16 Viability of the Saline Farming of Quinoa and Seed Potatoes in the Netherlands

An Assessment Supported by a Value Chain Analysis of Both Products

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16.1 INTRODUCTION

16.1.1 SALINIZATION: A GROWING THREAT

Globally, salinization leads to the loss of the contained resources, goods and services of soil, resulting in land degradation and decreasing crop productivity (Daliakopolos et al. 2016). Climate change impacts such as increased droughts and a rising sea level are expected to further increase the salinization problem (Oude Essink et al. 2010). The main challenge will be to ensure sustainable cultivation in agricultural production without compromising the environment and natural resources. Alternative strategies and agricultural practices that adapt to salinization can thus represent a valid help for meeting the rising food demand, preserving the already overexploited freshwater and prohibiting land from severe degradation (Atzori et al. 2019).

16.1.2 SALINE FARMING: A TRANSITION TO ADAPTATION

Current academic research focuses on the identification and exploration of strategies that mitigate or adapt to salinization rather than on the socio-economic feasibility and viability of these identified strategies (Stuyt et al. 2011). One potential strategy identified in research is saline farming, i.e. the cultivation of salt-tolerant crops on marginal, saline soils while using salt containing water (De Vos, 2011). The strategy is often mentioned as bring a promising means of supporting future food demand as water scarcity increases (Stuyt, Kselik & Blom-Zandstra 2016), with approximately 400 million hectares of saline soil that could be utilized with

the use of saline farming (Wicke et al. 2011). This study examines the opportunities and constraints for the scaling-up of two potentially salt-tolerant crops in the Netherlands: certain seed potato varieties and quinoa (De Vos 2011). Both are important crops because of their high nutritional value and therefore their increasing demand (Bazile et al. 2016). We choose the Netherlands as the case study area as it is inherently prone to salinization, with a quarter of the country located below sea level and over 65% at risk of flooding without the mitigative invention of dykes and polders (Huisman et al. 1998).

Within this research, two frameworks were used that have not been combined before in the field of saline agriculture; the local value chain development framework (LVCD) (Herr 2007) and the multi-level perspective framework (MLP) (Geels 2002). LVCD aids in the provisioning of information regarding the sector as a whole and the market requirements of a certain product, thereby supporting the identification of opportunities for increasing competitiveness and scaling (Herr 2007). LVCD has not yet been utilized for salt-tolerant cultivars.

MLP supports the examination of the opportunities and barriers to upscaling (i.e. increasing) and outscaling (i.e. expanding) of both products (Wigboldus et al. 2016). The framework assumes innovation to result from interactions at three different levels: (1) the fast-changing niche (micro-level), (2) the stable socio-technical regime (meso-level), and (3) the slow-changing socio-technical landscape (macro-level) (Geels 2002). The socio-technical regime consists of six regime-dimensions that potentially slow down or accelerate innovation: (1) industry, (2) technology, (3) policy, (4) science, (5) market, and (6) culture. The conditions at each level as well as these six dimensions affect the performance of an innovation (Geels 2002); for example, a shock at the landscape level could result in the regime level opening up and the niche level to take over, leading to the breakthrough of a particular innovation (Hermans et al. 2013). Supported by examination of the six dimensions, we mapped the various factors related to the scaling of saline farming of quinoa and seed potatoes. In addition, this research tends to identify potential lock-ins and windows of opportunity, thereby obtaining insights in the interaction of a variety of dynamics involved in scaling that could stimulate change but also lock-in current practice in its unsustainable mode (Geels 2002, 2011).

16.1.3 RESEARCH QUESTION

This research aims to bring a novel, social-economical scope into the examination of saline farming by answering the following research question: *Is saline farming of quinoa and seed potatoes a viable option in the Netherlands, based upon an analysis of the opportunities and constraints for the upscaling and outscaling of both crops?*

16.2 DATA COLLECTION

We conducted semi-structured interviews, allowing the interviewer or interviewee the flexibility to deviate regarding a certain topic (Gill et al. 2008). The use of data triangulation ensured the validity of this study (Bryman 2012). Data

triangulation is considered a suitable validation method that entails the combination of various sources to answer the research question: (1) scientific articles, (2) policy documents and (3) interviews with both stakeholders and experts (Turner & Turner 2009). We aimed to include different actors concerning the value chain as well as experts, including a balance between interviewees from the regime- and niche-levels. Guided by the snowballing method (Bryman 2012), we conducted 32 interviews in total, including eleven with experts, seven with farmers and four with policymakers. To broaden the scope of this research, three interviews were conducted with foreign experts, i.e. two from Belgium (Instituut voor Landbouw-Visserij- en Voedings-onderzoek) and one from Dubai (International Center for Biosaline Agriculture).

