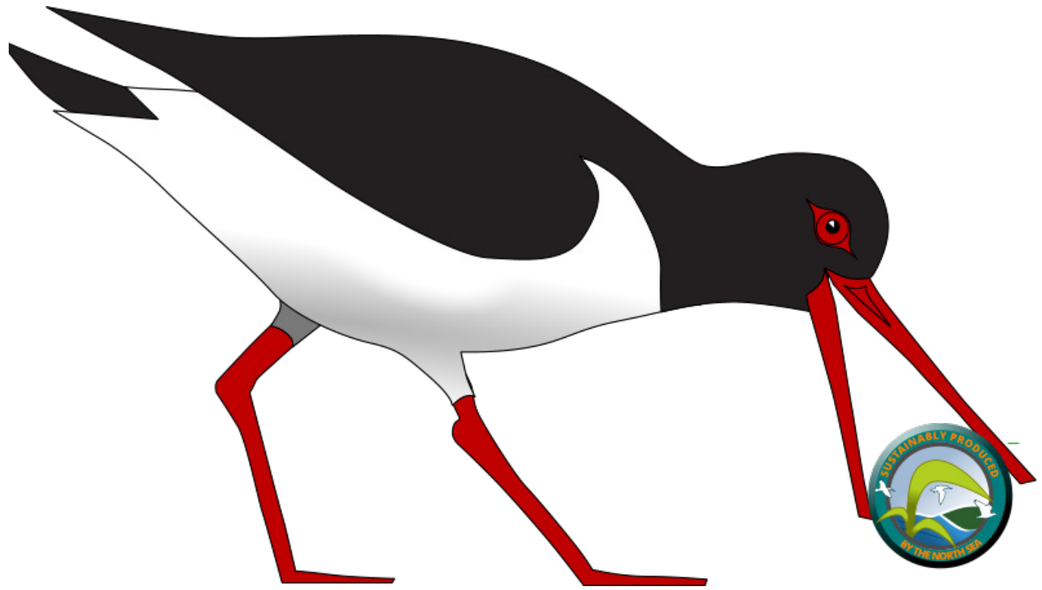
Halophytes are salt-loving plants which wouldn’t survive in freshwater. They are an enrichment for your daily food.

Salicornia being transferred to the greenhouse.
PHOTO *Wim Van Isacker, Vlaamse Landmaatschappij.*

Table 9: Halophytes grown under saline conditions applied via spray irrigation of a 15 dS/m solution

Scientific name	Common name	Annual, perennial, hardy annual	Salt tolerance	Usage tested	Notes
Salicornia europaea	Glasswort	A	High	Vegetable, salad, raw or cooked, pesto, jam, spirit	Salt treatment necessary for the characteristic taste
Mesembryanthemum cordifolium	Heart-leaf	P (N)	High	Salad, raw, leaves and flowers	Salt treatment necessary for the characteristic taste
Carpobrotus rossii	Karkalla	P (N)	High	Salad, fresh or dried	Rich in anti-oxidants
Limbarda crithmoides	Golden samphire	P (?)	High	Salad, raw, cooked as leaf vegetable, spirit	Sea-fennel-like taste
Crithmum maritimum	Sea fennel	P (Y)	Medium	Herb, raw and cooked food, spirit	Rich in vitamins and omega-3 fatty acid
Arthro-cnemum glaucum	Perennial salicornia	P (Y)	High	Similar to Salicornia europaea	Taste turns woody in autumn
Mesembrya-nthemum crystallinum	Ice plant	A	High	Salad, raw or cooked	Fresh and salty
Lepidium latifolium	Pepperweed	P (Y)	Medium	Salad, less bitter after cooking	Bitter and sharp taste like cress
Crambe maritima	Sea kale	P (Y)	High	Vegetable, cooked	Preparation like asparagus
Mertensia maritima	Oyster plant	P (Y)	Medium	Salad, raw	Taste like crab chips
Cochlearia officinalis	Scurvy grass	A	High	Salad & soap	Bitter, nice smell, high Vitamin C
Cochleria danica	Danish scurvy grass	P (Y)	High	See above	See above
Cochlearia glastifolia	Perennial Scurvy grass	P (Y)	High	See above	See above
Salsola soda	Opposite-leaved saltwort	A	High	Raw or cooked	Taste resembles spinach
Plantago coronopus	Buck's-horn plantain	P (Y)	Medium	Salad, raw or cooked	Rich in calcium & vitamins
Portulaca oleracea subsp. sativa	Golden purslane	A	Medium	Herb, salad	Similar to parsley or celery. High in vitamin C
Foeniculum vulgare	Fennel	P (Y)	Medium	Herb, raw & cooked	Bulb, seeds, and flowers are edible
Atriplex halimus	Mediterranean saltbush	P (?)	Medium	Salad or vegetable, raw or cooked	Forage plant in arid areas
Triglochin maritim	Seaside arrowgrass	A or P (Y)	High	"Röhrkohl" is a traditional spring dish in some northern regions of Germany	Cooking removes alkaloids

