Food and Agriculture Organization of the United Nations

Sand and dust storms (SDS): A transboundary issue of growing concern

SDS are complex environmental phenomena, the result of a series of interlinked natural and anthropogenic drivers operating at different scales. They have gained growing attention in the past decade due to their impacts on the environment and a range of socioeconomic sectors. SDS result in land degradation and production losses on croplands and rangelands. Transport is disrupted by reduced visibility and sand deposits that block roads. There are numerous impacts on health – for people, plants and animals – and dust deposited on solar panels results in less electricity being produced. Economic losses from a single SDS event can cost hundreds of millions of US dollars.

WIND EROSION

SDS occur when strong, turbulent winds raise clay, silt and sand particles typically from desert and semi-desert landscapes. These fine particles are released from dry soils, with little or no vegetation cover.

This natural process can be accelerated by human activities that result in the removal of vegetation, hydrological changes, and/or disturbance of soil surfaces.

Movement of desert dust through the so-called dust cycle is a natural part of the Earth system, a component of several biogeochemical cycles. Many SDS impacts are negative for human society, but not all.

Some dust movement is necessary for Earth system functions: dust in the atmosphere affects our planet's energy balance, and dust deposition delivers nutrients to terrestrial and marine ecosystems.

NATURAL AND ANTHROPOGENIC SOURCES

About two billion tons of sand and dust are emitted from the world's drylands each year. An estimated 75 percent of these global dust emissions come from natural sources; 25 percent from anthropogenic sources[1].

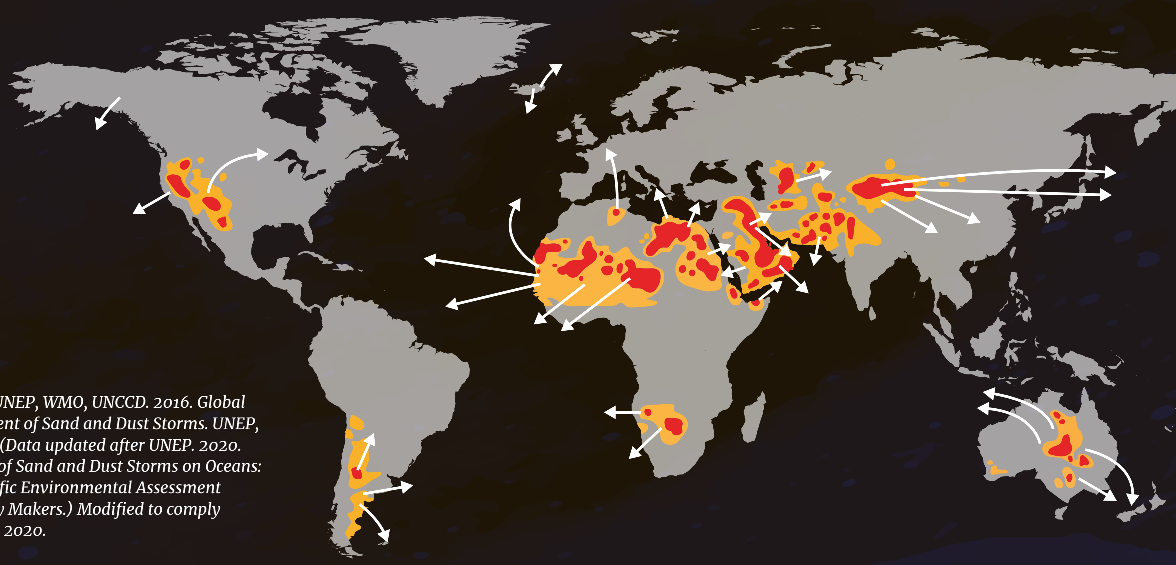
Unsustainable agricultural practices that lead to land degradation are a major driver of anthropogenic SDS sources. SDS frequently transport dust over thousands of kilometres, crossing national boundaries and taking dust and its problems far beyond dryland environments.

SDS, CLIMATE VARIABILITY AND CHANGE

SDS increase during periods of drought, due to reduced vegetation and drier soils, as many historical examples demonstrate (e.g. US Dust Bowl 1930s; Sahel 1970s/80s; Australia's "Millennium Drought" late 1990s-mid-2010). The IPCC (AR6 WGI, 2021[2]) warns that the land area affected by increasing drought frequency and severity will expand as global warming increases.