The interviews were recorded and summarized. Next, overarching or differentiating outcomes were analyzed. The results are presented with the support of a rating that identifies the quantity of interviewees that agreed on a certain topic; i.e. *few*; <4 (-/+), *multiple*; 5-20 (-/++) and *many*; >20 (-/+++). An overview of the interviewees is found in the Appendix.

16.3 RESULTS

16.3.1 THE VALUE CHAIN OF QUINOA AND SEED POTATO PRODUCTION IN THE NETHERLANDS

16.3.1.1 Quinoa

Based on the interviews, the value chain of quinoa production in the Netherlands is as summarized in [Figure 16.1](#).

16.3.1.1.1 Market Entrance

Approximately 30 years ago, Wageningen University and Research (WUR) pioneered quinoa breeding, aiming to develop a variety suitable for European (and preferably Dutch) conditions. WUR started to market their developed varieties under the auspices of The Dutch Quinoa Group, currently re-branded as The Quinoa Company (TQC). Another company, GreenFood50 (GF50), in turn distributes the quinoa to the retail sector. They sell the quinoa to processors, wholesalers, supermarkets, online stores and restaurants. Farmers produce quinoa for GF50 by contracted cultivation, which means that a pre-agreed amount is purchased at a fixed price.

FIGURE 16.1 The value chain of Dutch quinoa. (Adapted from Herr, 2007.)

16.3.1.1.2 Market Requirements

The most common quinoa variety, “Royal Quinoa”, is a protected Andean variety. Seed from this variety is white, large, contains saponins, and therefore needs to be washed and polished thoroughly. The first market requirement that was identified by *all* quinoa experts is therefore the common characteristic of Royal Quinoa. Quinoa cultivated in the Netherlands differs from this variety: *“the quinoa is less white [...] you can think of it as whole grain quinoa”* (quinoa expert 4). Secondly, the country of origin is identified to be important by *a few*: *“people are used to quinoa coming from Peru or Bolivia. Maybe they think that Dutch quinoa is less good”* (quinoa expert 3). However, *multiple* quinoa experts stated that the Dutch variety can be used for exactly the same things as the Andean. Thirdly, *multiple* people identify more demand for organic quinoa than imported conventional quinoa. To illustrate: *“the prices of organic crops are twice as high as those of conventional crops”* (quinoa expert 4). Therefore, it is of importance to gain or obtain organic certificates. This is possible, however expensive. Lastly, *multiple* interviewees identify local quinoa to be more expensive than conventional, imported quinoa. That makes the retail of local varieties difficult as *“quinoa is already an expensive product; consumers are expected to choose the product with the lowest price”* (quinoa expert 3). According to the interviewees, the higher price results from higher labor costs, labor-intensive production processes and the high investments regarding certificates.

16.3.1.2 Seed Potatoes

Based on the interviews, the value chain of seed potato production in the Netherlands is as summarized in [Figure 16.2](#).

16.3.1.2.1 Market Entrance

There are multiple different trading houses with their own breeding programs, aimed to develop new varieties to be licensed and taken to the market. As an interviewee from trading house 1 explains *“we want to register new varieties for Plant Breeding Rights, which is similar to a patent. If it meets the requirements you get a license; the Plant Breeder’s Rights Protection. This lasts 30 years for potatoes”*. Farmers produce seed potatoes for the trading houses through contracted cultivation. The amount to be produced is agreed to beforehand and thereby the farmers are secured revenue and take-off. What kind of seed potatoes farmers cultivate depends, as *all* trading houses agree that supply follows demand. This also applies to the (more) salt-tolerant varieties; as long as there is no (high) demand for salt-tolerant varieties, trading houses will wait with development and subsequently cultivation.

