



Food and Agriculture
Organization of the
United Nations

GLOBAL MAP of salt-affected soils



GSASmap v1.0

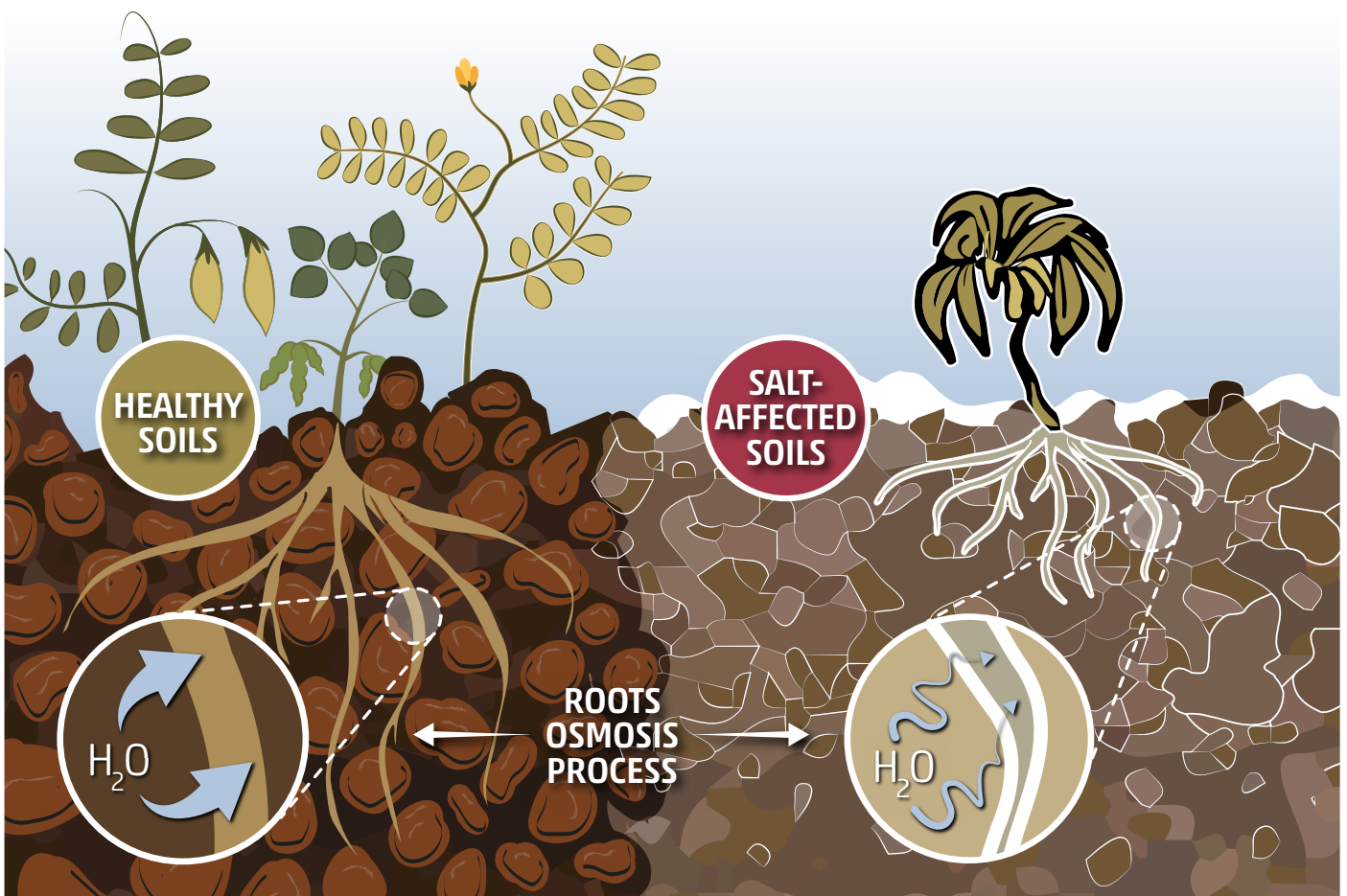


WHAT ARE salt-affected soils?

Salt-affected soils (SAS) include saline, sodic, and saline-sodic soils- and many sub-categories depending on the type of salts. Saline soils contain an excessive amount of soluble salts that reduces the ability of plants to take up water from soil. Only specially adapted plants - halophytes and salt tolerant crops - can grow well in these

soils. Sodic soils contain high amounts of adsorbed sodium ions which causes the degradation of the soil structure. As a result, aeration and water movement is restricted within sodic soil. Both saline and sodic conditions considerably reduce the agricultural productivity of these soils (Figure 1).