The complexity of predicting changes in many variables means that future climate change trends in SDS are uncertain, but the implications for SDS of increasing droughts and reduced vegetation cover are clear.

Major global SDS sources and long-distance transport pathways[3]



Source: UNEP, WMO, UNCCD. 2016. Global Assessment of Sand and Dust Storms. UNEP, Nairobi. (Data updated after UNEP. 2020. Impacts of Sand and Dust Storms on Oceans: A Scientific Environmental Assessment for Policy Makers.) Modified to comply with UN, 2020.

The boundaries and names shown and the designations used on this/these map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

[1] https://wedocs.unep.org/handle/20.500.11822/7681
[2] https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/
[3] Modified after https://www.unep.org/resources/report/impacts-sand-and-dust-storms-oceans

SDS and agriculture

The relationship between SDS and agriculture is twofold. On one hand, agriculture is a major anthropogenic driver of SDS – via poor land and water management, desertification and land degradation. On the other hand, SDS also have direct impacts on agriculture, resulting in the loss of crops, trees and livestock or significant decreases in their production, so also causing land degradation. Additionally, in some places, cropland and rangeland receiving deposits blown from other sources may be degraded in consequence, as when saline material is eroded from dry lakebeds. The socioeconomic impacts of these issues fall disproportionately on those with least capacity to cope, including smallholders and people living in poverty.

SDS AND DESERTIFICATION/LAND DEGRADATION

SDS are related to desertification/land degradation in complex, multi-faceted and synergistic ways. Wind erosion on productive land reduces soil productivity by removing soil particles, nutrients, seeds, fertilizers, organic carbon and beneficial microorganisms. The loss of fine particles is also detrimental to soil structure and reduces a soil's capacity to retain water.

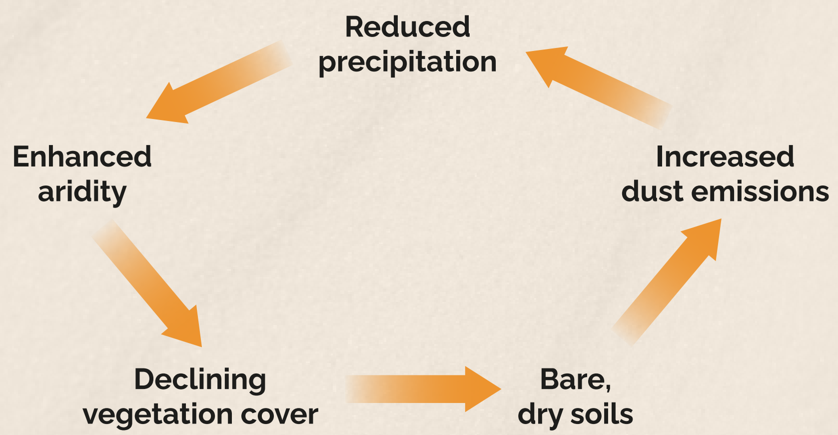
Overall, the loss of topsoil due to SDS readily translates into a measurable decline in crop yields and pasture quality. Grassland may also be covered by sand, thick dust clouds represent a hazard to livestock, animals can be lost when visibility is reduced, and livestock shelters damaged in strong winds.

DUST-DROUGHT FEEDBACK

Large-scale emissions of soil dust into the atmosphere during drought periods may act to suppress precipitation further through self-reinforcing "positive feedback".

Drier than normal conditions resulting in less vegetation cover and drier, more friable soils typically create more SDS. Analyses using computer models indicate that this feedback process may have effectively prolonged and intensified droughts in the US Great Plains during the 1930s and in Sahelian Africa in the 1970s and 80s.

Positive feedback between SDS and drought



NUTRIENT DELIVERY

In some cases, soil particles and nutrients eroded from one area can bring benefits to soils in areas where the material is deposited. Some plants may also gain nutrients from dust deposited on the leaf surface.

There is evidence to indicate that plants that evolved in dust-rich ecosystems (e.g. chickpea and wheat) have adopted specialized utilization strategies to obtain nutrients by direct foliar uptake. However, many plants are very sensitive to dust (e.g. soft fruits) and are easily damaged.

