Guideline on the Integration of Sand and Dust Storm Management into Key Policy Areas

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1. Introduction

This **Guideline on the Integration of Sand and Dust Storm Management into Key Policy Areas** ("Guideline") is designed to assist regions and countries with the management of sand and dust storms (SDS) sources and their impacts. The Guideline responds to a decision adopted by the Conference of the Parties (COP) to the United Nations Convention to Combat Desertification (UNCCD) at its 15th session which:

> *Reiterated that the global frequency, intensity, and duration of SDS have increased in the last decade and that SDS have natural and human causes that can be exacerbated by desertification, land degradation, drought, biodiversity loss, and climate change.*
>
> *Requested the secretariat and the Global Mechanism, within the scope and mandate of the Convention and in collaboration with partners, to develop a voluntary policy guideline, in consultation with countries affected by sand and dust storms, to assist in the integration of sand and dust storms management into key policy areas.*[1]

The Guideline is voluntary and intended for use by regional, national, and sub-national policymakers and decision makers tasked with developing and implementing sectoral and cross-sectoral initiatives (e.g., agriculture, natural resources, human health, infrastructure) to manage SDS sources and impacts. It builds upon the **UNCCD Policy Advocacy Framework for Sand and Dust Storms** which outlines the principles and enabling factors for designing and applying proactive policy approaches to mitigate SDS sources, reduce their socioeconomic impacts, and enhance community and ecosystem resilience.[2]

The Guideline aims to raise awareness on development issues related to SDS risk, vulnerability, and exposure, and to highlight the need for scientific assessments and actionable data that can inform the implementation of policies, strategies, and action plans to address SDS hazards in key policy areas. It recognises that the socioeconomic impacts of SDS are often not fully appreciated or considered as part of disaster planning and risk reduction efforts by authorities. As a result, investments are often far less than what is needed to address the extent and magnitude of SDS events. Incorporating SDS into disaster risk reduction, development, and climate finance can significantly expand the pool of resources available to reduce SDS sources and impacts as part of an integrated strategy to achieve long-term development priorities.

The Guideline advocates for the integration of SDS policy and implementation frameworks into regional and national strategies and action plans that have been or are being formulated to achieve the Sustainable Development Goals (SDGs), Land Degradation Neutrality (LDN), Paris Agreement, Sendai Framework for Disaster Risk Reduction, Global Biodiversity Framework, and food security priorities, among others. It is informed by numerous scientific, technical, and evidence-based knowledge resources produced by the UNCCD, the Food and Agriculture Organization of the United Nations (FAO), members of the **UN Coalition on Combatting Sand and Dust Storms**, and other partners and experts from around the world.

[1] UNCCD Decision 26/COP.15. "Follow-up on policy frameworks and thematic issues: Sand and dust storms". ICCD/COP(15)/23/Add.1. https://www.unccd.int/sites/default/files/2022-10/26_cop15.pdf.

[2] UNCCD, 2022. "Policy Advocacy Framework for Sand and Dust Storms". https://www.unccd.int/sites/default/files/2022-10/20220701_Policy-Advocacy-Framework-Sand-Dust-Storms.pdf.

2. Background and Context

As an essential element of the Earth's natural cycles, the atmospheric transport of minerals has been critical to the healthy and productive functioning of terrestrial and aquatic ecosystems.

Nevertheless, approximately 25 per cent of SDS phenomena can be attributed to human activities. These are predominantly the same drivers of desertification, land degradation, and drought, namely climate change, land use change, and unsustainable soil, water, and livestock management.[3] Indirect drivers of SDS include poverty and inequality, poor land governance, resource conflicts, and political fragility. Both sets of drivers must be considered and addressed when developing strategies, policies, and actions to more effectively manage SDS sources and impacts.

SDS have become a serious global concern due to their harmful impacts on food production, environmental and human health as well as on transportation, energy, and built infrastructure. These are the key policy areas addressed in the Guideline. Current trends indicate that continued agriculture expansion and more frequent and severe droughts will make countries more susceptible to SDS risks and hazards. Globally, SDS source areas are found in 45 countries, of which 38 are in Africa and Asia. Every year, an estimated two billion tonnes of fine particles are raised and transported by winds from the world's soil surfaces, impacting over 150 countries.[4]

2.1 SDS Definition

SDS are defined as an ensemble of particles of sand and/or dust energetically lifted to great heights by a strong and turbulent wind.[5]

SDS are considered a meteorological hazard which occurs when wind speed is sufficient to cause mineral soil, sand, and dust particles to move along the ground ("saltation") or into the air ("entrainment"). SDS are primarily composed of silicon particles, but other types of mineral soils can be salted or entrained by winds. SDS particles range in size from 2.5 to 10 microns; in general, the smaller the particle, the longer it can remain in the air and the further it can travel from its source. SDS particles can also carry biological or chemical substances, including bacteria and fungi (e.g., pathogens), chemical compounds (e.g., fertilisers, pesticides, toxins), and other minerals (e.g., uranium) that pose risks to human, plant, and animal health.

While SDS hazards are most prevalent and often localised in the world's drylands, major wind erosion events can transport fine particles over great distances. The impacts can be felt in areas where they originate and in communities sometimes thousands of kilometres from the source. SDS events are recognised as a transboundary challenge of increasing concern, with regional and national implications for food security, water scarcity, land degradation, human health, and sustainable development. In addition to national policies, strategies, and action plans, global and regional cooperation is urgently needed to better manage SDS source areas and the growing hazards they pose to our societies and economies.