FIGURE 16.2 The value chain of seed potatoes. (Adapted from Herr, 2007.)

16.3.1.2.2 Market Requirements

There are a couple of overarching requirements identified during the interviews. Firstly, *many* agree that it needs to be determined whether the potatoes grown from seed potatoes need to be consumed freshly as a table potato or need to be processed for fries, chips or starch. Currently “50% of the world market demands fresh potatoes, i.e. unprocessed” (trading house 2). For western countries, however, specifically processed products are identified more important. This poses problems, as “salt-tolerant potatoes produce more sugars, when fried or baked they turn brown” (expert 2). Thus, they are unsuitable for the chips and fries market.

A few also identify the difference between salt-tolerant varieties and common varieties as an opportunity for the niche market. However, this is only a small market and certainly not bulk: “we notice that there is a market in those special salt-tolerant products you don’t need a lot of: purple crisps or purple potato, for decoration in a restaurant” (farmer 3). In this market they prefer products that “are actually only interesting if they are distinctive in taste or appearance” (expert 1).

Additionally, the volumes a variety produces matters. Multiple people state that, currently, salt-tolerant varieties on average produce a lot less in terms of absolute volume. As sectoral representative 3 illustrates: “Salt-tolerance itself says little; you also have to think about the volumes. A salt-tolerant variety can give less volumes under saline conditions than a highly productive, not salt-tolerant variety of which half fails.”

16.3.2 WHAT ARE THE OPPORTUNITIES AND CONSTRAINTS THAT RISE FROM THE DIMENSIONS OF THE CURRENT SOCIO-TECHNICAL REGIME OF QUINOA?

The interviewees were questioned about the opportunities and constraints within the socio-technical landscape of quinoa, built upon six dimensions; industry, technology, policy, science, market and culture. Some of the findings are aligned with opportunities and constraints within the value chain.

16.3.2.1 Industry

Within the industry dimension of the socio-technical landscape of quinoa, there is no free market, as; “the quinoa grown here (i.e. in the Netherlands) is developed by the WUR, owned by TQC and marketed by GF50” (quinoa expert 4). Multiple interviewees identify the fact that there are scarcely any actors within the sector as a constraint: “you may not secretly collect and grow our (i.e. GF50) seeds and sell them, because then you are violating the breeder (i.e. TQC and WUR) who has invested 20 years in it” (quinoa expert 4). Besides, as GF50 manages supply according to the demand, there is no guarantee that the requested supply is constant. This dependency is identified to hamper the uptake of quinoa. Others are able and welcome to compete, but this has not happened yet. According to a quinoa expert, this is a result of the current numbers of TQC, that shows that the viability of quinoa cultivation within the Netherlands is very difficult: “first, you need more demand to make cultivation profitable in the Netherlands, then a competitor would be of value” (quinoa expert 5).

16.3.2.2 Technology

The cultivation of quinoa must be pesticide-free; thus, the whole cultivation plan must be pesticide-free due to legal jurisdictions. This is a prevailing issue within the technological dimension, highlighted by all quinoa farmers as well as *multiple* other interviewees. This means that the whole cultivation plan must be pesticide-free.

Dutch quinoa has a technological advantage as it is saponin-free. The absence of saponins in Dutch varieties is identified by *multiple* interviewees to smoothen the technological process of quinoa cultivation as it saves time and money for producers and consumers. As such, it is considered *“a huge advantage that makes it competitive to South-America. If it would contain saponins it would be at least 30% more expensive”* (quinoa expert 3).

The volumes of the quinoa are (too) low and unstable. A few interviewees identify a trade-off due to low productivity. As quinoa expert 3 illustrates, you can choose between *“more volume but lower price per product (e.g. barley), or less volume and a higher price per product (quinoa)”*.

16.3.2.3 Policy

In 2013, the FAO initiated the “international year of quinoa (IYQ)” with the objective of increasing awareness of the benefits of quinoa. IYQ resulted in the establishment of TQC, as *“it was an opportunity to create a market for local quinoa because of the increasing awareness and demand”* (Quinoa expert 1).