Saline plot set up in Lincolnshire, UK. **PHOTO** *Iain Gould, University of Lincoln*



SalFar Brand Book
ILLUSTRATION *Stephen Valentine.*

Marketing of saline products

Introducing new things - crops grown in saline conditions and food products produced from these crops - into the marketplace and onto the plates of people in the North Sea Region offers exciting possibilities. It offers many advantages as well as interesting challenges: Market awareness of foods and food products produced from crops grown in saline environments is low or non-existent. There is growing awareness of the increasing difficulties and problems presented by climate change. These together offer the chance to have a considerable impact on shaping people's perceptions of saline grown foods. In many respects there is a blank page to write on – a rare opportunity.

This chapter suggests some ideas and provides routes to some resources to focus thinking about how the marketing of these products can be developed and refined, opportunities can be capitalised upon and any difficulties encountered can be minimised.

Why do people buy?

People don't buy products. They buy the features and benefits the product offers them. They do this either directly or by association. Some of the features and benefits that saline farmed crops and foods offer include:

- using and keeping degraded farmland in production.
- ensuring efficient use of water resources.
- establishing future food security for our children and grandchildren
- helping to maintain and create jobs on farms and in rural areas.
- reinforcement of own values.

People can identify with these points and see them as 'a good thing' which they can buy into.

How do we tell, sell it and to who?

Everyone loves a good story. Storytelling is a critical, but often overlooked, skill every business owner can benefit from. In saline farming, its produce and products, we have a good story. It is one that will resonate with many people and it is one they can readily accept. Saline farming connects to concerns such as climate change, food waste and water scarcity and offers a solution for these problems. Taking the saline story and combining it with good quality, good tasting foods and telling this in a compelling way produces a proposition that an audience will accept and support.

Saline farming is at an early stage in its development. It is producing new and innovative products for a new and growing market. That audience contains a number of different groups including consumers, food product manufacturers and restaurants.

Consumers include:

People who:
- **are early adopters**
- **are concerned about the environment, the effects of climate change, about food security and who value local and sustainable food production**
- **are concerned about with the well-being of their children and grandchildren**
- **want to be pro-active, responsible and take action and offset their climate guilt**
- **are willing to pay a premium for sustainable and/or eco-friendly products**
- **are consumers interested in healthy food and may be, or have leaning towards being, vegetarian or vegan**

Food product manufacturers, identified as:
- **early adopters**
- **manufacturers who want to differentiate their products on environmental, conservation or sustainability grounds**
- **producers that use novel ingredients**
- **those who are eager to be pro-active**

Restaurants that:
- **have a connection to the sea**
- **like to use local produce**
- **are early adopters**
- **are users of novel ingredients**
- **are high-end gourmet places looking to stand out and be innovative**

Valuing the difference

Saline farmed foods and food products may or may not offer nutritional, culinary or taste advantages – it depends on the particular food or product in question. However, environmental and conservation-based arguments can be made for all saline-grown food products. Additionally, each saline food producer can identify the specific features and benefits that are unique to them, their business and their product – their Unique Selling Proposition (USP). This is what differentiates them and their products from other producers.