FIGURE 1
Impact of salts on plant growth



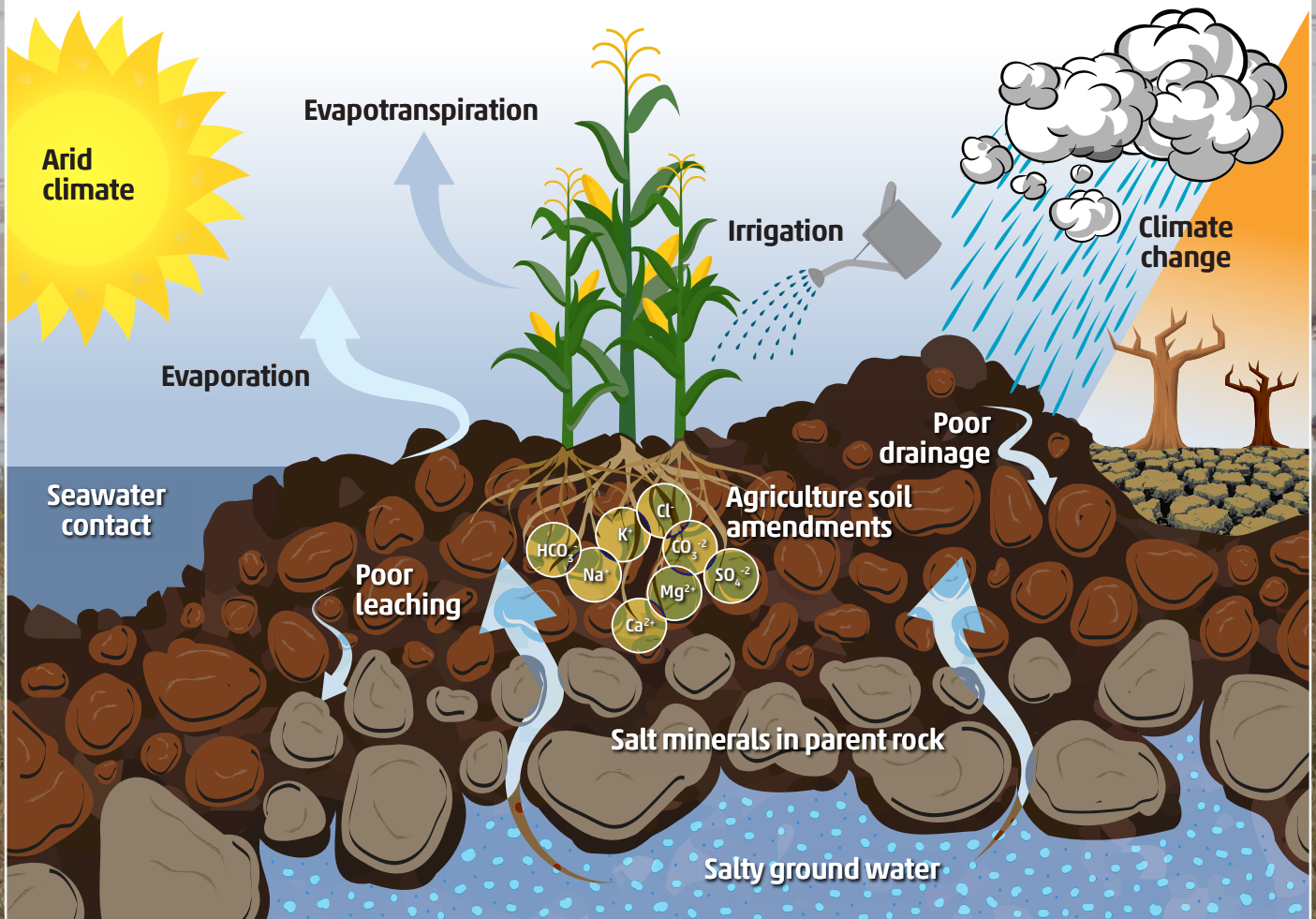
WHAT ARE THE MAIN CAUSES of salt-affected soils?



Soils that may have naturally elevated salt levels are dominant in coastal areas and in arid/semi-arid areas with restricted drainage. Soils that are not naturally salt-affected soils can also experience high salt accumulation due to unsustainable management practices including the use of low-quality irrigation water, inadequate irrigation methods, poor drainage, removal of deep-rooted vegetation resulting in raised water table, mismanagement of agricultural soil changes and fertilizers, and water

pumping in coastal plains. Climate change exacerbates the accumulation of salts in soils due to dryland expansion, water scarcity, as well as a rise in sea levels causing saltwater intrusion in coastal areas (Figure 2). In these cases, salts gradually accumulate in the soil, starting as a small hidden problem and progressing to severe degradation if not adequately managed. These types of salt problems may be found in many parts of the world.