[3] UNEP, 2016. "Global Assessment of Sand and Dust Storms". https://wedocs.unep.org/handle/20.500.11822/7681.
[4] Middleton, N. and Kang, U., 2017. "Sand and dust storms: Impact mitigation". *Sustainability,* 9(6). https://www.mdpi.com/2071-1050/9/6/1053.
[5] WMO, 2020. International Cloud Atlas. https://cloudatlas.wmo.int/en/dust-storm-or-sandstorm.html.

2.2 SDS Characteristics

Understanding the type, frequency, and intensity of SDS is an important first step in planning and designing source mitigation and impact management measures.

SDS are common meteorological hazards in arid and semi-arid regions where wind disturbs the layer of topsoil and lifts clouds of tiny dust particles that can roll across the landscape (e.g., dust bowl in the United States). Sand storms are typically limited to desert regions and more contained than dust storms, as sand is heavier and more difficult to be sustained airborne over long distances (e.g., Gobi Desert in China or the Sahara in North Africa). Weather, climate, and geomorphic characteristics – such as topographic depressions or locations near the downwind side of mountain ridges – also contribute to the risk of SDS events. SDS can also have significant impacts on glaciers influencing their physical attributes by reducing albedo, accelerating melting, and altering the hydrological regime of entire basins.[6]

The management of SDS sources and impacts can be enhanced with an understanding of the geological controls and climate states – past, present, and future. The most recognised type of SDS is caused by frontal weather activity, often referred to as a *haboob,* whereby walls of sand and dust are created and propelled by gusts of cold air in front of a thunderstorm (Middle East, North Africa, Australia, North America). Other **meso-scale examples** of SDS include the *harmattan* (from the Sahara over West Africa into the Gulf of Guinea) and the *sirocco* which refers to seasonal wind patterns and lifted dust that originates over North Africa which becomes hot and subsequently humid while blowing north into Southern Europe.

SDS phenomena range from **global-scale events** which result in very low densities of airborne sand or dust over very large areas (e.g., deposition of mineral nutrients from the Sahara in Central and South American rainforests) to **micro-scale episodes** (e.g., sand blasting across agricultural fields and roads, and into settlements and urban areas).

2.3 SDS Source Areas

Globally, there were three times as many natural SDS sources as human-induced sources; however, due to land use change and land degradation over the past few decades, the number, frequency, and size of anthropogenic SDS sources have increased.[7]

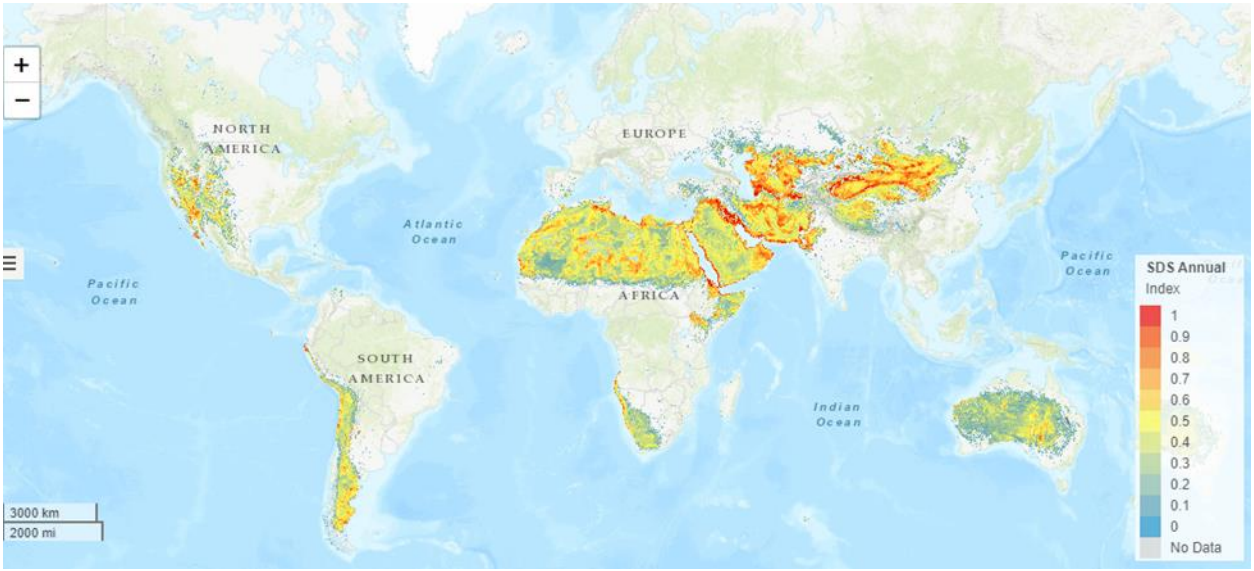
While the causes of SDS source areas are predominantly natural, the Guideline is most concerned with managing those that result from land use and management activities as requested by the UNCCD COP. The most well understood SDS source areas are in the drylands; however, they can manifest in other areas when and where soil conditions are conducive to wind erosion causing saltation or entrainment. Non-traditional SDS source areas have been associated with the warming of the Arctic and high latitude regions, the seasonal or permanent drying of inland waters and river deltas, or following large-scale deforestation and wildfires, volcanic eruptions, and even the ploughing of a single field.

