

Advancing towards a Climate-Resilient Future: Putting Saline Agriculture on the European Policy Agenda

Policy Brief

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Executive summary

In this policy brief, we explore integrating salinisation management into existing policy frameworks, challenges and solutions related to the saline agriculture nexus as well as policy recommendations for the future.

The threat of soil and water salinisation, which is growing in the last decades in the European Union (EU), has yet not been addressed in a comprehensive EU policy. By setting the agenda and implementing policies focused on saline agriculture as one of the principal measures, we can pave the way for successfully navigating the nexus challenges.

The main challenges and opportunities lay in:

- balancing the pathways of mitigation (increasing the efficiency of freshwater use) and adaptation (introduction of salt-tolerant crops and management practices) to salinity depending on the local conditions and available management techniques;
- sharing costs and benefits of salinisation among stakeholders through effective economic instruments;
- bridging the gap between research and practice with collaborative networks and partnerships on regional and international level;
- integrating the policy for saline agriculture into the existing policy frameworks to foster synergies and avoid potential conflicts building on the experience of countries with well-developed saline agriculture governance.

The policy recommendations that emerged from our analysis convey five main messages:

1. **Agenda setting** is a first step that can be taken to include the saline agriculture policy in the existing frameworks.
2. A variety of local, regional and international stakeholders should be included in the co-creation of an **inclusive policy** for saline agriculture that should address its complex nature and regional differences.
3. The policy for saline agriculture should link to the **existing policy frameworks**.
4. The policy instruments should focus on **equitable cost and benefit sharing** to ensure smooth transition to saline agriculture, **raising consumer awareness** of salinisation and **stimulating demand for saline products**.
5. The policy should support **long-term orientation** and **regional and international networks** that serve as a platform for science and policy interface.

Developing an integrated policy on saline agriculture could bring multiple benefits such as avoiding yield losses, safeguarding the income of farmer communities, protecting biodiversity and an increase in water efficiency. Incorporating saline agriculture into future EU policies will help to mitigate the impacts of climate change and related salinisation as well as promote sustainable and resilient agricultural practices in the face of climate change.

1 Governing salt-affected soils

Progressing salinisation is one of the interconnected contemporary challenges that demands immediate attention from the international community. It is a nexus problem between water and soil (Khan *et al.*, 2009), bringing together the interconnectedness and interdependencies between different sectors or systems, such as water, energy, food, and climate. To effectively address the challenge of salinisation, an integrated and collaborative approach that combines expertise in climate, soil, water, food and biodiversity policies with effective instruments is paramount. This approach is essential not only for meeting the escalating food demands of a growing population which is about to reach 8.6 billion people by 2023 (United Nations, 2015) but also for effectively adapting to and mitigating the impacts of climate change (Lal, 2015).

The issue of salt-affected soils presents a pressing challenge that demands immediate attention. The urgency of this topic is visible in the recent launch of international initiatives related to it such as the FAO International Network on Salt-Affected Soils or the United Nations furthermore established the Global Framework on Water Scarcity in Agriculture (WASAG). The second WASAG International Forum, co-hosted by the Government of Cabo Verde and the Food and Agriculture Organization of the UN (FAO), held on 7-10 February 2023, addressed the theme of making agriculture resilient to climate change by taking advantage of water scarcity as an opportunity for action and collaboration, of which salinisation was an important pillar. Further, in May 2023, the International Network of Salt-affected

Soils (INSAS), part of the Global Soil Partnership (GSP), held its second meeting in Tashkent, Uzbekistan, to address pertinent issues related to salt-affected soils.

In this policy brief, we **assess existing policies related to salinisation in Europe and offer policy recommendations** for enhancing the climate resilience of European food systems by governing the nexus in saline conditions. To reach this goal, we answer the following questions:

1. What is the current placement of salinity in the EU policies?
2. What are challenges and opportunities for the future policy for saline agriculture?
3. What are recommendations for the effective formulation of the saline agriculture policy?

To answer these questions, we employed the Transformative Innovation Policy Framework (TIPF) as our evaluation tool and applied the back-casting method including expert interviews to envision a desirable future and chart a path towards its realisation.

We commence with a brief introduction to salinisation in Europe. We continue by examining the role of saline agriculture within the current policy framework of the EU. With this foundation, we outline key interventions and propose policy reforms aimed at promoting saline food production. Finally, we present recommendations for the future policy for saline agriculture.