FIGURE 2
Factors influencing salt accumulation in the soil



WHAT ARE THE IMPACTS of salt-affected soils?



Salt-affected soils have serious impacts on some of the ecosystem services soils usually provide, which are critical for supporting human life and biodiversity leading to an array of consequences including:

- decreased agricultural productivity, water quality, soil biodiversity, and increased soil erosion;
- decreased ability to act as a buffer and filter against contaminants;
- degraded soil structure;
- decreased functions of ecological systems such as the hydrological and nutrient cycles;
- increased concentration of ions that are toxic to plants;
- reduced ability of crops to take up water;
- reduced soil fertility and availability of micronutrients.



WHERE DO WE FIND salt-affected soils around the world?



The Global Map of Salt-Affected Soils (GSASmap) represents the spatial distribution of salt-affected soils with $EC^1_e > 2$ dS/m and/or $ESP^2 > 15\%$ and/or $pH > 8.2$ at two depth intervals (0-30 cm and 30-100 cm).

The types of salt-affected soils are described in Table 1. All layers of GSASmap are made available through the GloSIS portal (<http://54.229.242.119/GloSIS>).³

The GSASmap includes a set of eight layers:

- I. EC in 0-30 cm;
- II. EC in 30-100 cm;
- III. ESP in 0-30 cm;
- IV. ESP in 30-100 cm;
- V. pH in 0-30 cm;
- VI. pH in 30-100 cm;
- VII. types of salt-affected soils in 0-30 cm;
- VIII. types of salt-affected soils in 30-100 cm.