[6] UNESCAP, 2021. Sand and Dust Storms Risk Assessment in Asia and the Pacific. https://apdim.unescap.org/knowledge-hub/sand-and-dust-storms-risk-assessment-asia-and-pacific.
[7] UNEP, 2016. *Global Assessment of Sand and Dust Storms*. https://wedocs.unep.org/20.500.11822/7681.

Many SDS source areas and impact locations either overlap or are adjacent to one another. The transport of particles can take place as creep or saltation close to the surface – rolling or sliding with the wind as is the case with the formation of sand dunes. The distance between SDS source and deposition areas is determined by: (i) the size and weight of particulate matter, (ii) wind speed, turbulence, and vortices, (iii) surface roughness, vegetation cover, and topography, and (iv) gravitational pull.

Numerous studies have identified the most significant SDS source areas, predominantly located in a zone from Northeast Asia to the west coast of Africa. In 2022, hotspots with significantly higher dust concentrations were identified in Central and South America, most of Central Africa, Spain, the Red Sea, the Arabian Peninsula, the Arabian Sea, the Iranian Plateau, the Bay of Bengal, South Asia, the Tarim Basin in north-west China and the tropical Atlantic Ocean between West Africa and the Caribbean. The **Global SDS Source Base-map** can be used to identify SDS sources of concern at national and sub-national scales. It can generate a geo-referenced map providing information on the distribution and annual variability of SDS source areas, from the drylands to high latitudes, as well as on the surface vulnerability to sand and dust emissions and the projected intensity of future SDS events.[8]

Figure 1: Global SDS Source Base-map



3. Socioeconomic Impacts

SDS present serious hazards to our societies and economies – from soil erosion and declines in food production to infrastructure damage, transport and energy disruptions, and human health risks.

SDS are a unique form of hazard in that the source and impact areas can often be separated by great distances. Globally, there is a significant lack of data and awareness, particularly on the socioeconomic costs of SDS events and the magnitude of the threat they pose to food security, human and environmental health, livelihoods and economic growth; losses from a single SDS event can be in the hundreds of millions of dollars.

[8] UNCCD, N.d. Sand and Dust Storms Source Base-map. https://maps.unccd.int/sds/.

- The economic impact of dust events in the **Asia-Pacific** region is estimated to be USD 5.6 billion annually.[9]

- In 2021, a major SDS event in **Northeast Asia** killed 200,000 livestock, destroyed 121 animal shelters in Mongolia, caused hundreds of flight cancellations in China, and prompted health advisories in the Republic of Korea.[10]

- In **Iraq**, exposure to SDS reduces crop yields by 0.7 to 2.8 per cent for each additional SDS day, with the greatest impacts on vegetables and dates.[11]

- In the **Middle East and North Africa**, the economic costs of SDS are estimated at more than USD 150 billion annually, equivalent to more than 2.5 per cent of GDP for most countries in the region.[12]

- On the island of **Crete**, during the most intense day of the African dust episode (22 March 2018), total losses were estimated in the order of EUR 3.4 to 3.8 million in the aviation, health, solar energy, and emergency services sectors.[13]

Unlike many other disasters, there is no systematic mechanism for tracking and recording loss and damage associated with SDS events, including non-economic losses and irreversible damages. In 2015, the UN General Assembly recognised the need to address the adverse socioeconomic impacts of SDS on communities and economies.[14] As a first step, enhanced data collection and analyses concerning loss and damage could better inform decision-making and policy coordination at regional, national, and local levels. To address this gap, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Asia and Pacific Centre for the Development of Disaster Information Management developed a complementary **Guideline on Monitoring and Reporting the Impact of Sand and Dust Storms through the Sendai Framework Monitoring**.[15]

3.1 Agriculture and Natural Resources

The impacts of SDS on crops and livestock of most concern are those that result in declines in agricultural yields and productivity due to:

- wind erosion, the loss of soil nutrients and water availability in croplands and rangelands;
- sand blasting and dust deposition that damage crops and leads to the loss of vegetation and pastureland;

[9] UNESCAP, 2018. *Sand and Dust Storms in Asia and the Pacific: Opportunities for Regional Cooperation and Action*. https://apdim.unescap.org/knowledge-hub/sand-and-dust-storms-asia-and-pacific-opportunities-regional-cooperation-and-action.
[10] FAO. 2023, *Sand and dust storms: a guide to mitigation, adaptation, policy and risk management measures in agriculture*. https://www.fao.org/documents/card/en/c/cc8071en.
[11] UNESCAP, 2018. *Sand and Dust Storms in Asia and the Pacific: Opportunities for Regional Cooperation and Action*. https://apdim.unescap.org/knowledge-hub/sand-and-dust-storms-asia-and-pacific-opportunities-regional-cooperation-and-action.
[12] World Bank, 2019. *Sand and Dust Storms in the Middle East and North Africa (MENA) Region – Sources, Costs, and Solutions*. Washington, DC. https://www.worldbank.org/en/region/mena/publication/sand-and-dust-storms-in-the-middle-east-and-north-africa-mena-region-sources-costs-and-solutions.
[13] Monteiro, A., et al., 2022. "Multi-sectoral impact assessment of an extreme African dust episode in the Eastern Mediterranean in March 2018". *Science of The Total Environment*, 843. https://www.sciencedirect.com/science/article/pii/S0048969722039584.
[14] UNGA, 2015. Resolution 70/195 Combating sand and dust storms. https://digitallibrary.un.org/record/820880?ln=en.
[15] UNESCAP-APDIM, 2020. *Guideline on Monitoring and Reporting the Impact of Sand and Dust Storms through the Sendai Framework Monitoring*. https://apdim.unescap.org/knowledge-hub/guideline-monitoring-and-reporting-impact-sand-and-dust-storms-through-sendai.