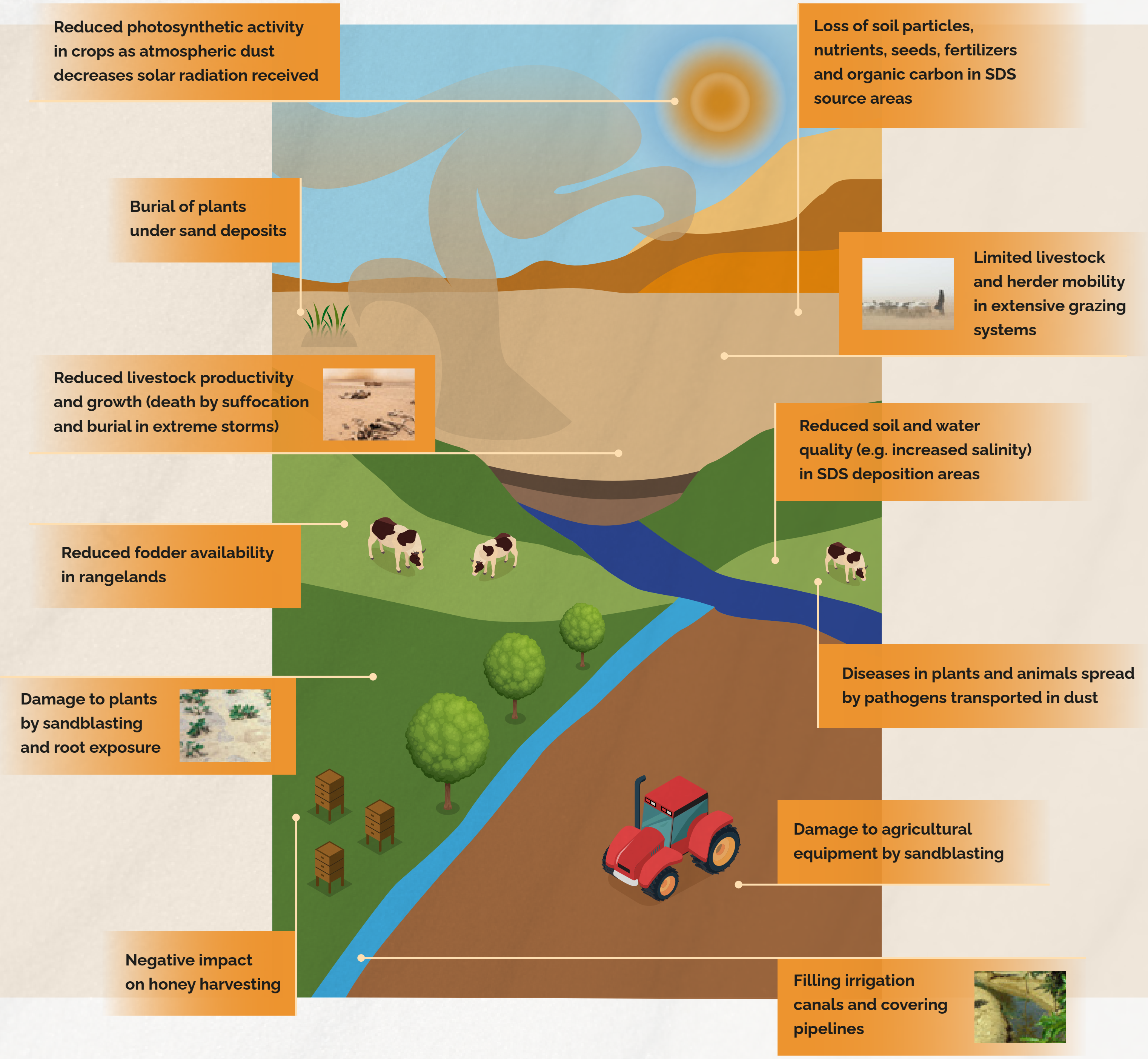
SOME ASPECTS WE DO NOT KNOW

There are few economic impact assessments of SDS in agricultural sectors and those that have been conducted use a variety of methods, making comparisons difficult.

We also have limited understanding of how SDS relate to disease outbreaks among farmers and herders as well as their crops and livestock, although the small number of studies conducted indicate that many SDS include large numbers of highly resilient microorganisms, some capable of causing disease in people, plants and animals.