2 Salinity in the EU and beyond

Salinisation, understood as the accumulation of water-soluble salts in water or soil resources, is known for decades as one of the major threats to water resources (Williams, 1999). According to research, approximately one billion hectares of land, which accounts for over 20% of all irrigated arable land, experience detrimental effects from salinity (Ghassemi *et al.*, 1995; Qadir *et al.*, 2014). Salinisation is recognised as a major direct factor leading to the degradation of land and ecosystems, as well as causing agricultural and biodiversity decline on a global scale. (e.g., Butcher *et al.*, 2016; Jabbar & Chen, 2008; Právělie, 2021; Snethlage, Wilbers & de Miguel-Garcia, 2021). Moreover, salinisation has a detrimental impact on freshwater resources, thus threatening water security (Vengosh, 2003). These negative effects of salinisation can be mitigated with appropriate adaptation strategies and supportive policies. Next to avoid land salinisation, it is crucial to find a way to restore salinised lands, by adapting these lands to saline soil and water resources (Hollington *et al.*, 2001).

In the European context, salinisation is one of the major soil threats and land degradation processes (Montanarella, 2007; Daliakopoulos *et al.*, 2016). 4.4 million ha of European topsoil and 10.8 million ha of European subsoils are salt affected (FAO, 2021). There are major differences in the extent of salinisation between different European regions. Overall, countries in the southern Mediterranean region are salinised to a further extent than regions in the north of Europe. However, salt affected soils (SAS) also occur elsewhere in Europe. Most affected are Campania in Italy, the

Ebro Valley in Spain, and the Great Alföld in Hungary, with total costs regarding salinisation for these three countries estimated to be between €158 and 321 million per year (Montanarella, 2007).

Generally, higher levels of salinity in soil are not favourable as production levels drop (Masters, Benes & Norman, 2007). A promising approach that has the potential to mitigate the problems of salinisation and freshwater availability in food systems is saline agriculture, an effective way to cultivate crops on brackish soil (e.g., de Vos *et al.* 2016, Ahmadzai, Tutundjian & Elouafi, 2021). Adoption of saline agriculture supports several the United Nations Sustainable Development Goals (SDGs), namely, SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), and SDG 15 (Life on Land) (Negacz *et al.*, 2021). This raises the question; why is saline agriculture not a widespread practice yet? Considering the aim of the EU to ‘to ensure food security in the face of climate change and biodiversity loss’ (European Commission, 2019a), it is important to consider saline agriculture on the EU policy agenda.

Saline agriculture can be both a preventative measure and an adaptive measure. In the prevention or mitigation sense, saline agriculture can help to maintain sufficiently low levels of salinity in the soil to maintain sufficient levels of crop production and sustain freshwater availability. However, sometimes soil salinisation cannot be avoided. As an adaptive measure, saline agriculture caters to the adjustment of already salinised soil. Here, saline agriculture can help to deviate away from common crop cultivation, towards agricultural techniques that are appropriate for salinised soil.

Combating salinisation is an urgent priority. Each year up to 1.5 million ha of farmland becomes salt-affected (FAO &

ITPS, 2015). Economic analysis indicates that soil salinisation may result in significant yield losses in agriculture (Ruto *et al.*, 2021; Negacz *et al.*, 2021; Qadir *et al.*, 2014). The true cost of fresh water is not factored into the pricing of agricultural products, making it more financially viable to develop new arable land rather than repurpose salt-affected land (Vellinga *et al.*, 2021). This puts saline agriculture at a disadvantage as it is not able to compete with conventional agriculture that heavily relies on freshwater. However, saline agriculture offers a multitude of benefits, including but not limited to:

- a solution to degraded lands, as salt-affected wastelands can still produce crops (Gul & Khan, 2003).
- reducing pressure on freshwater resources and mitigating the impacts of climate change, as saline agriculture is more resilient to droughts and rising temperatures (Ruto *et al.*, 2021).
- new job opportunities and stimulate rural development in areas affected by land degradation (Qadir *et al.*, 2014).

3 Our approach

In this policy brief, we draw on the Transformative Innovation Policy Framework (TIPC) to evaluate the potential role of saline agriculture in future EU policy. The TIPC framework guides the development of sustainable and inclusive policies (Schot *et al.*, 2017). The framework advocates for a holistic approach to innovation policy, considering externalities (Chataway *et al.*, 2017; Schot *et al.*, 2017). Building on this, we identify the policy problem and aim to ensure that our policy approach considers both sustainability and equity.