The lack of authorization to use pesticides obstructs the scaling of quinoa cultivation. *Multiple* interviewees stated that lacking jurisdiction regarding pesticides negatively influenced quinoa cultivation (and thus consumption): *“in Europe pesticides have to be authorised per crop, per purpose. Nothing is allowed for quinoa. This makes it more difficult to grow quinoa here”* (quinoa expert 3 endorsed by *multiple* interviewees). This has various reasons: *“it is a matter of slow regulation, but also the fate of smaller crops because tests are expensive”* (quinoa expert 4). In addition, the difficult admission procedure plays a part in this issue: *“the investment for the pesticide admission process is too high, compared to the revenue it generates. This does constrain the scaling of quinoa cultivation in the Netherlands”* (quinoa expert 5).

16.3.2.4 Science

Multiple interviewees identify that Dutch quinoa research is relatively underdeveloped, especially in comparison to established cultivars and the timeframe of variety-development: *“the reason why we are working with salt-tolerant species today is that when you start breeding, this development can take fifteen years”* (quinoa expert 1).

Quinoa needs to become better protected from external threats and the production of quinoa has to become more stable in terms of volume. Currently, as pesticides are not allowed, a few endorse that: *“research needs to be done to find out what does not damage the quinoa but the weeds and threats”* (quinoa expert 5). When looking at the production, also the variability of the crop needs to be examined: *“we have 4 hectares; one year 2000 kg is produced; the other year 2500 kg. The exact reason is still unclear, there is not enough knowledge about that”* (farmer 2, endorsed by *multiple* interviewees). As the volume of the yields varies, constant revenue is not guaranteed.

According to *many* interviewees, there is a knowledge gap within Dutch consumer preferences regarding quinoa. Thus, consumer preferences and the quinoa market itself are under-researched. The reasoning of consumers to make certain choices is therefore currently subject to guessing.

16.3.2.5 Market

The demand is expected to grow, but likewise, the international supply is growing. *Multiple* interviewees stated that they expect increasing consumer demand as well as increasing supply: *“the market itself is growing very fast, but there is also more and more supply from Europe, Spain and France, but also from Canada and (South) America”* (quinoa expert 3). In general, the prevailing belief identified by *multiple* interviewees, is that for quinoa to be competitive on the (international) market, you need to do it in bulk: *“efforts only work if you can concentrate investments, and if you can give high volumes”* (quinoa expert 1).

There is a higher demand for organic quinoa; however, organic certificates demand high investments. *Multiple* interviewees identify the high investments in order to gain organic certificates (e.g. Skal) as a constraint. Imported quinoa often has such certificates, however, *a few* interviewees stated that is unclear to what extent these have been acquired fairly as *“there’s a lot of corruption in the market”* (quinoa expert 4).

16.3.2.6 Culture

Quinoa research and development is mainly aiming to add value; *“if you invest in under-utilized plant species, you can actually add more diversity to food production systems”* (quinoa expert 1). As such, TQC is motivated to make quinoa a global staple crop; *“our objective is to accelerate the evolution of quinoa, so it can enter professional farming systems”* (quinoa expert 1). Increasing food demand is identified by *multiple* interviewees of importance as well; *“in 2050 we must produce 70% more food. That won’t come from saline agriculture only, but we need to use the saline resources for unconventional crops like quinoa to reach that 70%”* (expert 2).

Curiosity (regarding business opportunities and the sustainability of quinoa) drives farmers to cultivate. In the interviews, farmers explained their motivation; *“I like to try new things and quinoa is a healthy crop, a crop to be proud of”* (farmer 5). Additionally, the sustainability issue is of value: *“for us, farmers, growing this product is good for biodiversity and keeps the soil healthy”* (farmer 4).

For retail and distribution, the two labels “traceability” and “sustainability” make the concept of local quinoa powerful, according to *multiple* interviewees. As quinoa expert 4 explains: *“if you want to do it right, besides organic, quinoa has to be local”*.

