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Too Much Salt: The Growing Threat that Salinity Poses to Global Food Production

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Key Points

- Salt affected soils are present in more than 100 countries and irrigation is often a major contributing factor.
- As irrigation is used to produce 40 per cent of the global food supply, an increase in salt-affected land caused by careless irrigation practices is likely to decrease global food security and economic productivity.
- Salinisation is more likely to occur in arid and semi-arid climates, where there is a rising demand for water for irrigation to support agricultural production.
- There have been many attempts to solve the issue, but existing methods are often costly and are not easily accessible for smallholder farmers.

Summary

Soil salinity is a brutal environmental issue that limits crop productivity, because most crop plants are sensitive to salt. Salinisation can be caused by natural processes, such as mineral weathering or the gradual withdrawal of an ocean. It can also come about through artificial processes, such as the use of irrigation and road salt. Poor irrigation techniques have increased salinity in much of the world's farmland. Soil salinisation threatens major economic losses for countries with large agricultural sectors, both by lowering the available crop yield and the costly methods used in trying to solve the issue. So far attempts to deal with the problem have been largely unsuccessful, with the costs making the techniques inaccessible for smallholder farmers.

Analysis

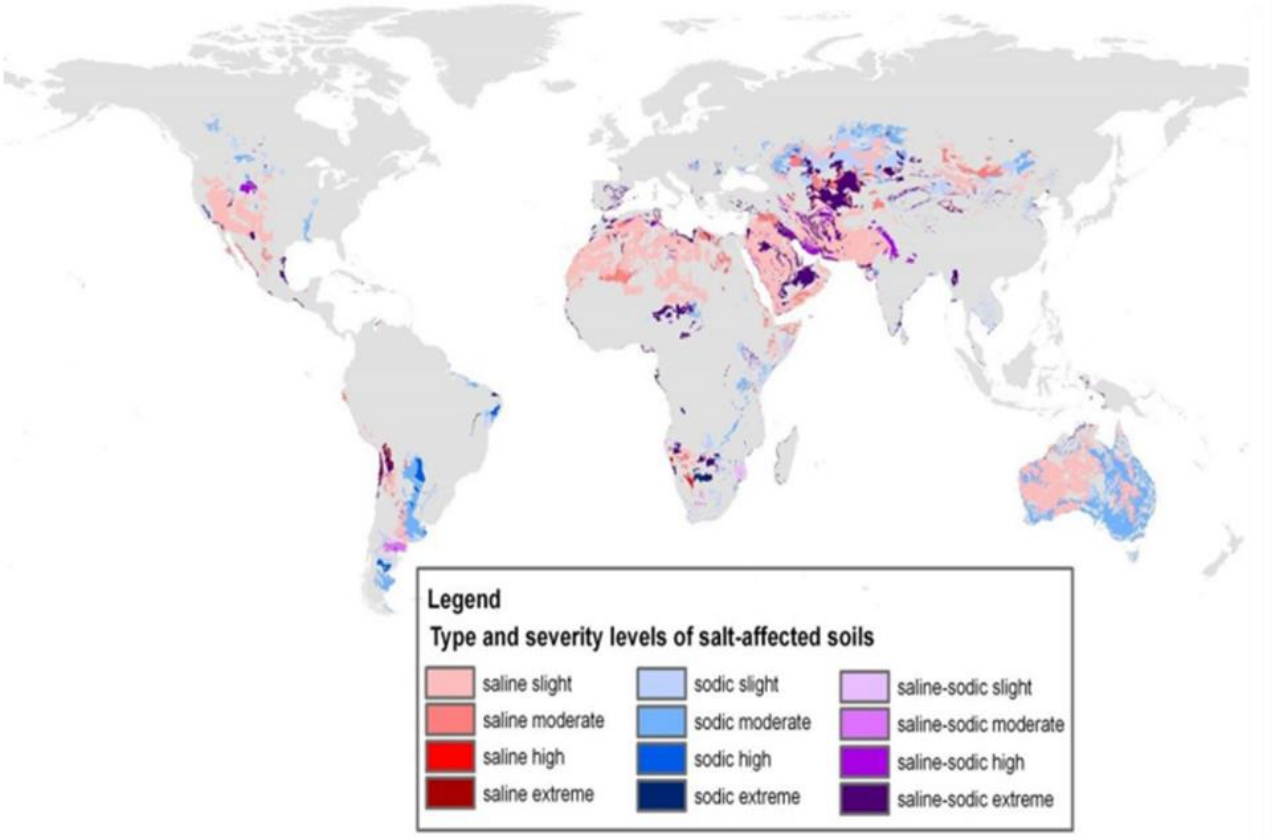
Irrigation plays an important role in food production, as it helps the world to keep pace with increases in food demand associated with increasing populations. Irrigation is used on 20 per cent of the world's cropland, but helps to produce 40 per cent of the world's food. Irrigated agriculture is likely to play an even larger role in global food security, as about half, or even two-thirds, of future gains in crop production are expected to come from irrigated land.