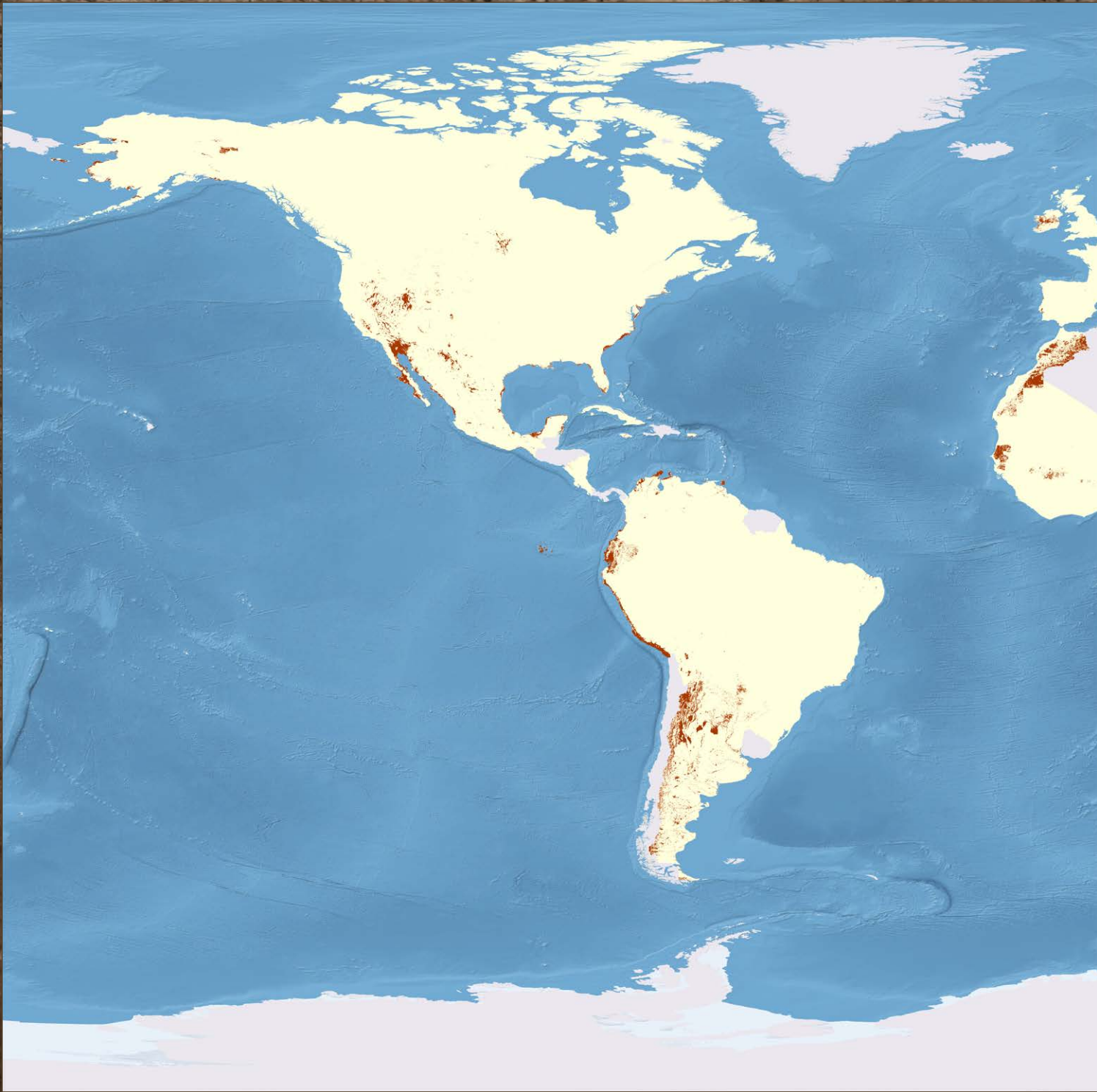


¹ EC IS ELECTRICAL CONDUCTIVITY OF SOIL SATURATED PASTE EXTRACT, IN DS/M

