EXPLORING SALINITY CONTROL OPTIONS FOR AGRICULTURAL LAND NEXT TO THE RENATURIZED COASTAL CHANNEL

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Introduction

Salinization is a degradation process that negatively affects the production potential of agricultural land, environmental health and economic welfare (FAO, 2011). Storm surges and saltwater intrusion play a key role on coastal ecosystems. In particular, agricultural land with drainage and irrigation channels in coastal regions is susceptible to salinization, especially with expected sea-level rise and resurging tides. This is particularly true if natural or technological protection measures are either absent or inadequate to prevent seawater intrusion into coastal lands (Rusco et al., 2008; Ruto et al., 2018). The renaturation of the channel in the coastal region of western Slovenia is planned to provide saltwater for restoring a brackish ecosystem.

Fig. 1: Slovenia with location of Koper (red dot) and Ljubljana (blue dot).

Materials and methods

The renaturized channel traverses prime agricultural areas with intensive plant cultivation and the presence of established drainage and irrigation systems has been restore. Mini dams, that prevented sea water intrusion at points 3b and 4, were removed to ensure seawater supply for brackish habitats (green area between points 6, 7 and 9, Fig 1).

Water salinity in the channel was monitored as electrical conductivity (in mS/cm, SIST EN 27888:1998) on points 3b to 7 before and after the restoration works. The area of agricultural land on the right bank of the channel is at risk of salinization from seawater intrusion into the subsoil system via channels and drainage ditches, primarily the area along the channel from points 5a, 6, to 7 (yellow area in Fig1).