Links between SDS and fisheries are also poorly understood, but desert dust generated by SDS provides a major source of nutrients and trace metals to the oceans, with effects on ocean primary production.

Impacts of SDS on agriculture and food security[4]



SDS TIMING

When SDS happen is as important as where they occur. In spring months, SDS may blow with sub-zero temperatures, the extreme wind-chill further weakening livestock at the end of winter. Smaller animals, sheep and goats in particular, can quickly become exhausted and die of exposu-re. Some stages in plant growth are also more vulnerable to SDS impact than others. Seedlings and sprouting plants – field crops as well as gras-ses and fodder plants – are easily destroyed. A farmer's field is also more susceptible to wind erosion when its soil is relatively bare, just after ploughing or harvest.

[4] Modified after https://apdim.unescap.org/knowledge-hub/sand-and-dust-storms-risk-assessment-asia-and-pacific

Tackling SDS

The transboundary nature of the SDS challenge highlights the critical importance of global, regional and national coordination and cooperation, particularly with increasing frequency and severity of SDS impacts. This includes the exchange of expertise, experiences and good practices, and the availability of data. Combined efforts are also needed to build capacities, strengthen long-term preventative measures such as SLM, promote SDS early warning, raise awareness, plan and mobilize resources, to support countries in embedding and implementing SDS issues as part of integrated disaster risk reduction (DRR) interventions. When SDS do occur, a coordinated response is required, along with planning to promote coping strategies within and across sectors. SDS risks can be reduced, and their impacts mitigated, through well-planned and systematic combinations of SDS source mitigation measures and the preventative and anticipatory approaches of DRR and risk management.


© FAO/Giulio Napolitano

Addressing Sand and Dust Storms in the agriculture sectors

IMPACT MITIGATION

- **Risk / impact assessment and vulnerability mapping**
- **Integrated monitoring, prediction and early warning**
- **Structural stabilization measurements through e.g. windbreaks, agroforestry, sand dune stabilization and afforestation**
- **Preparedness and emergency response and procedures**

SOURCE MITIGATION

- **sustainable land and water management**
- **Integrated landscape management**
- **Rangeland management**

For more information:
www.fao.org/land-water/land/sds/

Contact:
land-water@fao.org

SUSTAINABLE LAND MANAGEMENT (SLM)

SLM can play an important role in preventing SDS occurring at source and in enhancing mitigation and adaptation, while simultaneously optimizing natural resource use and restoring productivity. SLM promotes vegetation cover to protect soils, reduce local wind speeds and increase soil stability. Sustainable management of water resources, such as the use of raised-bed/furrow irrigation techniques to substitute for flood irrigation, will keep the soil wet for longer, reducing its susceptibility to wind erosion at field level. In the livestock sector, sustainable methods of rangeland management can achieve the same ends. They include encouraging mobility to spread grazing pressures and the use of enclosures to protect certain pastures and young growing trees.

RISK, VULNERABILITY AND CAPACITY ASSESSMENTS AND MULTI-HAZARD DRR PLANNING

Assessing the risks and vulnerabilities posed by SDS is a critical step towards reducing them. Assessing institutional capacities, sector-specific exposure and needs are also key. SDS impacts are best mitigated when effective DRR measures are established as part of long-term strategies and agricultural policies. Development and implementation of sector-specific contingency plans and Standard Operating Procedures will also help reduce adverse SDS impacts in agriculture. Regular dust monitoring, forecasting and early warning measures are equally important, to produce alerts about potentially harmful impacts. Herders, for instance, may gain the time needed to move their animals into shelters before SDS strike, given adequate and timely warning.

JOINT AND COORDINATED ACTION

The United Nations has voiced considerable concern about the growing threat of SDS. Recent resolutions entitled "Combating sand and dust storms" warn that they may undermine the achievements of the Sustainable Development Goals. Hence, a United Nations Coalition on Combating Sand and Dust Storms was launched in 2019 to prepare a UN response to this transboundary issue, and to support countries and regions in their efforts to combat SDS. The Coalition became operational under FAO leadership and is moving from the planning to implementation stage, joining forces with countries to mobilize resources and awareness, both key elements in promoting global action to combat SDS.

CC0109EN/1/05.22