To evaluate the policy potential for scaling up saline agriculture, we use a back-casting approach, which is a planning strategy that starts with a desirable future and works backwards to identify the steps needed to achieve it. By creating a desirable future, then looking back to the present, back casting helps strategize and plan for how to reach that goal (Olsson *et al.*, 2015). During back casting, we conducted 17 semi-structured interviews between March and June 2022 with a variety of stakeholders, including policymakers, representatives from local, regional,

national and European governmental institutions and scholars who specialise in saline agriculture and sustainable agricultural policy (Annex A).

4 Current EU policy agenda

Considering the interconnectedness of various EU policy domains, their alignment and integration would foster sustainable and inclusive adaptation to salinisation. We found saline agriculture related regulations in the following policy areas: 1) Agricultural and rural development, 2) Water management, 3) Environmental and climate change, 4) Land degradation, 5) Research and innovation, 6) Trade and market, and 7) Biodiversity conservation. By recognizing the interplay between these policy domains and harmonising their objectives, we can effectively address the challenges posed by salinisation.

Among these areas, several frameworks and policies stand out: the Common Agricultural Policy (CAP), European Climate Pact, EU Green Deal, including the Farm to Fork Strategy (F2F), Biodiversity and Soil Strategy for 2030, and the long-term vision for rural areas. The main agenda for agriculture specifically, is the CAP, a set of policies and subsidies implemented by the EU to support and regulate agricultural production and trade within the EU. It mentions salinisation as one of the biggest contributors to soil biodiversity loss (European Commission, 2023). The EU also supports the development of sustainable land use and management practices, which can help to reduce the risk of soil salinisation and improve the productivity of saline soils.

Regarding salinisation and soil management in CAP history, several programmes attempted to help farmers with better soil management, or to adapt

to unfavourable conditions. One example is the policy on Less Favoured Areas (LFA). The LFA offers farmers compensatory payments in mountainous areas or other areas where the physical terrain results in higher production costs (Eliasson *et al.*, 2010). The aim of the LFA was to ensure the continuation of agriculture in disadvantaged areas (Eliasson *et al.*, 2010). Although saline soils are classified in existing LFA's as 'agricultural areas with a natural handicap' (Böttcher *et al.*, 2009), policy for agriculture in saline conditions is not further specified.

The European Green Deal, launched in 2020, aims to steer the EU towards a sustainable transition, including climate neutrality by 2050 (European Commission, 2019b). Within this framework, the Farm to Fork (F2F) strategy sets policy targets for food security and environmental protection by 2030 (European Commission, 2019a). However, the European Green Deal and the F2F strategy do not specifically address salt-affected soils or saline agriculture. The same applies to the European Climate Pact (European Commission, 2022).

The EU Biodiversity and Soil Strategies for 2030 are important policy areas to consider when adapting food systems to salinisation. The Soil Strategy stresses the importance of restoring salinised soils (European Commission, 2021a), while the Biodiversity Strategy proposes legally binding nature restoration targets to prevent and reduce the impact of natural disasters and improve carbon capture (European Commission, 2021b). Salinity adaptation or prevention is not covered in either of the strategies.

These observations clearly highlight the insufficient attention given to incorporating salinity adaptation measures in the current strategies and

policies implemented at the EU level. Saline agriculture is notably absent from important EU policy and strategy documents, including the European Green Deal and the F2F strategy. To address this gap, it is crucial for the EU to establish policies that prioritise saline agriculture, ensuring the security of food and water, preventing land degradation, and sustaining biodiversity.

5 Challenges and opportunities for saline agriculture policy

In order to ensure transformative change following the TIPC framework and reach desired outcomes, we identify four interlinked challenges and opportunities for saline agriculture policy. two main policy strategies for saline agriculture: saline mitigation and saline adaptation.

5.1 Choosing policy pathways - mitigation and adaptation

Depending on the local environmental and socio-economic situation, we identify two main policy strategies for saline agriculture: saline mitigation and saline adaptation. Saline mitigation refers to

addressing the increasing problem of soil salinisation while ensuring the long-term availability of freshwater resources and maintaining current cropping systems

(e.g., Negacz *et al.*, 2021, Litalien & Zeeb, 2020; Machado & Serralheiro, 2017) (see Figure 1). Research shows that adequate salinity mitigation strategies can help to avoid further land degradation (Qadir *et al.*, 2008). For example, drip irrigation is a practice that supports this strategy on the farm level. It is a method where water is dripped onto the land, close to the rootstocks of crops through a system of pipes, hoses, and drippers. This irrigation method can provide a relatively constant water content and it creates a fertile environment for root growth as the wetted area around the crops is leached of salts (Hanson & May, 2011). Policies that support a change towards saline mitigation farming practices, either financially or through education, could be a cost-effective approach to prevent salinisation. However, mitigation methods are not always a feasible option for areas that are affected by salinity.