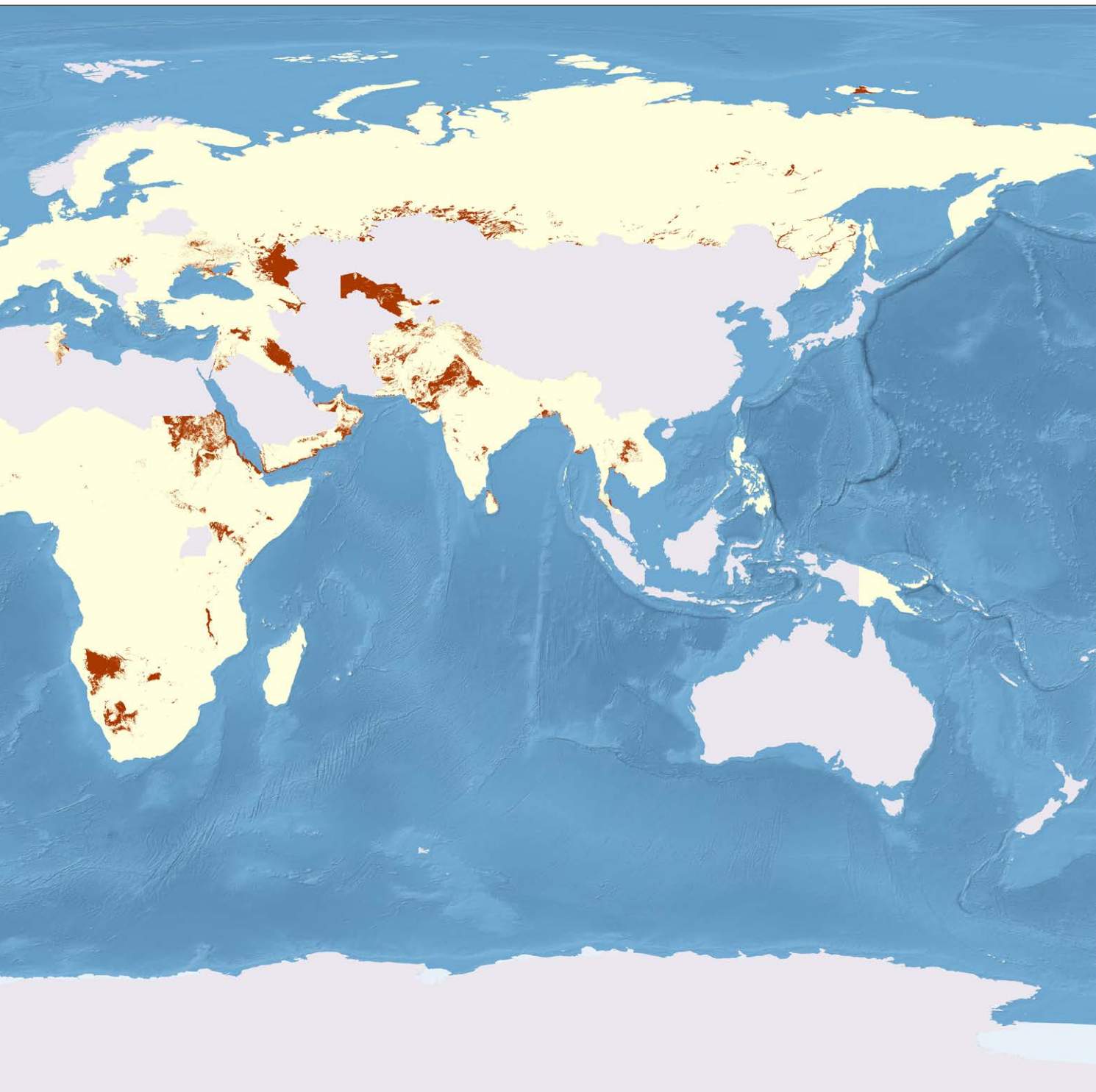
² ESP IS THE EXCHANGEABLE SODIUM PERCENTAGE, IN %

