Ecology and Environmental Science
– Reduction of Water Stress and Adaptation to Aridity
Faculty of Environmental Engineering and Land Surveying
University of Agriculture in Krakow
Kraków, 9–10 June 2017

# Soil degradation by salinization

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## Soil salinization processes

Salinization develops over time and space due to the gradual accumulation of soluble salts, whatever their nature, in soil or on the soil surface (saline crusts or efflorescences). Certain salts, in particular sodium salts, favour the dispersion of clay minerals, degrade soil structure and slow down water infiltration. The salinization and sodisation processes of soils are complex, occurring in all latitudes and climates. They are closely related to surface water and groundwater flow processes. Beyond a given threshold of soil salinization, plant growth, crop production, water and soil quality are severely affected, leading to soil erosion, land degradation and ecosystem desertification.

Natural saline environments, so-called „*primary*" salinization, present a wide variety of landscapes ranging from diffuse salinization to extreme salinization. Saline soils develop in relation to a remarkable biodiversity (halophytes), which offer resources available to local populations (saliculture, pastoralism). Many natural factors generate soluble salts on the planet Earth: weathering and dissolution of minerals contained in soils and rocks, geothermal sources, wind erosion, necrosis of living beings), transport them (rains, rivers, groundwater, seawater, winds) and accumulate them in soils (dry climates, temporary droughts, near the sea in coastal and deltaic zones, near a shallow saline water table, aeolian deposits (sea spray, aerosols), endoreic zones (sebkhas, chotts).

Human activities, which induce so-called „*secondary*" salinization, are numerous: irrigation misconduct, practices of old irrigation techniques, irrigation with waters rich in salts, intensive deforestation, fertilizers containing potassium and nitrogen salts, atmospheric deposition near industrial sites. Anthropogenic salinization increases natural salinization, changes the composition of natural waters (lakes, rivers, groundwater), degrades the quality of water required to satisfy do-

mestic, agricultural and industrial needs, contributes to soil biodiversity and soil fertility losses, modifies local climatic conditions, creates health issues, drastically reduces agricultural and fish farming activities.

Photo 1. Halophytic vegetation and pastoralism activity along the Kelbia sebkha (Central Tunisia)

### Rehabilitation of saline soils

Soils in many countries are particularly affected by salinization due to the semi-arid to arid climate and the development of intensive irrigation for agriculture through the construction of numerous storage and distribution systems (dams, hillside dams, canals and water pipes). The consequences of climate change (reduced precipitation, increased freshwater evaporation and higher plant evapotranspiration rates) will result in a concentration of soluble salts within the water bodies and in the extension of soil salinization. The predicted sea-level rise by the Intergovernmental Panel on Climate Change scenarios will have an impact on coastal areas and wetlands (deltas of major rivers) and will promote the saline contamination of coastal aquifers due to underground seawater intrusions. The overexploitation of fragile freshwater layers on brackish aquifers will intensify, with increased need for agricultural, industrial and domestic activities which are mainly located along the coast.

As in the past, farmers know how to control and reduce soil salinization. They must combine key parameters including a good freshwater supply to dissolve salts,

a good soil structure to favor water infiltration and salt leaching, and a good drainage to evacuate the salts out of the root zone of the crops. The soil salinization extension due to climate change will be mitigated through adaptive measures including:

- the protection of coastal areas and lowlands (deltaic plains) from flooding (tidal waves) and seawater intrusion;
- the change of cropping patterns by promoting saline farming, salt-tolerant crops, and rainfed-irrigated systems;
- the increased incentives for water saving techniques improving the water quality (drip irrigation, seawater desalination);
- the effective overexploitation control of deep groundwater bodies.

The development of plants, under natural and agricultural conditions, is directly affected by the saline degradation of water and soil, especially in dry, arid and semi-arid regions. Remediation of saline soils is feasible through substantial financial investments, which mainly penalizes countries with limited incomes. The good conduct of irrigation and drainage techniques is a guarantee of success, but the poor quality of irrigation water is a brake on the sustainable development of irrigated areas. The local grouping of farmers in collective structures promotes the dissemination of technical knowledges and access to credit institutions.

Photo 2. Pomegranate plantation using drip irrigation on clayey and saline soils (Kairouan region, Central Tunisia)

**Keywords:** soil salinization processes, rehabilitation of saline soils, Tunisia

Montoroi Jean-Pierre (2017)

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In : Gawronski K. (ed.), Ziernicka-Wojtaszek A. (ed.), Ksiazek L. (ed.), Nizinski Georges (ed.). *Ecology and environmental science : reduction of water stress and adaptation to aridity : proceedings of the third Ecoscience Workshop*

Cracovie : Université d'Agriculture ; Fonds régional pour la protection de l'environnement et la gestion de l'eau, p. 104-106

Ecoscience Workshop : Ecology and Environmental Science : Reduction of Water Stress and Adaptation to aridity, 3., Cracovie (POL), 2017/06/09-10

ISBN 978-83-647-5857-7