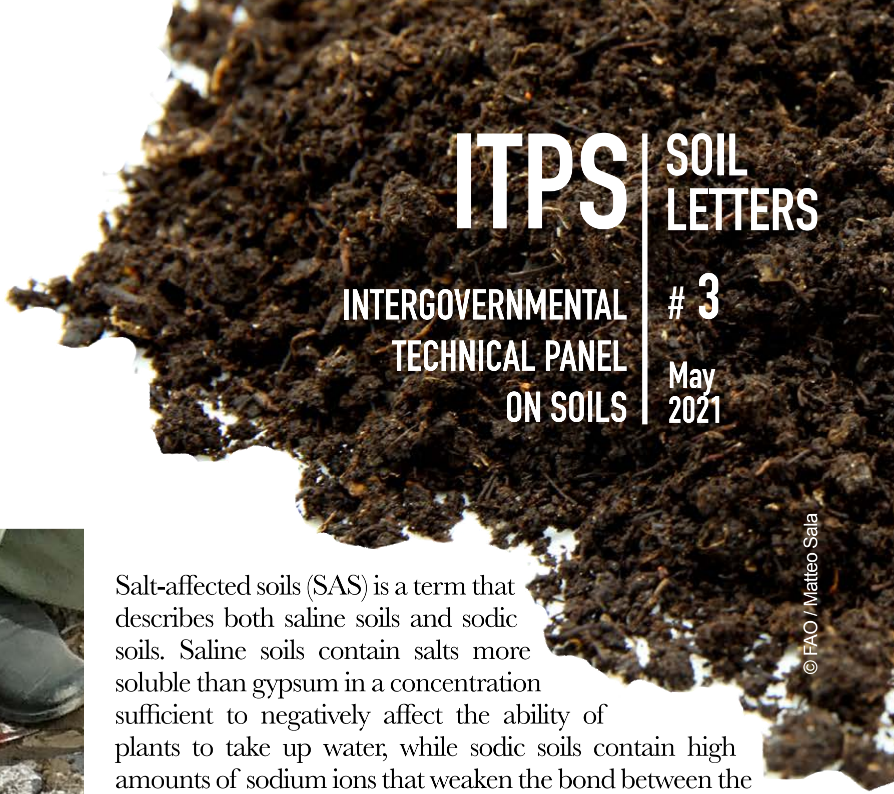
Food and Agriculture Organization of the United Nations



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SALT-AFFECTED SOILS ARE A GLOBAL ISSUE

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Salt-affected soils (SAS) is a term that describes both saline soils and sodic soils. Saline soils contain salts more soluble than gypsum in a concentration sufficient to negatively affect the ability of plants to take up water, while sodic soils contain high amounts of sodium ions that weaken the bond between the soil particles forming the soil's structure. This loss of soil structure through dispersion leads to soil compaction, severely reducing the flow of water through the soil and impacts plant growth and health. Alkaline soils occur when sodic soils have a pH higher than 8.5. Naturally saline or sodic soils host valuable ecosystems, including a range of rare plants, that are adapted to the extreme conditions. However, salt-affected soils may develop quickly in response to human activities. Soils often become affected by salinity due to inappropriate management, e.g. by poorly managed irrigation or fertilization; or through saline water intrusion from sea, river or groundwater. In these instances, soils undergo a rapid decline of health, losing their capacity for biomass production, natural filtration, carbon sequestration and other necessary ecosystem functions.

Over 1 100 Mha of soils are affected by salinity and sodicity, according to the available information (FAO, 2008), of which about 60 percent are saline, 26 percent sodic and the remaining 14 percent saline-sodic. Salt-affected soils are found on all continents. The most affected regions are the Middle East, Australia, North Africa, and Eurasia (FAO 2008). The Global Soil Partnership is working at present to develop a Global Map of Salt-Affected Soils that will surely give a much improved assessment of the salinity and sodicity status of the soils of the world. Salinization due to poorly managed irrigation is one of the major concerns for global food production. Since most of the salt-affected soils occur under arid or semi-arid climates, food production in these regions requires irrigation. Some estimations indicate that 20 to 50 percent of irrigated soils are salt-affected (Pitman and Läuchli, 2002).