- increased livestock mortality and/or reduced animal health and productivity;
- increased siltation and sedimentation in water sources and irrigation canals;
- pathogen transmission that increases the spread of plant and animal diseases;
- prolongation of drought conditions and the loss of pollinators; and
- damage to farm equipment and infrastructure.

Declines in agricultural production due to SDS often disproportionately affect the poorest and most vulnerable communities. They affect men and women in different ways and to different extents, based on their roles and activities in the agricultural sector. The impacts of SDS on water quality and availability can also be significant due to the siltation and contamination of reservoirs, dams, catchments, underground canals, and flood control installations. This can lead to the need for additional water treatment and the increased demand for water in operations to remove sand and dust, leading to greater operating (e.g., frequent water sluicing) and capital (e.g., additional labour, equipment) costs.

Sustainable land and water management practices in the agriculture, forestry, and livestock sectors are key approaches to mitigating anthropogenic SDS sources globally. For example, traditional water harvesting practices have significant potential to reduce the susceptibility of the land to become a source of SDS. While in areas where SDS are generated naturally, a combination of source mitigation measures along with proactive planning for emergencies and adaptation are critical to effectively manage unavoidable impacts.

3.2 Human Health

SDS negatively affect human health, primarily through exposure to air pollution from particulate matter in both source and impact areas. Epidemiological research has established a correlation between SDS events and the increased risk for respiratory morbidity and cardiovascular mortality.[16] The World Health Organization (WHO) has included a section on good practice statements in its 2021 Air Quality Guidelines to reflect the concern that SDS may be a significant risk factor for inflammatory and allergic lung diseases, such as child and adult asthma, and can also contribute to the transmission of infectious diseases, such as Valley fever and meningitis.[17]

Sand and dust emissions represent a multi-faceted threat to human health. Air pollution from increased concentrations of particulate matter is responsible for 7 million deaths globally each year; a 2016 study estimated the global welfare losses from air pollution – to which SDS contribute – at USD 3.6 trillion.[18] Additional indirect costs to society and the economy can be attributed to SDS events that debilitate individuals, especially those with compromised respiratory and cardiovascular systems or other underlying health conditions. The elderly, disabled, and pregnant and lactating women are also particularly vulnerable to sand and dust emissions.

[16] Lwin, K.S., et al., 2023. Effects of Desert Dust and Sandstorms on Human Health: A Scoping Review. *GeoHealth* 7(3). https://doi.org/10.1029/2022GH000728.
[17] WHO, 2021. *Global air quality guidelines*. https://www.who.int/publications/i/item/9789240034228.
[18] World Bank and Institute for Health Metrics and Evaluation, 2016. *The Cost of Air Pollution: Strengthening the Economic Case for Action*. World Bank Group, Washington, DC. http://hdl.handle.net/10986/25013.

3.3 Transport, Energy, and Built Infrastructure

SDS impacts on transportation are linked to those that compromise the built environment. While the interruption of air transport and safety risks due to SDS events have been reduced by improved navigation technologies, disruptions in road and rail travel remain a significant challenge. High impact consequences can occur when blowing sand and dust contributes to low visibility, leading to fatal accidents. SDS can also disrupt waterway transport (e.g., canals, rivers, inland waters) which appears to be more correlated to the nature of the SDS event (e.g., high winds) worsened by airborne sand and dust.

In areas where vegetation is absent or severely disturbed, wind-blown sand and dust can impede the functions of energy and built infrastructure. Sand and dust infiltrate solar panels, wind turbines, and power stations and grids which reduce energy generation and transmission. This can lead to their abandonment or additional maintenance costs to continue operating efficiently and profitably. Poor air quality and limitations on mobility during and after SDS events can affect normal social and economic activities that rely on built infrastructure, such as those related to work, education, and recreation.

3.4 Sectoral Linkages

While sector-specific interventions can boost source mitigation, SDS events often have cross-sector impacts which require policy coherence for their effective management. For example, SDS impacts on built infrastructure can simultaneously affect the transport, manufacturing, and energy sectors. Likewise, reduced agricultural productivity and water availability can contribute to food insecurity and poor human health, education, and livelihood outcomes. These linkages highlight the need for integrated, multi-sector policies and multi-hazard approaches to improved SDS management. Relevant policy and regulatory mechanisms that encourage institutional coordination within and across sectors and at all levels (e.g., national, sub-national, local) are essential while, at global and regional levels, knowledge-sharing and transboundary partnerships are indispensable.

3.4.1 Additional Considerations

Gender and Youth

Disasters exacerbate many of the prevailing gender inequalities that exist in society. In general, women are more vulnerable due to existing gender norms and barriers. SDS events affect people differently, even when they reside in the same location. The impacts of SDS on women and girls, men and boys can also be expected to differ across sectors as vulnerability and exposure to SDS varies according to their social and economic roles and responsibilities. For example, exposure to SDS impacts may be significant for men and boys working in fields while the additional burden of cleaning up after a SDS event may be greater for women and girls, or vice versa. Gender-based differences and intergenerational equity should be considered and addressed in SDS policies, strategies, and action plans through the inclusion of youth- and gender-responsive measures that contribute to improved SDS management.