A few interviewees identified that the problem with quinoa is that people see it mostly as a specialty crop as consumption of quinoa is not embedded in the Dutch culture. To prevent this, *a few* argued that you should sell quinoa as an alternative to common products: *“when you introduce a new crop and you can offer it as an alternative to something very similar, that you can replace easily, the threshold for the consumer is lower”* (expert 2). This could entail e.g. rice or couscous. That quinoa is not culturally embedded also influences the use of pesticides: *“e.g. wheat and maize*

can be developed with a lot of pesticides [...] it is from the historical point of view that new crops are watched more closely than old ones” (quinoa expert 3).

16.3.3 WHAT ARE THE OPPORTUNITIES AND CONSTRAINTS THAT RISE FROM THE DIMENSIONS OF THE SOCIO-TECHNICAL REGIME OF SALT-TOLERANT SEED POTATOES?

16.3.3.1 Industry

Research and development regarding salt-tolerant seed potato varieties occurs in both the commercial and scientific fields and is supported by governmental agencies, e.g. ministries. However, *“researchers would like to cooperate more with the trading houses”* (expert 1). This lack of cooperation could result from the contradicting motivations of actors. There is cooperation within fundamental research, but the actual development of salt-tolerant varieties is separate. What could be of importance here is that the main revenue for trading houses comes from licensing varieties. Trading houses explain: *“closer to what you want to put on the market, there is simply no cooperation because of competition”* (trading house 1). As such, multiple interviewees identify this friction comes from the fact that trading houses focus on increasing revenue, whereas scientists generally do not have a commercial aim. A few interviewees state that *research* is becoming more accessible. In general: *“research in the potato sector is becoming easier and cheaper [...] prices are dropping due to available technology. As a result, we start to understand complex things better and better”* (trading house 3).

16.3.3.2 Technology

Multiple interviewees identify the technological quest to develop a salt-tolerant potato variety that is close to existing, regular cultivation: *“it must remain a common, regular seed potato, but one that can withstand higher salt values”* (expert 4).

A few interviewees identify the subsequent requirement for salt-tolerant seed potatoes to be grown organically. However, this is considered difficult, as regular varieties are already hard to produce organically. Thus, the development of organic common varieties (non-salt-tolerant) is prioritized over salt-tolerance, as the demand for the first is bigger.

The quest for appropriate varieties will potentially be smoothened thanks to the emergence of hybrid breeding, as identified by a few. Hybrid breeding programs are faster and therefore cheaper. Solynta is a firm focused on this technique and expects to present their first seed potato seeds in the late 2020.

16.3.3.3 Policy

Many interviewees identify the need for official standardization of labeling for salt-tolerance. The absence of such a label is identified as a constraint because it leads to unsubstantiated claims. This poses problems for production as well as distribution and retail: *“if we (i.e. trading house) are asked if we have salt-tolerant varieties, we cannot and will not claim it”* (trading house 1 endorsed by trading house 2 and trading house 3). Therefore: *“we currently only tell which breeds are best and worst suited for saline soils”* (trading house 1).

Multiple interviewees identify the fact that some countries have import jurisdictions as a current constraint for the uptake of salt-tolerant seed potato varieties. As expert 4 argues: “*you cannot just grow any potato anywhere, and certainly not import it*”. There are numerous countries with breeding lists; “*often salt-tolerant breeds are not listed, making it difficult to cultivate them here*” (expert 2).

16.3.3.4 Science

A *few* interviewees identify that knowledge is currently not up to date. As water board 1 illustrates: “*a lot of knowledge is still based on old figures or outdated experiments. There are no recent norms or standards*”. However, *many* state that in recent years, a lot of important research has already been done in this domain, and that progress is made.

Multiple interviewees identify that the market is a research area that needs to be examined. There is need for information regarding the end use of salt-tolerant potato varieties (e.g. market research and consumer preferences).

Hybrid breeding is identified by a *few* as an opportunity. In addition, in this dimension, the faster, and potentially cheaper process of hybrid breeding could aid in accelerating research and development of new varieties.

16.3.3.5 Market

Many interviewees endorse the view that there is not yet an existing export market of salt-tolerant seed potatoes. As trading house 2 explains, “*No matter how good a variety performs in the Netherlands, it must also excel abroad*”. Currently, however, the demand from abroad is from developing countries where they have little budget. The need to target more prosperous countries is identified: “*focus on more wealthy European countries where salinization takes place: Spain, Italy and France*” (policymaker 2). The paradox is that “*The value will only increase as the target-area increases, thus as more area becomes saline*” (trading house 1 endorsed by a *few*).