On the other hand, saline adaptation covers issues and solutions to soil that already has become too saline (see Figure 2). This strategy opens the

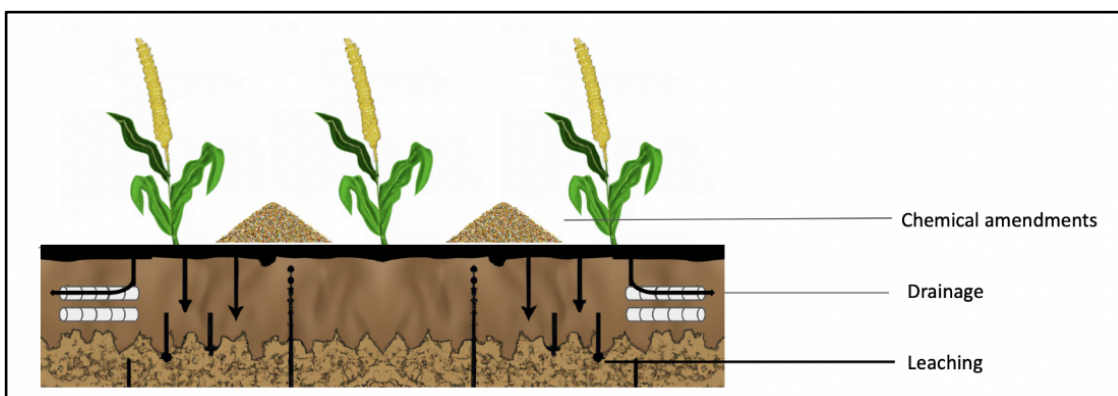


Figure 1 Examples of salinity mitigation strategies

possibility to adapt the land use to the changing environment and entails halophyte cultivation and use of salt tolerant varieties of commodity crops such as rice, potatoes, and grains (e.g., Britton, Müldner & Bell, 2008; Negacz *et al.* 2021; Panta *et al.*, 2014). Salinity management can also entail a combination of mitigation and adaptation strategies, depending on the geographical context of the landscape (Zaman, Shahid & Heng, 2018).

5.2 A shared responsibility - economic feasibility of upscaling

A major concern, expressed by many experts, is the economic feasibility of saline agriculture upscaling. This accounts mostly to the adaptation strategy. In Europe, saline agriculture is currently a niche market. However, generally saline products could cater more regions and reach a larger audience. The consideration of the whole value chain can help ensure an inclusive way of scaling up. Although many experts see challenges in the upscaling process, there are ample opportunities for the future of saline agriculture.

To transition towards cultivation of regular crops on salt-affected soils, aligning with the saline adaptation strategy, the shared responsibility for economic losses and benefits among the stakeholders should be ensured. Costs should be spread out along the value chain; consumers are willing to pay higher prices and governments help with subsidies and transitioning tools.

5.3 Bridging the gap between theory and practice - networks

Another challenge is the necessity to bridge the gap between theory and practice. While the expertise on saline agriculture is advancing at a fast pace, the institutional environment for upscaling is not ready yet, as emphasised by an interviewee. In the European context, different geographical regions could come together in a task force or knowledge centre, where customised information can be provided and exchanged, to educate about salinisation and facilitate custom solutions to region-specific issues in order to facilitate transformative change.