With the growing use of irrigation as a method to achieve global food security, the risk of salinisation increases. Salt contamination, which leads to stunted and uneven plant growth, is already estimated to affect 20 per cent of cultivated land worldwide. Soil salinisation has long been a looming issue for global agriculture, with about one billion hectares of agricultural land being affected globally; 60 million hectares damaged by salinisation and a staggering 76 million hectares of arable land permanently lost. While salt-affected land can still produce crops, albeit at a lower yield, cultivated land that is damaged will not be able to produce any agricultural product because it is affected to such an extent that nothing will grow. If rising global salinity is not addressed, it could pose a real threat to the world achieving the 70 per cent increase in food production that the United Nations has projected will be needed by 2050.

Soil salinisation is caused by two different processes. Primary salinisation results from an accumulation of salts over long periods of time, through natural processes, such as wind and rain depositing oceanic salts on nearby soils. The effects of secondary salinisation, however, are much more severe; it results from humans disturbing the water balance in the soil, mainly through the use of irrigation. Consequently, irrigation, if not planned and managed properly, can result in increased soil salinisation. Water used for irrigation is not always pure and often contains minerals, including sodium and calcium salts. When the water evaporates, salt is left around the roots of plants, preventing them from absorbing water, stunting growth and contaminating drinking water supplies. Soil salinity is a very real and serious issue and is likely to become more serious in the future.

While salinisation is a global issue, the severity differs between regions. Arid and semi-arid regions are most affected, as the soil in these regions is already slightly saltier than in temperate regions, and farmers in those regions are more likely to rely heavily on irrigation to grow crops to meet food demand.

Central Asia and the Middle East and Northern Africa (MENA) are good examples of this and suffer most from increasing salt levels in their soils. Climatic conditions in these regions, especially in MENA, are some of the harshest in the world and they have little land available for agricultural production. Furthermore, as the populations in Central Asia and MENA are predicted to increase by 2050, food production must also increase to meet the expected growth in demand. Irrigation is the only way to increase food production in these regions, but it is likely to also increase the risk of salinisation.



Source: Saline Agriculture Worldwide

Salinity could also destroy the soil structure, which would restrict water infiltration and limit productivity. A large proportion of salt-affected soils in irrigated areas occur on small farms with limited access to resources. Smallholder farmers often do not have the resources to treat and manage their soil to prolong its lifespan. They are also more likely to relocate if the soil becomes particularly degraded.

With the ongoing severity of climate change, the increasing heat in the earth's climate has also led to an increase in salt levels in soils globally. In some regions, climate change has increased sea levels and decreased water flows in river mouths, causing the low-lying coastal areas to soak up more salt water, gradually contaminating the soil. That salt is dissipated by rainfall, but climate change is also increasing the frequency and severity of extreme weather events, including droughts and heat waves. This leads to more intensive use of groundwater for drinking and irrigation, which depletes the water table and allows even more salt to leach into the soil. Climate change also causes heat stress, which puts great strain on groundwater resources and increases saline contamination of inland soils. This process is already affecting parts of Australia, Sub-Saharan Africa and California.