Equity

In much the same way, issues of equity should be specifically considered when identifying SDS sources and impacts and evaluating management options, recognising that each person has

different circumstances and opportunities to achieve equitable outcomes. Not everyone is affected in the same way by SDS events or has the same means to mitigate sources and cope with and adapt to impacts. Economic inequalities need to be considered in SDS policies, strategies, and action plans, including through source and risk mapping, and vulnerability and impact assessments. Early warning systems linked to anticipatory actions that benefit all strata of society can reduce the impacts of a forecasted SDS hazard before it occurs, or before its most acute impacts are felt.

Climate Change

Changes in climatic conditions lead to differences in weather patterns that are associated with SDS events. Where changes lead to wetter conditions, the likelihood of SDS events may decrease while, under dryer and drought conditions, the incidence and severity of these events may increase. Weather is only one element in the generation of SDS. Local soil conditions, ground and air temperature, the presence or lack of vegetation, and seasonal variations caused by global warming also affect the frequency and intensity of SDS events. Climate change forecasts are an important consideration when planning source mitigation measures and preparing for the future impacts of SDS. This could include linking climate trends based on future projections to seasonal weather forecasting. Given the significant investments in climate change mitigation and adaptation, bringing together these communities of policy and practice could help encourage increased investments in SDS management.

4. Knowledge Resources to Manage SDS

An extensive range of knowledge resources on the management and mitigation of SDS already exist to support and facilitate policy and actions to address this hazard. These can be used for stand-alone projects or to integrate actions to address SDS into other policies, projects, and programmes.

There is a wide range of scientific evidence which can be used to understand the threats posed by, and the options available to reduce and manage, SDS sources and impacts.[19] This chapter describes the primary sources and repositories of the latest science and evidence-based information, tools, technologies, and knowledge products on SDS that policymakers and decision makers can draw upon for the successful application of the Guideline.

In response to UN General Assembly resolution 72/225, the **UN Coalition on Combating Sand and Dust Storms** was officially established at the UNCCD COP14 in 2019.[20] The UN System is committed to a proactive approach that enhances cooperation and coordination for the management of SDS at global, regional, and national levels. The mandate of the UN Coalition is to promote and coordinate a collaborative response that facilitates:

- the exchange of knowledge, data, and good practices;
- dialogue and collaboration among affected countries and the UN system; and
- capacity building in countries, as well as awareness-raising, and improvements in their preparedness and response to SDS in critical regions.

[19] FAO, N.d. "Sand and Dust Storms". https://www.fao.org/land-water/land/sds/en/.
[20] UN Environment Management Group, N.d. "UN Coalition to Combat Sand and Dust Storms". https://unemg.org/our-work/emerging-issues/sand-and-dust-storms/.

4.1 Global

The first **Global Assessment of Sand and Dust Storms** was produced in 2016 by the United Nations Environment Programme (UNEP), World Meteorological Organization (WMO), and the UNCCD. The report presents the science of SDS processes and forms the foundation for technical and policy options for reducing and managing SDS sources and impacts. It includes an overview of recent SDS trends, including global and regional characteristics and sources as well as the environmental, social, and economic impacts of SDS, including those on human health. The assessment also describes existing policy and monitoring initiatives, including case studies at regional and national levels.[21]

The **Sand and Dust Storms Compendium: Information and Guidance on Assessing and Addressing the Risks,** launched at the UNCCD COP15 in 2022, includes approaches and methodological frameworks for data collection, assessment, monitoring and early warning systems, impact mitigation and preparedness, source mapping and mitigation needed for the development and implementation of SDS policies at sub-national, national, regional, and global levels.[22]

The **SDS Toolbox** was inaugurated during the first observation of the **International Day to Combat Sand and Dust Storms** on 12 July 2023. It provides practical tools, guidance, and training modules which can be used to identify SDS sources, and develop and implement policies, strategies, and action plans to manage SDS sources, risks, vulnerabilities, and impacts. The SDS Toolbox provides decision support tools to observe, monitor, forecast, and provide early warning for SDS events as well as technical guidance to develop and implement projects and programmes that mitigate the sources and manage the impacts of SDS.[23]

The WMO established the **Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)** in 2007, which aims to enhance the ability of countries to deliver timely, quality SDS forecasts, observations, information, and knowledge. The WMO SDS-WAS operates as an international hub of researchers, operational centres and end-users, that provides regional services through its regional activity nodes. At present, there are four regional nodes: (i) North Africa, Middle East and Europe; (ii) Asia; (iii) the Americas; and (iv) the Gulf Cooperation Council countries. Emerging initiatives, such as Iran and Türkiye cooperation, are also building regional alliances in West and Central Asia.[24]

4.2 Regional

The **Sand and Dust Storms in Asia and the Pacific: Opportunities for Regional Cooperation and Action** analyses potential drivers, points to the risk of problem areas, and identifies gaps in information, cooperation, and policy action to enhance the science-based understanding of SDS phenomena among policymakers. It aims to support the development of adaptation and mitigation policies related to SDS at the regional and national levels.[25]

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[21] UNEP, WMO, and UNCCD, 2016. *Global Assessment of Sand and Dust Storms*. https://wedocs.unep.org/handle/20.500.11822/7681.
[22] UNCCD, 2022. *Sand and dust storms compendium: Information and guidance on assessing and addressing the risks*. https://www.unccd.int/resources/publications/sand-and-dust-storms-compendium-information-and-guidance-assessing-and.
[23] UNCCD, N.d. Sand and Dust Storms Toolbox. https://www.unccd.int/land-and-life/sand-and-dust-storms/toolbox.
[24] WMO, N.d. Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS). https://community.wmo.int/en/activity-areas/gaw/science-for-services/sds-was.
[25] UNESCAP, 2018. *Sand and Dust Storms in Asia and the Pacific: Opportunities for Regional Cooperation and Action*. https://apdim.unescap.org/knowledge-hub/sand-and-dust-storms-asia-and-pacific-opportunities-regional-cooperation-and-action.