Trading houses often have other priorities. Trading houses identified the need to rank the characteristics that future varieties need to obtain. This goes as follows: “*we ask our salespeople once a year what the most important aspects of a new variety are. They come up with a top 10, and salt tolerance is not yet in it*” (trading house 2 endorsed by trading house 3). Currently, organic cultivation is prioritized over salt-tolerant cultivation.

Multiple interviewees identify that farmers are highly dependent on seed potato cultivation as for many “*seed potato is a cash crop; if the yield and revenue would decrease it would mean end of business*” (sectoral representative 3). This could be interpreted as an opportunity for the development of salt-tolerant varieties.

16.3.3.6 Culture

Multiple interviewees highlight the leading position of the Dutch industry in the sector, but also its dependency on exports: “*we are dependent on 60-80% export. This has consequences that you see during such a crisis (i.e. Covid-19), that resulted in the collapse of the global fries’ market*” (expert 1).

Multiple interviewees identify the cultivation of salt-tolerant varieties as means to maintain the leading position within the seed potato sector in the future. A few argue that overall system change is needed. However, trading house 2 disagrees “*you have to ask yourself; should we (trading houses) develop a variety that is more resistant to saline soils, or should people with salinized land start growing other crops?*”

There is ambiguity in how to market salt-tolerant seed potato varieties. For the retail sector “*there has to be some kind of marketing involved when you enter the product as a saline product in a certain segment. You have to try to make a product for which people are willing to pay a higher price, because you will be able to produce less*” (expert 3). Not everybody agrees with the idea to market the product as something special: “*we do not want to commercialise the product as a salty potato*” (trading house 1 endorsed by *multiple* interviewees).

16.3.4 OTHER INFLUENCES ON THE SCALING OF SALT-TOLERANT CULTIVARS

Certain themes were identified that were applicable to the socio-technical regimes of both quinoa and seed potatoes.

A few identify a change in attitude towards saline agriculture by governmental agents: “*at first, policy had the adage ‘we must combat salinification’. This changed in ‘we will prevent it as long as possible, but if it is no longer possible, we will invest in saline agriculture’*” (expert 5). This has results in the new adage of “mitigation where possible, adaptation where needed”. As expert 4 explains: “*we strive for mitigation strategies with the aim of maintaining conventional agriculture as it is today. In some places however, it is better to let the saltwater take its course. In those areas, you could potentially apply saline agriculture*”. However, *multiple* interviewees identify that it also important to remember that saline farming is only suitable for parcels where the costs of keeping conventional agriculture ‘sweet’ outweigh the benefits of saline agriculture. As independent agent 1 argues; “*you shouldn’t start recommending salt-tolerant crops to farmers unless they can’t do otherwise*”.

Multiple interviewees identify the need for active policy to stimulate salt-tolerant cultivation as an adaptation strategy for salinization as well as freshwater shortages. Currently “*there is no active policy to stimulate salinization risk reduction [...] you have to pursue a targeted policy, with targeted strategies*” (expert 4). Policymaker 2 explains: “*active policy isn’t on the schedule yet. The ministry prefers it tomorrow, but LTO (i.e. Dutch farmers union) is holding it back*”. In any case, this tardiness is not because of the Minister’s personal involvement “*the motivation of her interest (i.e. Ms. C. Schouten): food security. [...] We believe in growing salt-tolerant crops as one of the solutions to the salinization problem*” (policymaker 2). However, they cannot do it alone; “*we need Brussels to implement overarching policy at the European level*” (policymaker 2).