Benefits that apply more generally to saline-grown products include:

- enabling climate change adaption and resilience ('future-proof foods')
- enhancing food security
- conserving of fresh water
- offering healthy products
- providing new and interesting (plant) foods
- offering unique food products for the gourmet market
- providing opportunities and resources for rural business devel opment
- appealing to vegetarian, vegan and flexitarian consumers
- being sustainable

Saline farming can offer:

To the consumer:
- **healthy and tasty food products that are sustainably produced**
- **locally produced foods provided by someone they have met and know**
- **a solution to salinisation, a problem facing both us and future generations**
- **comfort, in that someone is thinking about mitigating the harmful effects of climate change**
- **an opportunity to do something - they can be part of the solution not the problem**

to food processers:
- **a brand identity (North Sea Region)**
- **something to do to be part of the solution not the problem**
- **something new and different**
- **an opportunity for differentiation of products on sustainability, taste, etc.**
- **new and novel ingredients for niche products**

to cafés and restaurants:
- **locally sourced food products**
- **something which can be done to be part of the solution not the problem**
- **Something new and different**
- **an opportunity to differentiate products on sustainability, taste, and more**
- **new ingredients for novel dishes**

SalFar Brand Book
ILLUSTRATION *Stephen Valentine*

Building perceptions

Among the majority of people there is little knowledge or understanding of the effects and implications of salinisation. The general public are also not familiar with some of the plants, particularly the halophytes such as Salicornia and ice plant, that saline farming has to offer. They do not know what they are, what they taste like or what to do with them. It is therefore important to introduce people to these new foods.
Partners in the food chain, farmers, food processors, manufacturers, restaurateurs etc. need to be willing to offer help and information about the particular qualities, characteristics and benefits saline products have. They could also usefully provide information on how to use them in interesting and good tasting recipes. This needs to be done in a positive way providing reassurance about the health and safety of things where necessary. Reassurance about salt concentration in the food may be particularly important for people concerned about possible increases in their sodium intake.

Knowing that saline crops are grown organically and sustainably, and which contribute to the mitigation of climate change will help, both directly and by association, to make them more readily accepted. This is particularly so if they are also seen as healthy products.

Brands & Branding

Building a brand takes time, effort, dedication, and work. A good reputation takes time to build and is easily lost.

Techniques for effective brand building include:
- always complying with regulations concerning hygiene, food safety, traceability, packaging etc.
- living up to the promise made for products; reliability and consistency matter
- not over-promising – a sure way to loose customer confidence in both the business and its product
- building trust with consumers. This creates confidence in both the business, its products, and its activities. It also builds brand loyalty. People buy into a brand's values and will adopt them as their own. They can become very loyal to a brand and are willing to pay a premium for this
- being clear about what quality means to you and your customers (it is not always the same in each case). Quality then needs to be delivered consistently and reliably
- creating and maintain customer satisfaction and being in touch with both customers and the marketplace
- continually working to get clear and honest feedback – even if it hurts
- having clean, clear and honest labelling

Building a brand takes time, effort, dedication, and work.

A common brand identity

To support individual farmers and producers, a common brand identity and a logo for saline grown food products has been produced by SalFar. This will provide a consistent brand image throughout the North Sea Region and is available for use against the criteria specified in the SalFar Brand Book. The logo is intended to be used as a supplementary label that provides additional information about how the product and how it was produced. It is not intended as the primary brand identity. Food producers in the North Sea Region, who are interested in using the SalFar brand logo are encouraged to contact Louise Krogh Johnson, Business Development Manager at Food & Bio Cluster Denmark, lkj@foodbiocluster.dk.

Increasing revenue

Generally, when growing plants in saline affected soils, yield is reduced when compared to conventionally produced foods. Costs are higher relative to earnings and to more traditional cultivation methods. Costs are expected to fall over time as techniques, skills and knowledge develop. It is possible however that there will always be a price differential and saline crops will remain more expensive than those produced by conventional intensive farming practices. To offset this, it may be necessary to search for ways and opportunities to make up the income deficit. This can be achieved by adding perceived implicit value to the product as is the case with organic and environment friendly foods. It may also be offset by people's willingness to pay more than for non-organic foods. A further possibility is increasing income by owning more of the value chain and/or shortening the supply and production chain.

Scan or click on the QR-code to read what the difference between value chain and supply chain is.

Saline farming may make new and different demands on businesses. A thorough audit to identify any changes, new knowledge, skills, ideas, techniques, and equipment needed, may be useful and necessary activities. Business models for saline farming and foods have been developed in the SalFar project. Ideas can be found on the SalFar website

Salicornia pickled with herbs & spices.
PHOTO *Stephen Valentine*

Building reassurance and adding value

Conventional crops, grown in saline conditions and from saline resistant varieties, can be used in familiar recipes and are well understood by most people. However, many people have not tasted or cooked with halophytes before. An apparently 'new' food or product can turn out to have a long history of use. This can be beneficial in reassuring and developing people's interest in using 'new to them' foods and products. A variety of recipes from experience gained in the SalFar Project as well as links to other resources can be found here.