The **Sand and Dust Storms Risk Assessment in Asia and the Pacific** examined the potential impact of SDS on various socioeconomic sectors, including human health, agriculture, energy, transportation, the environment, and urban areas, taking into account the distinct mechanisms through which these events affect each sector.[26] The insights derived from this assessment played a pivotal role in shaping the **Regional Plan of Action on Sand and Dust Storms in Asia and the Pacific,** which was endorsed by UNESCAP in May 2022.[27]

Sand and Dust Storms in the Middle East and North Africa Region: Sources, Costs, and Solutions provides a state-of-the-art assessment of the SDS trends and sources as well as the solutions to inform policymakers and stakeholders in the region.[28]

The Value of Landscape Restoration in Uzbekistan to Reduce Sand and Dust Storms from the Aral Seabed estimates the economic benefits of landscape restoration to enable national and local authorities to allocate limited resources for measures focused on soil stabilisation and related ecosystem services.[29]

4.3 Sectoral

The United States Department of Agriculture's **Dust Mitigation Handbook: One Stop Guide to Dust Mitigation**, published in 2019, provides some of the most detailed descriptions of source management methods based on the field experiences and research of practitioners.[30]

The FAO published **Sand and dust storms: a guide to mitigation, adaptation, policy and risk management measures in agriculture** in 2023, which provides an overview of SDS and the impacts on agriculture and food systems. It reviews how agriculture can create SDS sources and highlights the impacts of SDS on agricultural production in source and deposition areas. It includes a searchable database of more than 150 high-impact, location- and context-specific practices to reduce SDS sources and impacts on agriculture subsectors at the local level, comprising technical and non-technical interventions. Moreover, it assesses how SDS risk is addressed at the policy level and discusses options for integrating SDS at national and regional levels into multi-hazard disaster risk reduction and management strategies or sectoral development programmes.[31]

The WHO **Global Air Quality Guidelines** provide recommendations focused on the likely consequences of SDS and mitigation options, including: (i) strengthening and/or establishing air quality management programmes; (ii) measuring particulate matter components for the purpose

[26] UNESCAP, 2021. *Sand and Dust Storms Risk Assessment in Asia and the Pacific*. https://apdim.unescap.org/knowledge-hub/sand-and-dust-storms-risk-assessment-asia-and-pacific.
[27] UNESCAP, 2022. Regional Plan of Action on Sand and Dust Storms in Asia and the Pacific. https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_78_12%20Add%201_E.pdf.
[28] World Bank, 2019. *Sand and Dust Storms in the Middle East and North Africa (MENA) Region: Sources, Costs, and Solutions*. https://www.worldbank.org/en/region/mena/publication/sand-and-dust-storms-in-the-middle-east-and-north-africa-mena-region-sources-costs-and-solutions.
[29] Akramkhanov, A., et al., 2021. *The Value of Landscape Restoration in Uzbekistan to Reduce Sand and Dust Storms from the Aral Seabed (English)*. World Bank Group, Washington, DC. http://documents.worldbank.org/curated/en/750031635227796665/The-Value-of-Landscape-Restoration-in-Uzbekistan-to-Reduce-Sand-and-Dust-Storms-from-the-Aral-Seabed.
[30] United States Department of Agriculture, 2019. *Dust Mitigation Handbook: One Stop Guide to Dust Mitigation*. https://www.climatehubs.usda.gov/hubs/southwest/topic/dust-mitigation-handbook.
[31] FAO, 2023. *Sand and dust storms: a guide to mitigation, adaptation, policy and risk management measures in agriculture*. https://www.fao.org/documents/card/en/c/cc8071en.

of source apportionment; and (iii) conducting research on health impacts and epidemiological studies.[32]

5. Guiding Principles and Recommendations

The Guideline is meant to be adapted to specific contexts and applied in key policy areas consistent with integrated risk management approaches and existing obligations under national and international law.

The Guideline is compatible with the level of ambition set out in national LDN targets under the UNCCD and is closely aligned with the principles and practices contained in the Sendai Framework for Disaster Risk Reduction 2015–2030.

The Guideline encourages the integration of SDS management approaches into national strategies and action plans that address desertification, land degradation, drought, food systems, climate change, biodiversity loss, air pollution, and disaster risk reduction to ensure a holistic approach to natural resource and disaster risk management.

The Guideline recognises the need for greater awareness-raising, capacity development, technical expertise, knowledge- and information-sharing. The provision of adequate and sustained finance is also needed to support the implementation of SDS management measures, particularly through the application of sustainable land and water management and restoration practices.

The Guideline offers recommendations that are grounded in practical, proven, gender-responsive, scientifically based, and well-recognised principles for creating an enabling environment, including responsible and inclusive governance, that can assist with the integration of SDS management measures into key policy areas.