Although soil maps can provide valuable interpretative information, they do not represent the full extent of salinization. Salinization can be quite localized within landscapes, adversely impacting landuse. Maps also do not necessarily represent the latent salinity risks existing in many landscapes where salts lie below the soil, or account for the potential effects of recent landuse changes, since the process of salinization can occur quickly. Every country needs to be concerned by the consequences of salinization and sodification since the impact on the environmental services provided by soils goes

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beyond political boundaries. In those countries directly affected, such soils need careful management and special irrigation practices implemented to prevent further degradation (Wang *et al.*, 2019), as well as the utilization of adapted crops. Globally, the off-site effects of salinization and alkalinization range from the salinization of waterways and water bodies, downstream of salt-affected soils, through increasing prices of agricultural products produced in arid areas due to the need of higher inputs, as well as imbalances in the global water trade, since higher salinization implies higher green water needs (Khan *et al.*, 2009). In some regions adverse effects of soil salinity and sodicity will likely be exacerbated by climate change. Therefore at a regional scale a careful reservoir and aquifer management will be needed, to meet both with plant water needs and the necessary leaching fractions to maintain lower salt levels within the soil.

Water scarcity in many regions has led to the use of residual waters for irrigation. Unfortunately, some alternatives being used, like treated grey water, produced water from oil fields, or effluents from mining, can cause secondary salinity and sodicity (Al-Hamaiedeh and Bino, 2010; Scanlon *et al.*, 2020). It is also known that the continued application of some fertilizers and organic amendments can induce soil and water salinization and sodification (Li-Xian *et al.*, 2007; Buvaneshwari *et al.*, 2020). The application of sodium chloride and other chemicals as deicing agents on roads and streets is another practice that contributes to the salinization of soils and waters. Europe adds 1 million metric tons (10^9 kg) of salts per annum to the environment, while USA applies about 10 times more than this annually to paved surfaces, causing secondary salinization (Gavrichkova *et al.*, 2020; Jackson and Jobbágy, 2015).

Climate change is creating newly salt-affected soils. According to the last IPCC reports (Oppenheinmer *et al.*, 2019), coastal areas are amongst the areas most at risk from rising seawater levels, not only because of the loss of land, but also due to seawater intrusion into groundwater and the consequent increase of soil salinization and sodification (Jung, Park and Park 2021). Catastrophic events, like tsunamis, with seawater invading large inland areas have also been the cause of increased salt in soils (Kume, Umetsu and Palanisami, 2009). In addition, higher evapotranspiration due to increased temperatures, and the potential for reduced precipitation in areas without irrigation, can lead to increasing salt levels in soils due to reduced net water movement through the soil that would normally remove salts from the root zone.

Permafrost thawing is one of the consequences of climate change, with strongest implications in the carbon cycle, as it causes the release of large amounts of carbon dioxide and methane into the atmosphere. As some permafrost ice contains significant salt, the progressive permafrost thawing is also affecting those areas of the polar regions containing saline frozen soils (Brouchkov, 2003), dissolving and releasing salts, that were relatively stable under the previously lower temperatures (Kokelj and Lewkowicz, 1999).

Salt-affected soils are a global issue. Some of the processes involved in soil salinization and sodification have been thoroughly studied, such as those related to irrigation, but others have not, and the magnitude of some of their impacts on soils are still largely unknown. If not carefully managed, salinization will have further impacts on the prices of commodities produced in vulnerable areas, as well as increasing the risk of food and soil insecurity in the affected regions and the potential for mass migration of peoples into the future.

As an answer to all these threats, the Global Soil Partnership (GSP) has launched the International Network of Salt-Affected Soils (INSAS) to deal with these crucial issues. The Global Map of SAS will provide an up to date and accurate estimation of salt-affected soils and their distribution. Besides, a Global Symposium will be organized to update and discuss the main issues of SAS with the objectives of proposing concrete actions and guide policies to prevent, manage, or mitigate the effects of salt accumulation in soils.

The focus of the World Soil Day 2021 celebrations will be on increasing social awareness of the dangers of soil salinization and the actions that can be taken, under the motto: “Halt Soil Salinization, Boost Soil Productivity”.

Aerial view of fields with salt upwelling at the surface (California Valley, USA)

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Salt lake in Tajikistan

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The Intergovernmental Technical Panel on Soils (ITPS) is composed of 27 top soil experts representing all the regions of the world. ITPS members have a 3-year mandate and provide scientific and technical advice and guidance on global soil issues to the Global Soil Partnership primarily and to specific requests submitted by global or regional institutions. Created in 2013 at the first Plenary Assembly of the Global Soil Partnership held at FAO Headquarters, the ITPS advocates for addressing sustainable soil management in the different sustainable development agendas.

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