The “water distribution priority sequence” is identified by a few to possibly play a role in the uptake of saline farming: “*in case of extreme conditions like droughts, this (i.e. leaching) is no longer allowed, and we have to think about adaptation strategies*” (water board 2). Overall, *multiple* interviewees identify that the cooperation between the agricultural and the governmental sector should be smoothened, as the

distance between practice and policy is currently too big. As farmer 6 states: *“the water boards are high and dry”*. Farmer 2 adds; *“we need scenarios from the water board. Everyone is unsure about what’s going to happen, we’re not familiar with possible scenarios.”* However, water board 2 argues that the water boards choose to *“place the responsibility for choosing the right crops with the entrepreneur: ‘This is the water you’ll receive; it is your responsibility to choose a suitable crop. If you need better fresh water for your crop, then you have to come up with a trick yourself’”*. This can be seen as a *“passive invitation”* (water board 2) to start salt-tolerant cultivation in areas with salt-containing water supply. As such, many identify that, as long as the water boards continue to supply water with acceptable effort, there is no direct incentive to switch. In total, the cooperation within the agricultural industry *“is very difficult because different parties involved: policy-makers, landscape managers, environmental agents, water boards, soil experts et cetera. They all have an opinion and as a result, few decisions are taken because everyone keeps their hands off the risk as much as possible instead of looking at where to innovate”* (expert 3).

In the retail sector, many state that we should look for various ways to expose salt-tolerant products to the consumer market. It seems to be a matter of consciousness: *“we all have the mind-set of conventional agriculture; you use fresh water and it grows. You have to think differently to start saline agriculture on a large scale”* (expert 2). As expert 1 adds: *“the problem that everything is finite is slowly but surely becoming aware”*. Thus, the need for a different system is identified by a few: *“if different countries are supported to link their cultivars directly to water needs, water efficiency and primary protein supply for the local population, you’ll see a difference”* (expert 1). For the farmers, also the long-term vision plays a role: *“many generations after us must be able to live off the land. Given the high demand for food for the ever-growing world population, this is a very important issue for us”* (farmer 4). Farmer 6 adds: *“I’m looking for salt-tolerant crops to keep the soil healthy for the next generation. My successor should be able to cultivate too”*.

16.3.5 WHAT LOCKS IN THE CURRENT SOCIO-TECHNICAL REGIME AND WHAT ARE WINDOWS OF OPPORTUNITIES FOR THE SCALING OF SALT-TOLERANT CULTIVARS?

16.3.5.1 Lock-Ins

The issue that there is no specific market for salt-tolerant products within the Netherlands, let alone for export, is identified as a lock-in. This lock-in can be explained because of: (1) no explicit demand for salt-tolerant cultivars from prosperous areas, therefore; (2) no direct priority/urgency for trading houses to develop varieties, therefore; (3) no ability to produce salt-tolerant products in bulk, therefore; (4) no direct incentive for farmers to cultivate salt-tolerant seed potatoes. Secondly, next to the lacking economic benefits there is also a lacking awareness regarding salinization and the threats it poses. As such, there is no awareness of the ability

of salt-tolerant cultivars to give economic prospects on marginal land. Therefore, products obtained from saline land currently have no benefit on the consumer market as well as within the agricultural sector. This is primarily a result of short-term thinking and the prevailing idea of “mitigation first, adaptation later”. Governmental agents and sectoral representatives see saline farming as a last resort thereby neglecting its possible potential. The third identified lock-in involves the fact that currently the societal demand for saline products stops at the niche market. The niche market might have benefits for current uptake; however, the question is whether this will help in the scaling of these crops. After all, a niche product is not a niche product anymore when produced in bulk. As trading houses focus on bulk, they are not interested in producing for the niche market.

16.3.5.2 Windows of Opportunity

The most frequently mentioned window of opportunity follows from the more frequent recent droughts. Many mention the summer of 2018 as a turning point where farmers and policymakers became increasingly aware of the problems regarding salinization. Besides, the Covid-19 crisis increased attention as the weakness in our current food system led to an interest in food security issues. Both led to a shock at the landscape-level and an increasing awareness regarding dependencies due to diminishing (export) markets. As a result, the interest in local value chain management could potentially increase.