5.1 Creating the Enabling Environment

A combination of awareness and knowledge, stakeholder engagement, capacity building, access to finance, tools and technologies, and policy and regulatory mechanisms are required to create the enabling environment for efficient and effective SDS management.

SDS management approaches and measures are often fully aligned with nature conservation, regenerative agriculture, and ecosystem restoration commitments made under various multilateral processes, such as the Rio conventions and the Bonn Challenge. Solutions must address not only the failures of transboundary governance but also those of national governance linked to budget priorities. A concerted effort to enhance policy coherence can be employed by regions and countries to leverage synergies, manage trade-offs, and maximise benefits from integrated actions.

Inclusive and responsible land governance (e.g., tenure security), integrated land use planning (ILUP), and sustainable land and water management are key principles and practices that can increase the efficiency and effectiveness of efforts to combat SDS. By incorporating these into policies, strategies, and action plans, regions and countries will find themselves in a better position to reduce the socioeconomic risks, vulnerabilities, and exposure to SDS events while

[32] WHO, 2021. *WHO global air quality guidelines. Particulate matter ($PM_{2.5}$ and PM_{10}), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*. WHO, Geneva. https://www.who.int/publications/i/item/9789240034228.

simultaneously improving livelihood opportunities and food security, contributing to disaster risk reduction, climate change adaptation, and gender equality.

5.1.1 Integrated Risk Management Approaches

A multi-hazard, multi-sectoral, and multi-actor risk management approach is needed to address the linkages between SDS and other environmental challenges, such as desertification, land degradation, drought, and climate change.

In developing or revising SDS policies, strategies, and action plans, countries must first consider the ways and means to enhance the integration of SDS source and impact mitigation measures into key sector and policy areas (e.g., through ILUP, tenure security, land restoration projects and programmes)[33] [34] For example, when selecting a particular SDS source management intervention, full consideration must be given to how it will interact with other social, economic, and environmental functions (e.g., poverty, gender, social inclusion) to ultimately create a host of societal co-benefits, including creating green jobs and income opportunities, that extend far beyond soil stabilisation and erosion control.

The adoption and upscaling of good practices for SDS management at local and landscape scales should be complemented by well-coordinated risk monitoring and early warning systems. These should be made operational and trigger anticipatory actions that minimise the socioeconomic impacts of SDS through the implementation of robust monitoring, analytical, and forecasting systems. Ideally, these systems will incorporate agrometeorological, environmental, and human health data to provide timely information and alert populations at risk to leave no one behind.

Once SDS risks and vulnerabilities have been identified and mapped, these should be merged into national, sub-national, and local disaster risk management planning and activities centred on early warning, prevention, mitigation, preparedness, response, and recovery. Risk reduction should be the primary focus of SDS management efforts and integrated into relevant sectoral and development action plans, rather than formulated as stand-alone policies, to take advantage of the potential afforded by multi-level and cross-sectoral interventions.

Regional Strategy for Sand and Dust Storms Management in Central Asia[35]

More than 80 per cent of the 400 million hectares of the territory in Central Asia is covered by deserts and steppes which, coupled with climate change and persistent drought, represent a natural source of SDS. However, unsustainable practices of irrigated farming and livestock grazing, mining and other activities create favourable conditions for the formation of anthropogenic SDS sources. For example, the drying of the Aral Sea led to the creation of 5.5 million hectares of salty desert and the source of 100 million tonnes of dust and poisonous salt. In 2020, the UNCCD secretariat initiated a pilot project on Regional Approaches for Combating SDS and Drought in Central Asia. This regional strategy will be integrated into the Regional Environmental Programme for Sustainable Development in Central Asia 2021–2030. The key priorities are to:

[33] Verburg, P.H., et al., 2022. "The Contribution of Integrated Land Use Planning and Integrated Landscape Management to Implementing Land Degradation Neutrality: Entry Points and Support Tools". A Report of the Science-Policy Interface. UNCCD, Bonn. https://www.unccd.int/resources/reports/contribution-integrated-land-use-planning-and-integrated-landscape-management.

[34] FAO, N.d. Land Resources Planning Toolbox. https://www.fao.org/land-water/land/land-governance/land-resources-planning-toolbox/category/en/.

[35] Regional Environmental Centre for Central Asia, 2021. *Regional Strategy for Sand and Dust Storms Management in Central Asia, 2021–2030. Regional SDS Strategy*. https://www.unccd.int/sites/default/files/2022-10/Regional%20strategy_SDS_%D0%B0%D0%BD%D0%B3%D0%BB_print.pdf.

- raise awareness of potential harms, risks and related mitigation measures to help inform integrated and synergistic interventions and stimulate knowledge and technology transfers;
- eliminate the environmental and socioeconomic causes of desertification, land degradation, and drought; and
- ensure regional cooperation and coordinated action.