One of the writers of this chapter remembers, a lot of years ago, as a small boy, going on family expeditions to collect marsh samphire, Salicornia europaea, from Morecambe Bay in North West England. Taken home this was used in salads, and some was pickled into jars. The name samphire was originally 'sampiere' a corruption of the French 'Saint Pierre' – Saint Peter, the patron saint of fishermen. In Britain it is also known as Glasswort or Soapwort and has been used since at least the 14th century as a source of sodium carbonate in the manufacturing of both soap and glass.

Adding this kind of background information to a business' own unique story helps to generate interest, creates a bond between the company, its products and its customers and raises the business profile. It helps people to remember the story, the product and where and from who they heard it. They are also much more likely to tell the tale to others – all part of building, expanding, and maintaining a brand.

A good example of the potential to produce a high added-value product, Ökowerk Emden, one of the SalFar partners, has been working with a distillery to explore the use of saline plants as ingredients in their spirits.

Ökowerk also uses seaweed as a fertiliser which is particularly suitable for use in saline soils. Using seaweed in this way has a long history. Its use today and yesterday adds to the story of the products and their production. Using seaweed is organic, sustainable, environmentally friendly, and potentially appeals to customers. When a story combines new ideas with older traditions, it adds both value to, and confidence in, the product.

Scan or click on the QR-code to read more about Ökowerk Emden's collaboration with Nordcraft Distillery.

PHOTO *Nordcraft Distillery*

SalFar Brand Book
ILLUSTRATION *Stephen Valentine*

Another example of adding value is given in an interview with a Danish farmer producing a high added-value product.

Watch Laurids Christensen telling about his production of free range geese and ducks.

It is always useful to see what others are doing: for an excellent example of adding value through packaging, product placement and storytelling scan the QR code to see www.rinci.it/en.

And finally

The intention of this chapter is to encourage thinking about how to determine, create and maintain a brand and how to tell its story. The most-often missed ingredient in a sales message is an interesting story. Good storytelling is a vital component of a marketing campaign. That is one of the reasons successful businesses put a great deal of effort, time, people, and resources into building, maintaining, and controlling their brand identity.

“At its very core, marketing is storytelling. The best advertising campaigns take us on an emotional journey – appealing to our wants, needs and desires – while at the same time telling us about a product or service.”
– Melinda Partin, Multimedia Producer, Digital Marketing director

PHOTO *Nordcraft Distillery.*

Join the saline farming community

Saline Farming is an innovative method of farming for people in coastal areas that anticipates the coming changes in practice necessary to withstand climate change and sea level rise.

If your soil is salt-affected or the groundwater is getting more and more saline, if more droughts are expected in the coming years, and if there will simply not be enough fresh water for irrigation then you could consider making a switch to farming with salt tolerant crops. It will be an interesting learning process for yourself and for your customers, beneficial to all concerned and the planet.

Across the NSR we are just starting to become aware that the salinisation of farmland is becoming a problem. It is one whose effects are predicted to increase over the coming years. Currently saline farming is mainly carried out on marginal farmland or by innovative small-scale food producers who want to bring new products to the market. They, and those involved in the SalFar project continue to aquire a body of knowledge, skills, and experience from which others can learn and on which they can build. Knowing the specific local circumstances is particularly important in saline farming as salinisation takes different forms in different places.

Farmers interested in starting a saline field can choose between two different approaches: They can opt for conventional crops: potatoes, carrots, sugar beet, cabbages, barley, oats or wheat etc. using varieties that are known to be salt tolerant, but which will flourish in saline conditions and offer added value in the marketplace because of their specific taste and sustainable produce. Alternatively, they can specialise in halophytes, salt-loving plants that grow naturally in e.g. the Waddensea in Northern Europe, in big river deltas in Egypt or Bangladesh, or along the salty lagoons of the Mediterranean coasts.