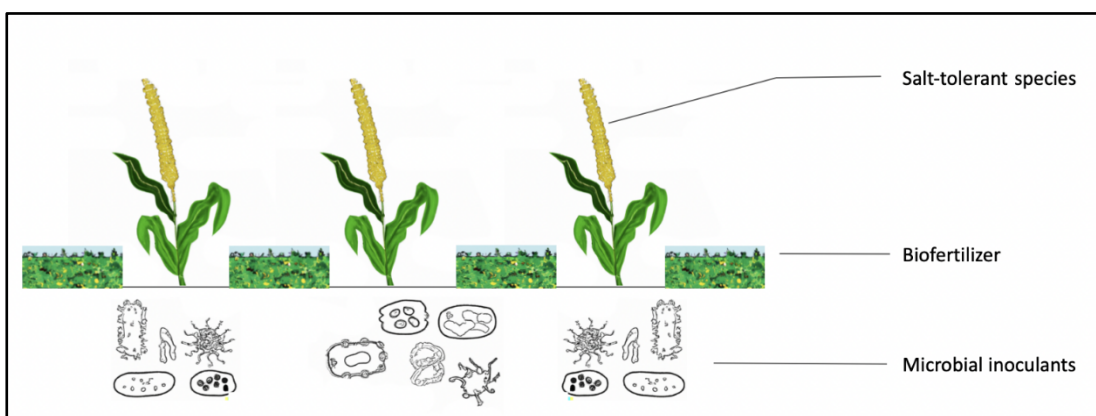


Figure 2 Examples of salinity adaptation strategies

Knowledge exchange centres, such as *Ökowerk Emden, Saline Water and Food Systems Partnership (SW&FS) or Kenniscluster voor Verziltingsvraagstukken in Delta's* are national examples. The networks should include various stakeholders representing the whole value chain, from producers, food processors and consumers.

5.4 Maximising synergies and avoiding trade-offs - integrated saline agriculture policy

Currently, the policy on salinisation and saline agriculture is not integrated within existing policy frameworks. Saline agriculture could become a part of the Climate Smart Agriculture narrative. Climate Smart Agriculture is already a substantial part of the EU CAP (European Commission, 2023). Improved integration would help to increase the policy coherence on the EU level. It can lead to synergy effects among existing policies and instruments, and aid in avoiding trade-offs and cancelling effects of non-aligned policy measures.

The policy should also support the long-term perspective. At present, many initiatives related to saline agriculture are short-term oriented with an average duration of three years (Negacz *et al.*, 2022). These subsidised short-term projects are the primary way in which government institutions are involved in saline agriculture. Although these projects show promising results, they should have a longer-term focus to succeed and make a lasting impact to reach the desired outcomes through transformative change. Furthermore, academic-dense pilot projects are perceived as concerning.

6 Towards policy on saline agriculture – policy recommendations

The expert interviews reveal several insights that indicate a vision for saline agriculture policy but also specific policy packages. We have categorised them under four overarching questions with answers presented below.

6.1 How to create an inclusive policy for saline agriculture?

To ensure an inclusive policy for upscaling saline agriculture, policymakers should consult a **wide range of stakeholders**, and farmer unions, cooperatives, and local organisations. For example, lobby organisations like LTO and Copa-Cogeca can effectively express farmers' interests to international institutions.

Employing effective policy instruments is a key factor for a successful policy on saline agriculture. A comprehensive policy approach could provide financial and technical support to farmers, as well as creating favourable market conditions for saline agricultural products. The policy should also aim to educate the public and raise awareness about the benefits of saline agriculture, including the protection of water resources, increased food security and job creation.

Salinisation is a nexus problem, and we should explore possibilities to **include the measures for salinisation in existing policy frameworks**, such as the CAP, making sure a long-term vision is adopted, thus ensuring transformative change. European policy makers can also build on previous experiences. Despite the challenges, many regions with a long history of dealing with salinity in agriculture, such as South America, North Africa, and the Arabian Peninsula, hold

valuable knowledge and innovations that can be leveraged.

6.2 Who are the key stakeholders to involve in the process of scaling up and policy design?

Experts name multiple stakeholders including farmers, seed technology/breeding specialists, food processing companies, trade unions and agri-co-ops, consumers, local policymakers, national governments, and the academic community. Experts indicate that in the future, **stakeholders from every step in the value chain** should be involved in the scaling up process. However, most interviewees agreed that many stakeholders are currently not sufficiently involved. For instance, 'users' of water, i.e., the agricultural sector, are not informed adequately when considering adaptation possibilities to salinisation issues.

To put this recommendation into practice, the experts suggest that **policy must be co-designed with stakeholders**. On the local level, regional governments should work together to include farmers and bring knowledge from the agricultural practitioners who have to deal with the consequences of salinisation. As communities are the first to be impacted by salinisation, it is important to involve them in policy making. Interviewees emphasise the importance of the role of national governments with the political mandate to start the agenda-setting process at the international institutions such as the EU and FAO.