³ THE DETAILED INFORMATION ABOUT THE STATUS OF SALT-AFFECTED SOILS AT THE NATIONAL LEVEL WILL BE CONTAINED IN THE GLOBAL STATUS OF SALT-AFFECTED SOILS REPORT WHICH WILL COMPLEMENT THE GLOBAL MAP OF SALT-AFFECTED SOILS. THE LAUNCH OF THE GLOBAL REPORT ON THE STATUS OF SALT-AFFECTED SOILS IS SCHEDULED FOR DECEMBER 5, ON WORLD SOIL DAY (WSD) 2021.

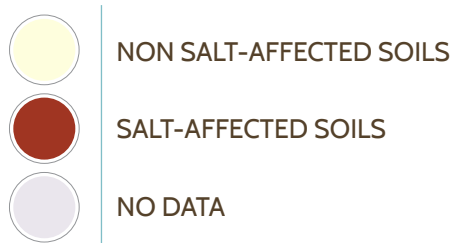
GSASmap v1.0



Salt-affected soils

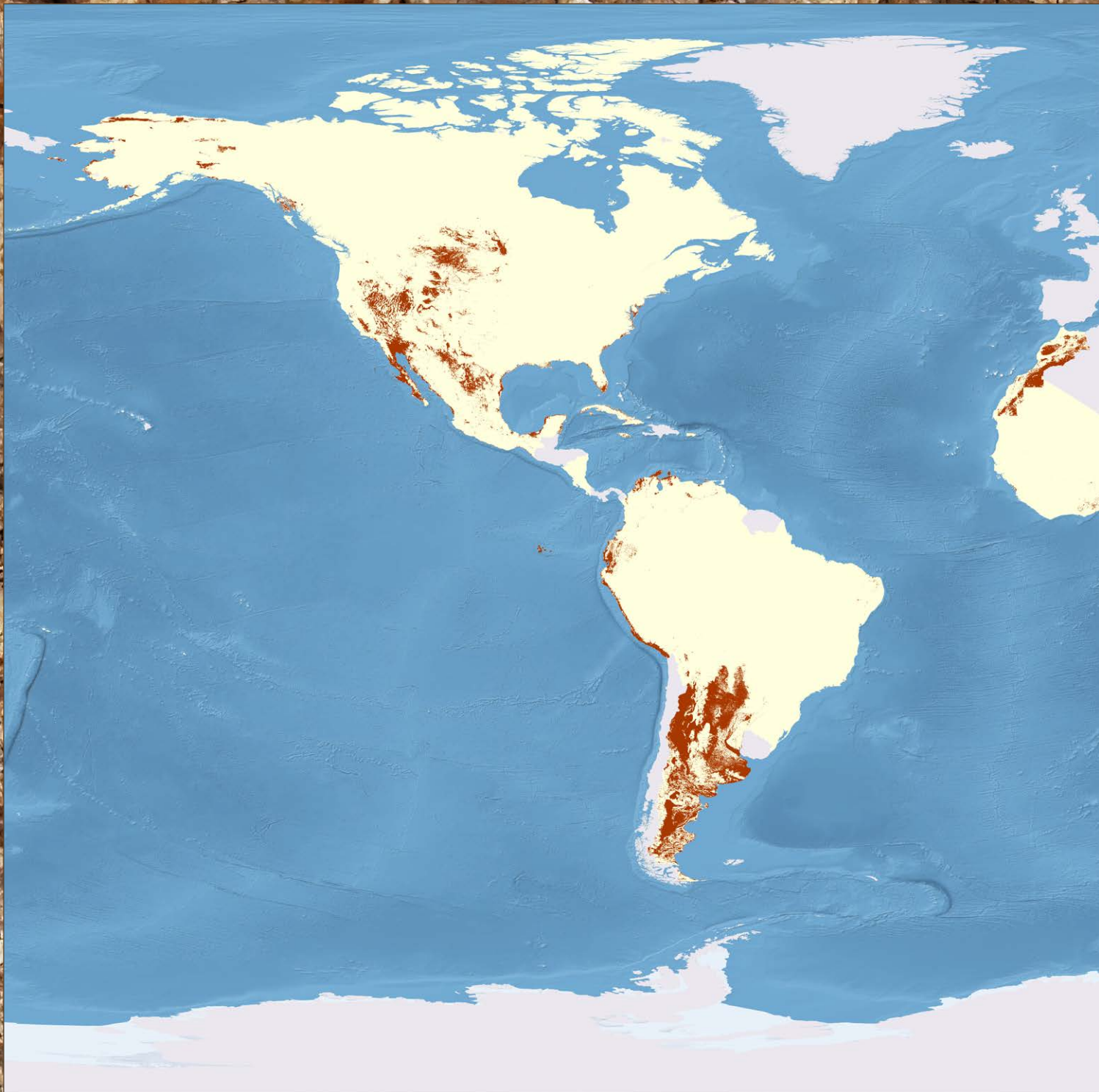


BACKGROUND LAYER: NATURAL EARTH II (NATURALEARTHDATA.COM)