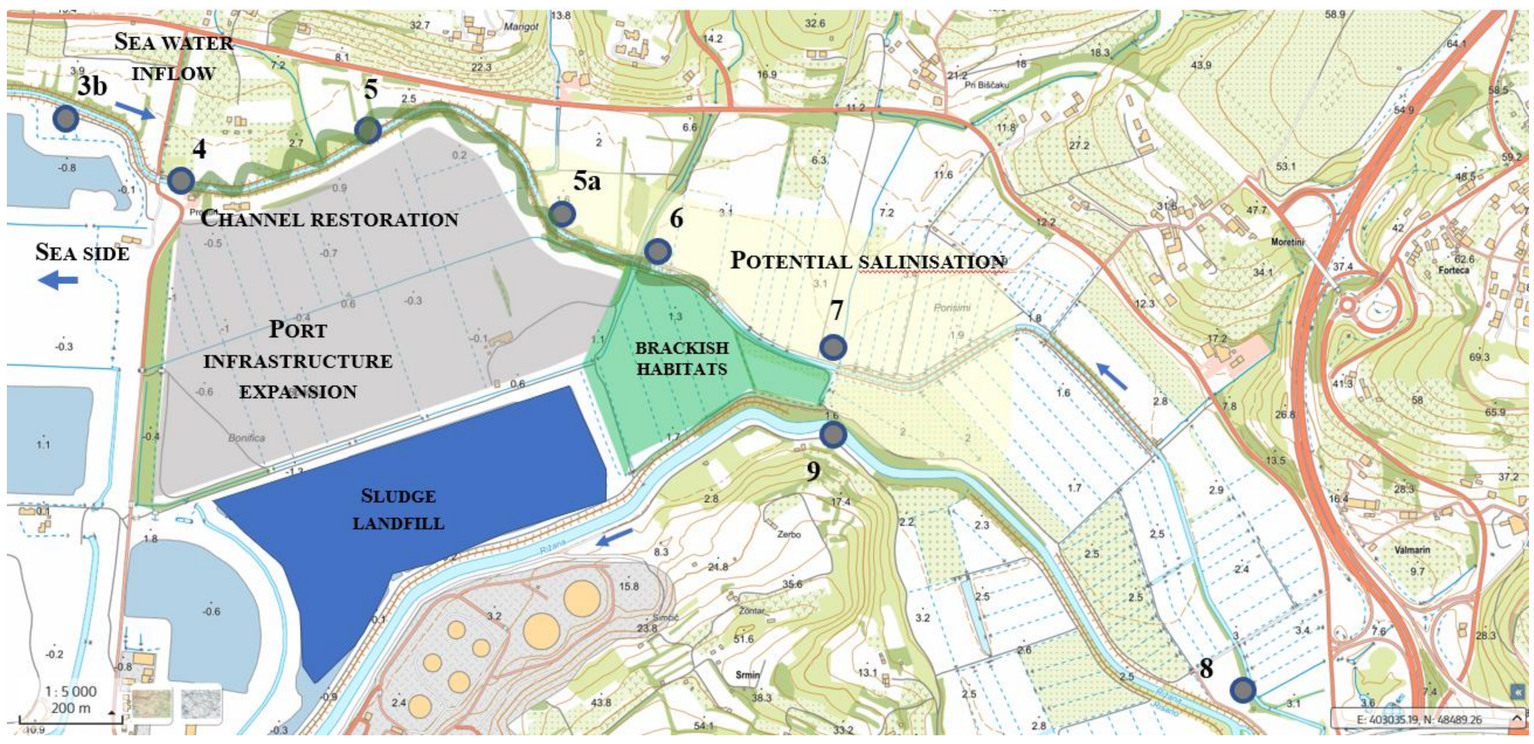

Fig. 2: Case study area on the coastal agricultural land in West Slovenia near port Koper, channel salinity points, restoration scheme, location of brackish restored habitats and potential salinization area.

Results

The renaturation and restoration of the coastal channel increased the salinity of the channel water as shown by measurements of the electrical conductivity of water in the channel before and after the works (20. 9. 2024 and 19. 9. 2025, respectively), Table 1. For reference, the average salinity of seawater is 50 mS/cm, and water with salinity up to 0.8 mS/cm is considered drinking water.

The renatured channel crosses an area of the best agricultural land (land value 87 or 63), which contains public infrastructure, specifically drainage and irrigation systems. The area was designed to facilitate the supply of fresh water and enable the irrigation of agricultural land through capillary rise and pumping from the channels, and drainage of excess water during periods of surplus via channels and drainage ditches. It is expected that saline water will spread into the intergranular space in the agricultural land on the right bank of the channel, particularly in the area between points 5 and 7 downstream.

The following tasks are required: i) a baseline assessment of the soil (chemical and physical properties, salinity, pedological profiles, and grid-based soil sampling), ii) establishment of native vegetation on the banks to create a vegetative barrier against salinity, and iii) monitoring of salinity in the saturated soil zone (using piezometers and a network of points for continuous measurements) and soil sampling twice a year.

By removing the mini dams that regulated both the salinity and the water level in the canal, salt water from the canal and the melioration ditches will freely enter laterally through capillary suction into the intergranular space and from there rise higher into the soil through capillary movement. Flooding due to sea tides and additional acute soil salinization are also possible (Cantelon et al, 2022).

Table 1. Electrical conductivity (EC, mS/cm) of the water in the channel prior (20. 9. 2024) and after (19. 9. 2025) restoration works .

Measuring point	EC (20. 9. 2024)	EC (19. 9. 2025)	Comment
1	57.6		
2	46.3		
3	54.6		
3a	55.3	18.6	Sea water
4	0.747	31.2	
5	0.658	2.6	
5a		3.6	Brackish water
6	0.642	3.2	
7	0.616	0.692	
8		0.579	Drinking water
9		0. 472	

Conclusions

The restoration of the channel in the coastal region of western Slovenia enabled the renaturation of the brackish ecosystem. With increased salinity in the channel and the potential intrusion of saline water during high tide into the prime agricultural land adjacent to the channel, soil degradation due to increased soil salinity is possible. The restoration of the channel resulted in increased salinity, which enables the establishment of brackish habitats, yet poses a threat of soil degradation and reduced fertility, creating poor conditions for plant growth. To preserve agricultural land, several options should be considered, such as establishment of monitoring system and technically advancing the irrigation system.

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