There are exciting new markets to be developed and new foods, products, and recipes to be offered into them. Consumers are aware of ‘climate proof’ food that is seasonal, regional, fresh and healthy, and therefore produces a much lower CO2 footprint. Research has shown that saline crops contain more polyphenols than crops grown conventionally. With more work on this area, we would be able to talk about a new “super food”, which adds significantly to a healthier life style.

PHOTO *Wim Van Isacker, Vlaamse Landmaatschappij.*

Oudlandpolder
PHOTO *Vlaamse Landmaatschappij.*

Change is a fact of life. Some changes occur whether we wish them to or not and we have no control over their happening. We can however choose if and how we respond to change. Other changes are within our control. They are our choice: 'change what you can change, don't change what you can't change and give me the wisdom to know the difference between the two' is a corrupted version of Niebuhr's Serenity prayer. In the original prayer he asked for courage to be given before wisdom; a wise request for it takes courage to do things differently, to try out new ideas, to experiment, to innovate, to lead rather than follow but it can also be exciting, fun and, in many ways, hugely rewarding. The choice is ours - the hard bit is making the choice -just don't be like the frog.

There are several possibilities to get more information: by visiting test fields, exchange experience and ideas in so-called farmers' cafés or workshops, get in contact with a "saline farmer" and more, see the list below.

In the various North Sea Region countries, and the European Union, there are also funding mechanisms for innovative farming, which you can also find in the list.

There is the SalFar project website: https://northsearegion.eu/salfar with its special "online resource centre", where you can find a lot of inspiration on saline farming.

SalFar partner "Salt Farm foundation Texel" runs an international knowledge platform: www.salineagricultureworldwide.com with the purpose to share knowledge with farmers and food producers around the world, especially those who are struggling with issues such as salt-accumulation and drought on their farmlands.

International networks

There are two international networks of the FAO of the United Nations:

WASAG – Global Framework on Water Scarcity in Agriculture.
It has been designed to bring together key players across the globe and across sectors to tackle the collective challenge of using water better in agriculture to ensure food security for all. It is an initiative for partners from all fields and backgrounds to collaborate in supporting countries and stakeholders in their commitments and plans related to the 2030 Sustainable Development Agenda, the Paris Climate Agreement (including implementing nationally determined contributions) and other plans and programs related to agriculture and water.
http://www.fao.org/land-water/overview/wasag/en/

INSAS - International Network on Salt-Affected Soils
Launched in 2019 during the International Center for Biosaline Agriculture'fs (ICBA) first Global Forum on Innovations for Marginal Environments, is a Technical Network of the Global Soil Partnership (GSP) and follows its rules of procedure. The Network aims to facilitate the sustainable and productive use of salt-affected soils for the current and future generations. The mission of INSAS is to support and facilitate joint efforts towards the sustainable management of salt affected soils for food security, agricultural sustainability and climate change adaptation and mitigation.
http://www.fao.org/global-soil-partnership/insas

There is a myth that says if you put a frog in a pot of water and slowly apply heat the frog will remain in the pot and eventually expire through not responding to its changing environment. True or not, it is a good metaphor for the situation we find ourselves in today. We do have choices. We just need to be active, make a decision and do it.

Visit test fields and contact saline farmers in the North Sea Region

With the SalFar project more than 30 test fields have been established in the North Sea Region. They offer a wide range of conditions, different soil types and crop varieties.

Denmark

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GPS: 55.90135N 11.11202E
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Germany

Ökowerk Emden, Kaierweg 40a, 26725 Emden
Contact: Frank Gaupels
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E: info@oekowerk-emden.de
W: www. oekowerk-emden.de

The Netherlands

Province of Groningen - Double Dyke Project
Contact: Gert Noordhoff
T:+31 (0) 50 316 42 82
E: g.j.noordhoff@provinciegroningen.nl
W: https://www.provinciegroningen.nl/projecten/dubbele-dijk/

Stichting Salt Farm Foundation, Hoornderweg 42, 1797 RA Den Hoorn, Texel
T: +31 (0) 651327951
E: info@saltfarmfoundation.com
W: www.saltfarmfoundation.com

Stichting SPNA, Locatie Kollumerwaard, Hooge Zuidwal 1, 9853 TJ Munnekezijl
T: +31(0) 594-688615
E: info@spna.nl
W: www.spna.nl