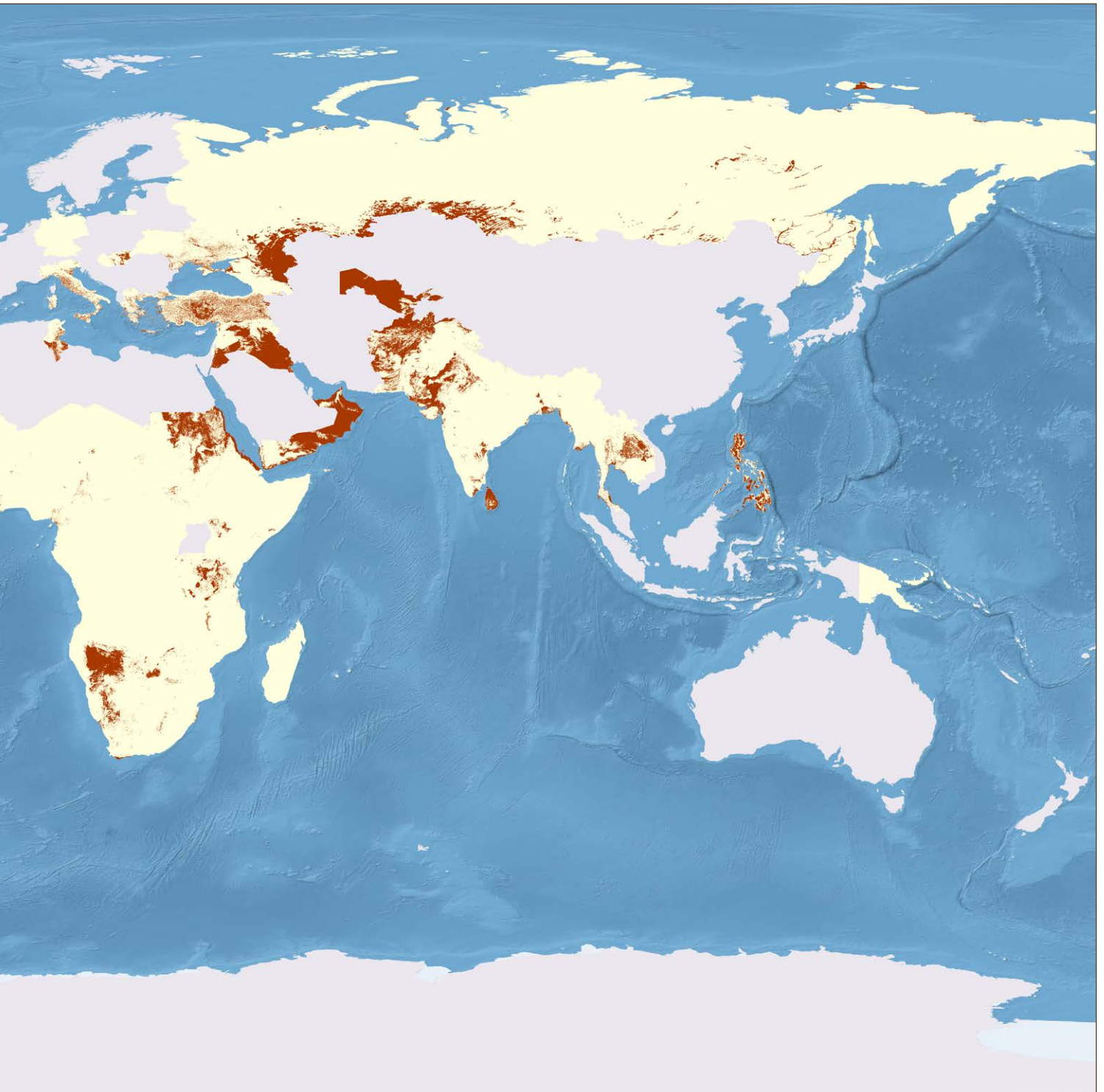


0 - 30 cm

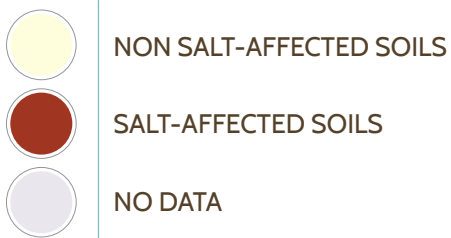
GSASmap v1.0



Salt-affected soils



BACKGROUND LAYER: NATURAL EARTH II (NATURALEARTHDATA.COM)



30 - 100 cm

TABLE 1

The types of soil salinity and sodicity

EC _e , DS/M	SALINITY INTENSITY ⁴	EFFECT ON CROP GROWTH ⁵	ESP, %	SODICITY HAZARD
<0.75	None	None	<15	None
0.75-2	Slight	None	15-30	Slight
2-4	Moderate	Yields of sensitive crops may be restricted	30-50	Moderate
4-8	Strong	Yields of many crops are limited	50-70	High
8-15	Very strong	Only tolerant crops yield satisfactorily	>70	Extreme
>15	Extreme	Only a few very tolerant crops yield satisfactorily		

The GSASmap currently indicates that more than 424 million hectares of topsoil (0-30 cm) and 833 million hectares of subsoil (30-100 cm) are salt-affected:

- 85% of salt-affected topsoils are saline, 10% are sodic and 5% are saline-sodic
- 62% of salt-affected subsoils are saline, 24% are sodic and 14% are saline-sodic.

These estimates, based on the submitted data (118 countries covering 73% of the global land area), show that more than 4,4% of topsoil and more than 8,7% of subsoil of the total land area is salt-affected.

More than two thirds of global SAS are found in arid and semi-arid climatic zones:

- 37% of SAS are located in arid deserts
- 27% of SAS are distributed in arid steppe (half in cold arid steppe and half in hot arid steppe)

⁴ FAO. 2006. GUIDELINES FOR SOIL DESCRIPTION. 4TH ED EDITION. ROME, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS. 97 PP.

⁵ ABROL, I.P., YADAV, J.S.P. & MASSOUD, F.I. 1988. SALT-AFFECTED SOILS AND THEIR MANAGEMENT. FAO SOILS BULLETIN 39. ROME, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO). 131 PP.

TABLE 2
Regional SAS coverage

THE AREA OF SALT-AFFECTED SOILS (MILLION HECTARES)*								
	AFRICA	NORTH AMERICA	ASIA	EUROPE	LAC	NENA	EURASIA	PACIFIC
Topsoil (0-30 cm)	57.2	21.1	63.2	4.4	74.9	97.2	105.8	0.0**
Subsoil (30-100 cm)	67.9	48.0	120.0	10.8	227.5	176.1	182.1	0.0**