Table 2.3
Global estimates of secondary salinization in the world's irrigated lands. (Summarized from Ghassemi et al. 1995; Mashali 1995)

Country	Area (mha)		
	Cropped	Irrigated	Salt-affected[a]
China	97.0	44.8	6.7 (15)
India	169.0	42.1	7.0 (17)
Commonwealth of independent states	232.5	20.5	3.7 (18)
United States of America	190.0	18.1	4.2 (23)
Pakistan	20.8	16.1	4.2 (26)
Iran	14.8	5.8	1.7 (29)
Thailand	20.0	4.0	0.4 (10)
Egypt	2.7	2.7	0.9 (33)
Australia	47.1	1.8	0.2 (11)
Argentina	35.8	1.7	0.6 (35)
South Africa	13.2	1.1	0.1 (9)
Subtotal	**842.9**	**158.7**	**29.7 (19)**
World (Total)	**1474**	**227**	**45 (20)**

[a]Salt-affected soils within the irrigated area; values in parentheses are percentage

Source: Food and Agriculture Organization

High levels of salt can also cause permanent damage to the land and if salinisation goes unchecked, more land will be at risk of becoming highly degraded, potentially leading to large tracts of wasteland in agriculturally important parts of the world. Furthermore, a reduction in crop yields threatens the livelihoods of smallholder farmers and their ability to feed themselves. A farmer in Vietnam, who is affected by salinisation, stated that in the past ten years the soil was ok to farm, but now barely anything grows, due to salinisation of both the soil and water. The farmer also states that she needs to grow rice to feed her family and make a small living, but now that the water in the region is unusable for her crops, she has to venture out to buy fresh water, adding a cost that increases her difficulties.

The cost of repairing lands that have been damaged, or even partly affected, by salinisation is often very expensive (especially for smallholder farmers) and the process is very slow. Soil restoration projects can take generations to return the soil to a condition suitable for agriculture. While projects to mitigate salinisation prove to be less time consuming and have a shorter time-frame, the costs are often still steep and would be unbearable for smallholder famers. As the need to increase agricultural production to meet rising food demand becomes more apparent, the need to solve this issue is of grave importance.

Land affected by primary salinisation tends to be near the coast and is more likely to be affected by salt-water intrusion caused by higher sea levels, reduced water flow in rivers or land subsidence. Developing salt-tolerant crop varieties and farming methods, while funding infrastructure projects designed to prevent saltwater flooding, would help coastal farms remain viable. As climate change continues to increase, storms and floods are likely to become more frequent in coastal regions. Infrastructure to protect coastal areas will be required, but the cost of those infrastructure projects is likely to be high and might not be a priority for poorer countries, which are often the most likely to be adversely affected.

It has been proven that there are varieties of vegetation that are more salt tolerant than others, such as barley, sunflowers and canola. These types of cash crops are a good substitute for small farmers who are trying to grow crops in saline soil; they provide a large return on investment, and are not as expensive as funding additional irrigation infrastructure. Even though these crops are salt-tolerant, however, they will still be affected eventually by salinisation if poor irrigation practices continue.

Restoring the balance of inputs and outputs of the soil-water system, by controlling the process of groundwater recharge, is one of the most reliable methods for reducing the spread of salinity. That can take time, however, and is not always the easiest course of action. Restoring vegetation, where it is appropriate to do so, is often a quicker and more effective solution. In dryland areas, the large-scale establishment of deep-rooted trees will be required to restore the water balance. In high rainfall areas, plantation forestry may be one means of achieving the scale of tree planting required. Deep-rooted perennial pastures are more likely to be effective in lower rainfall areas. In irrigation regions, control techniques may include more efficient irrigation, drainage and reuse systems, groundwater pumping and techniques of land preparation that facilitate surface drainage and water application.

Salinisation has been an environmental hazard for most of human agricultural history and will continue to be so, especially with climate change threatening to accelerate the process. With salinisation becoming more severe and widespread, there is a fear that the world might be unable to produce enough food to meet increased demand. Countries located in arid or semi-arid climates have limited amounts of cultivated land to produce food, but are the most likely to experience salinisation due to their heavy reliance on irrigation. Increased salinisation in those regions could contribute to the creation of other problems, such as the loss of agricultural jobs and massive socioeconomic upheavals in affected countries.

The need for a controlled environment for agriculture is essential; it requires a balance in the soil-water system, which will prevent the water table from coming too close to the surface. Greater use of irrigation will be necessary to lift global crop yields, but it will need to be used with care, to ensure that it avoids damaging essential agricultural land.

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