Stichting De Zilte Smaak Terschelling, Tordelenweg 7, 8896 JG Hoorn (Terschelling)
T: +31(0) 6 10434089
E: info@ziltesmaak.nl
W: www.deziltesmaak.nl

Norway

Contact: Arne Vagle, senior advisor at the Norwegian agricultural advisory service
T: +47 (0) 90563861
E: Arne.Vagle@nlr.no
W: https://rogaland.nlr.no/

Sweden

University of Gothenburg, Dept. of Biological & Environmental Sciences
Medicinaregatan 18, 40530 Göteborg
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W: www.bioenv.gu.se

United Kingdom

Onions, brussels sprouts, potatoes:
University of Lincoln Riseholme Farm, Riseholme, Lincoln, Lincolnshire, LN2 2LG
Potatoes: Sutton Bridge, Spalding, Lincolnshire, PE12 9EN
Contact: Iain Gould,
E: IGould@lincoln.ac.uk
W: www.lincoln.ac.uk

Possibilities for funding

Denmark:

GUDP: https://gudp.lbst.dk/
Green Development and Demonstration Programme (GUDP)
Short general description:
GUDP Sustainable growth in the food industry GUDP is a modern grant scheme for businesses that are open to innovation. GUDP invests in sustainability and growth in collaboration between industry and research. Innovation happens when researchers, farmers, fishermen and food businesses meet. However, growth that leads to increased export and create more jobs does not come about on its own. This is why GUDP requires environmental sustainability and a sound business philosophy as levers for innovation. GUDP was established under the Ministry of Food, Agriculture and Fisheries in 2010. Read more about GUDP (in Danish)

Promilleafgiftsfonden: https://promilleafgiftsfonden.dk/om-fonden supporting farming development

Innovationsfonden: https://innovationsfonden.dk/en/about-innovation-fund-denmark
Above mentioned are publicly funded (Danish capital)

EU funding:
LAG (Local Action Groups) Only described in Danish. Supporting small business and cultural projects in outskirt areas: https://www.statens-tilskudspuljer.dk/erhvervsministeriet/erhvervsstyrelsen/4 Landdistriktspujen: https://www.livogland.dk/ministeriets-egne-puljer-stoetteordninger/landdistriktspuljen. This Rural Development Fund support rural development through projects and selected actors. They have previously co-funded SalFar (SAD/VIFU).

For advice you could contact:
The Danish SalFar partner: www.sagro.dk
Farmersorganisation the Danish Agriculture and Food Council: https://agricultureandfood.dk/
They have a large knowledge and development organization: SEGES
The Taste of Denmark (Smagen af Danmark): www.smagenafdanmark.dk
Contactperson: Laurids Siig Christensen

Germany:

BMEL: www.bmel.de/DE/themen/laendliche-regionen/foerderung-des-laendlichenraumes/gemeinschaftsaufgabe-agrarstruktur-kuestenschutz/gak-foerdergrundsaetze.html

Niedersachsen: www.niedersachsen.de/niedersaechsischer-weg

The Netherlands:

Waddenfonds: https://waddenfonds.nl/

Rijksdienst voor Ondernemend Nederland | RVO:
https://www.rvo.nl/subsidie-en-financieringswijzer

Norway:

https://www.landbruksdirektoratet.no/nb/jordbruk
https://www.innovasjonnorge.no/no/tjenester/landbruk/finansiering-for-landbruket/tilleggsnaring/
Business development includes investments in permanent facilities and associated production equipment, product development, competence building, network building, market research and marketing of new products):
https://www.innovasjonnorge.no/no/tjenester/landbruk/finansiering-for-landbruket/vekstfinansiering/
Eligible: primary producers in agriculture, reindeer herders, inland fishing and food companies that develop, process and sell quality products based on local raw materials

EU:

There are many EU funding possibilities, just to name a few:

https://ec.europa.eu/eip/agriculture/en/focus-groups/soil-salinisation

https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en

https://ec.europa.eu/growth/sectors/tourism/funding-guide/european-agricultural-fund-rural-development_en

https://ec.europa.eu/info/funding-tenders/how-apply/eligibility-who-can-get-funding_en

Test field on Texel
PHOTO *Salt Farm Foundation*

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More information can be found on:
https://northsearegion.eu/salfar/

Interreg
North Sea Region
SalFar
European Regional Development Fund

EUROPEAN UNION