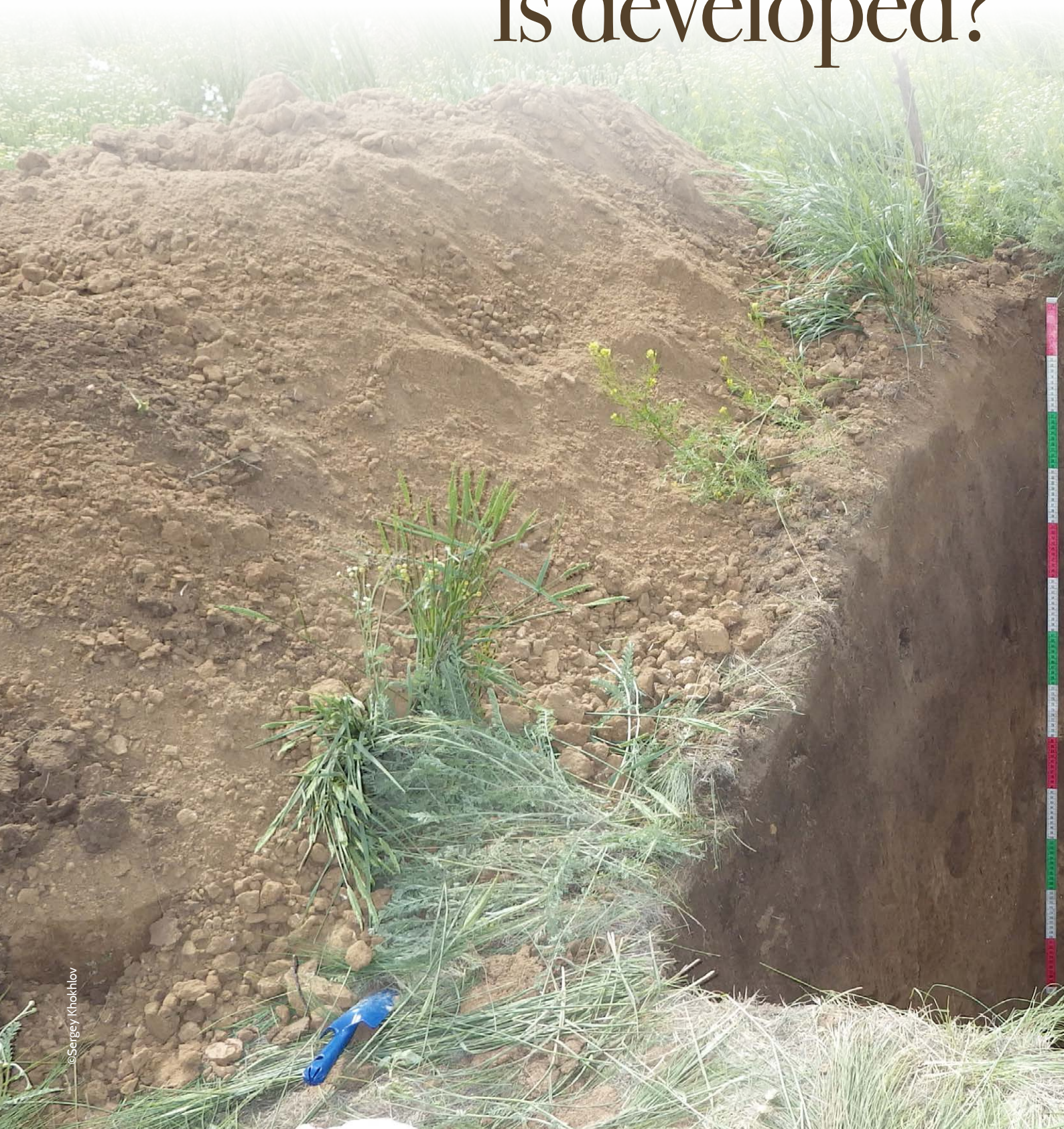


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* FIGURES ARE BASED ON THE DATA SUBMITTED BY COUNTRIES WITH $EC_e > 2$ DS/M AND/OR $ESP > 15\%$ AND/OR $PH > 8.2$

** DATA FROM SIX SMALL ISLAND DEVELOPING STATES (SIDS) SHOWING BELOW 0.1 MILLION HECTARES

HOW the GSASmap is developed?



The current version of GSASmap is a product containing contributions from over 118 countries in 257 419 locations containing measured soil data. More than 350 national experts were involved in the harmonization of its input data and methods for mapping salt-affected soils and were trained in state-of-the-art methods for digital soil mapping. Every country then produced their maps following the agreed technical specifications⁶.

Some countries did not prepare their maps because of a lack of data, capacities or because they were not affected by SAS, and in those cases the map was not complete. However, the GSASmap is a living product and the total global coverage will increase in the next approximations of the GSASmap. This participatory country-driven process offers more opportunities for future periodic update, which is an important aspect that has been missing from previous global SAS information.

⁶ OMUTO, C.T., VARGAS, R.R., EL MOBARAK, A.M., MOHAMED, N., VIATKIN, K., YIGINI, Y. 2020. MAPPING OF SALT-AFFECTED SOILS: TECHNICAL MANUAL. ROME, FAO [HTTPS://DOI.ORG/10.4060/CA9215EN](https://doi.org/10.4060/ca9215en)



HOW CAN WE USE the GSASmap?



1. The GSASmap is an important tool for identifying salt-affected soils where sustainable soil management practices should be adopted to halt salinization and sodification.
2. It is a foundation for launching a monitoring framework to track soil salinization and sodification and move into early detection and management.
3. As a knowledge product, the map provides useful information for developing evidence-based decisions for conserving natural salt-affected ecosystems, sustainably managing SAS, and restoring areas that had lost their original potential due to salt accumulation.
4. The map can support evidence-based decision making for interventions related to agro-food systems, climate change adaptation and irrigation projects.





The Global Soil Partnership (GSP) is a globally recognized mechanism established in 2012. Our mission is to position soils in the Global Agenda through collective action. Our key objectives are to promote Sustainable Soil Management (SSM) and improve soil governance to guarantee healthy and productive soils, and support the provision of essential ecosystem services towards food security and improved nutrition, climate change adaptation and mitigation, and sustainable development.



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