6.3 What are the key interventions that would create an enabling environment for scaling up saline agriculture?

First, **costs and benefits should be equitably shared**. Costs, both direct and external, should be spread out along the value chain and included in fair prices for the consumers. The producers and processors could be helped by governments with subsidies and transitioning tools. Effective policy instruments are needed to support upscaling of saline agriculture.

Second, **regional and international networks** such as NSFWP, GSP or INSAS **should support and maintain long-term projects** that would allow for a systemic change. Networks and knowledge centres could function as a mediation platform between government institutions, the academic community and practitioners. This could be a fruitful opportunity to bring together practitioners and scientists. Regional initiatives that combine saline agriculture with aquaculture, could be implemented as catch-all policy clusters, tackling multiple environmental and demand issues at once.

Third, **regional differences within the EU should be considered** when addressing salinisation issues. Water resource-rich countries like the Netherlands require different approaches compared to drier coastal areas in the Southern Mediterranean. Specifically, policy on saline agriculture can be **integrated within existing policy programmes** on different issue areas and regional challenges. Furthermore, saline agriculture should become an integral part of national policies, e.g. the Dutch freshwater strategy. Policy makers should also be involved in the public

partner-partnerships projects with a longer-term focus.

6.4 What policy reforms are necessary to encourage saline food production?

First, **agenda-setting** is a crucial first step to be taken by the European Commission to create inclusive policy and initiate integrative processes within current policy frameworks. Salinisation is becoming an increasingly urgent issue on the international agenda, however, specific strategies are not yet often discussed. According to the experts, salinisation and climate-friendly agriculture is becoming an increasing issue of conversation at the FAO. This is a promising step getting issues of salinisation and the possibilities of saline food systems on international agendas.

Second, it is essential **to employ instruments to stimulate consumer awareness and demand for saline agriculture products**. Focusing on locally produced food, could help in building a narrative around saline agriculture products. Considering the emphasis that was put on the consumers by many experts, policy instruments can play a role in the upscaling of saline agriculture. As one of the interviewees argues, European policy comes from the consumer, from the people in the

member states who vote for the people in Brussels. Building a narrative around healthy, sustainable and locally produced food in a saline food system could be taken up by the European Commission for instance. This suggestion is in line with the previous examples, e.g. the European Union using campaigns to stimulate consumption of certain EU-produced food items, such as the ‘Bread from Europe – Great Story’ campaign.

Finally, a **long-term vision for policy** is needed to create a supportive environment for implementation of saline agricultural practices in 30-40 years in coastal areas prone to climate change. A goal to stimulate saline farming should not be to make people abandon their land and move their business, but to make use of the land where their historical and cultural values lie. Policy measures to stimulate saline agriculture practice should emphasise the potential of restoring degraded lands. It is crucial to convey a strong narrative that highlights how saline agriculture can coexist with existing agricultural practices and even add value to degraded lands. By reframing the perception of degraded lands, policymakers can encourage the adoption of saline agriculture as a viable and valuable option for sustainable land use.

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IVM

The Institute for Environmental Studies (IVM) at Vrije Universiteit Amsterdam, contributes to sustainable development and cares for the environment through scientific research and teaching. A unique feature of the institute is our capacity to cut through the complexity of natural-societal systems through novel interdisciplinary approaches. Being the oldest environmental research institute in The Netherlands (est. 1971), IVM is currently one of the world's leading institutes in sustainability science.

SALAD project

SALAD (Saline Agriculture for ADaptation) is a transcontinental, innovative research project in the field of food systems and climate. It addresses the research area of food security under climate change through saline agriculture, aligning vision, research and practice among European and African countries focusing on saline agriculture upscaling. The project involves both basic and applied transdisciplinary (biophysical, social, cultural, economic and environmental) research. It includes a consortium of four countries from the EU: Belgium, Germany, Italy, Netherlands, and two from Africa: Egypt, and Morocco. SALAD focuses on promoting innovative technology deployment and improving climate resilience through saline agricultural practices.

Annex A

Table 1 Sample of interviewees

Stakeholders involved in the upscaling of saline agriculture	Number of interviews
(Sub) Government	
Deltaprogramma	1
Ministry of Agriculture, Nature and Food Quality	1
International Organisations	
European Union (European Parliament)	1
Food and Agriculture Organisation	1
Scientific community	
Universities	4
Other	7
Lobby organizations	6
COPA COGECA LTO Nederland LTO Noord ZLTO	
Total	17