16.4 DISCUSSION AND CONCLUSION

16.4.1 DISCUSSION

When examining aspects considering the scaling of saline farming it is important to acknowledge the belief that a socio-technical regime is not deliberately shaped. It is the result of different (inter-) dependencies between actors and actions (Geels 2002). The acknowledgment that the Netherlands is new to water-scarcity issues can thus explain the prevailing motto “mitigation first, adaptation later”. Involved actors are not so much denying or downplaying the possible issues that salinization entails, but rather not experiencing and recognizing the situation as urgent enough to take action. Based on the MLP there are certain pressures in place that may accelerate this. At the macro-level, there is a growing awareness regarding scarcity, vulnerability and interdependency due to the shocks of the recent droughts and Covid-19. At the micro-level, pressure is exerted in the form of further development of knowledge and pioneering, e.g. in the development of more salt-tolerant crops. Thus, according to Geels (2002), when saline farming goes through different niches, the market share will grow and even more pressure can be exerted on the existing regime. This brings up the perceived ambiguity of the MLP framework (Geels 2002). The different levels (i.e. niche, socio-technical regime and landscape) are rather broadly defined. As Berkhout states: “it is unclear how these conceptual levels should be applied empirically.” (Berkhout 2004). As such, due to the difficulty to provide clear definitions and boundaries, the indication of saline

farming as a niche, the sector as socio-technical regime and societal norms and values as landscape, are open for debate. A recommendation to overcome this ambiguity is to: (1) incorporate a degree of flexibility when utilizing the different levels, (2) include a clear outlook of the desired socio-technical regime, and (3) be transparent in the assumptions made.

There are more limitations to the findings of this study. First of all, the snowball method used affects the representativeness as two very important groups were not included in the examination: the retail sector and average farmers. This is unfortunate, as the retail sector is expected to play a big role in the uptake and thereby the economic viability of the products. Besides, their view on the framing of such products (niche vs. common) would be of high relevance. Additionally, the interviewed farmers should be considered as pioneers and the sectoral representatives speak for the concerns of their affiliates solely, not for all farmers. Hence, the “average farmer” is not represented. Additionally, it is important to mention that the occurrence of Covid-19 made face-to-face interviews rather difficult. Therefore, all but two interviews took place online. This limits the results, as it was not possible to read facial expressions and indirect responses of interviewees.

16.4.2 CONCLUSION

This research aimed to answer the question: *“Is the saline farming of quinoa and seed potatoes considered a viable option in the Netherlands based upon the opportunities and constraints of the scaling of both products?”* The obtained results indicate that the lack of economic benefits is the main constraint for the scaling of quinoa and/or seed potatoes cultivation on saline soil. Most actors identify the potential of saline farming either when: (1) its saline origin offers added value, or (2) when the saline origin of the product does not play a role, but cultivation on saline soil offers added value. The latter is the case when the costs of keeping conventional agriculture “sweet” outweigh the benefits of saline agriculture. Both seem not yet to be applicable.

The lacking economic benefits could potentially emerge from lacking awareness regarding the salinization issue. Currently, the uptake of and interest in saline products takes place in niche markets, which primarily entail small-scale production with a regional image. However, trading houses are only interested in bulk markets with products that can be competitive with similar products from other production systems. Conflicting interests (e.g. trading houses versus research institutes) further delay acceleration. The recent droughts and emergence of Covid-19 could possibly change this. These two windows of opportunity are expected to lead to a growing awareness and interest in adaptation measures.

Regardless of its current economic viability, saline farming is perceived as an attractive novel opportunity that deserves suitable support for required innovations and transitions. Supporting saline farming offers the opportunity to invest in a forward-looking way: one can facilitate new production in saline areas, thus giving marginal land economic meaning. It is not expected to be economically viable in the short-term; however, if salinization increases at the current rate, maybe its viability will come faster than expected.

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APPENDIX: LIST OF INTERVIEWEES

Sector	Seed Potatoes	Quinoa
Trading houses	C.C. Meijer B.V. HZPC Solynta Agrico	
Farmers	Texel	Noord-Holland Brabant
	Groningen	-
	Friesland	Flevoland Zeeland
Retail	Marc. Foods*	
Polymakers	Wetterskip Fryslân (2) Hoogheemraadschap Rijnland Ministry of Agriculture, nature and food quality	- - -
Independent agents	STOWA PBL	- -
Sectoral representatives	Boerenverstand Potato Valley LTO-Noord	-
Experts	Salt Doctors ILVO Acacia water Rijksuniversiteit Groningen ILVO SPNA	- - - -
Quinoa experts		ICBA The Quinoa Company Mercaderos Wageningen University and Research GreenFood50