Likewise, the **Regional Plan of Action on Sand and Dust Storms in Asia and the Pacific** provides a strategic framework and reference for countries in the region to act at the national and regional levels, in the context of multi-hazard disaster risk reduction, to reduce the negative impact of SDS and identify measures that could contribute to or mitigate their formation and intensity.[36]

5.1.2 Source and Impact Assessments

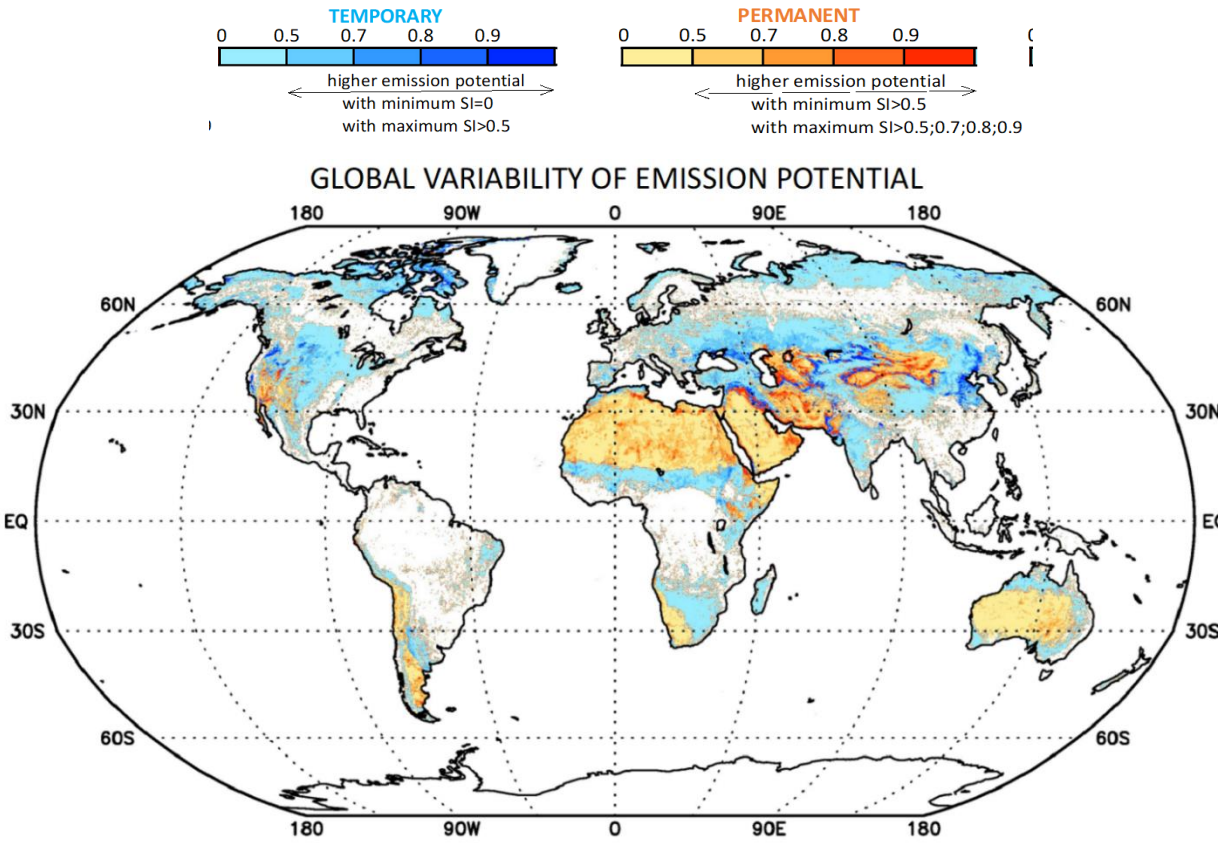
Any project or programme targeting SDS source and impact reduction should first conduct assessments that identify the drivers and potential impacts, and map the risks and vulnerabilities posed by SDS events.

For **SDS source management**, assessments should be based on the latest scientific information (e.g., geospatial data and analysis) on the character of sources, land use and degradation status, location in the wider landscape, and the nature and degree of anthropogenic influence. Many SDS sources are highly specific landscape units (e.g., individual fields, ephemeral lakes, large-scale depressions) which need to be differentiated from larger-scale source areas to formulate the most effective response measures. Understanding historical SDS events and their meteorological drivers and applying that knowledge toward climate change projections should also be an important consideration in assessments.

The **SDS Source Base-map** is one tool that can be used to identify and analyse intervention sites located in or near SDS source areas. At the regional level, the **Sand and Dust Storms Risk Assessment in Asia and the Pacific** and **Sand and Dust Storms in the Middle East and North Africa Region: Sources, Costs, and Solutions** could be consulted.

[36] UNESCAP, 2022. Regional Plan of Action on Sand and Dust Storms in Asia and the Pacific. https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_78_12%20Add%201_E.pdf.

Figure 2: Global Variability of SDS Emission Potential



For **SDS impact mitigation**, assessments should involve consultations with affected stakeholders to ensure that policies, projects and programmes: (i) address potential SDS impacts identified by the local population; and (ii) respond to any issues or considerations that may have been omitted during the planning and design stages. There are numerous guidelines and good practices for conducting environmental and socioeconomic impact assessments which can be used by regions and countries. Consult **SDS Compendium Chapter 13** on impact response and mitigation.

For both SDS source and impact mitigation, expert and community level impact assessments (**SDS Compendium Chapters 4 and 5**) can be efficient and effective modalities. Economic impact assessments are critical for policymakers and decision makers (**Chapter 6**) and the use of geographic information systems can provide a better understanding of how SDS events impact lives and livelihoods (**Chapter 7**). Scientific research and technical reports can also provide useful information to assess SDS sources and impacts at regional and national levels.

5.1.3 Awareness-raising, Stakeholder Engagement, and Capacity Building

The efficacy of SDS management approaches is significantly increased with the active and meaningful involvement of local stakeholders and affected populations, starting from the initial planning and design phases to implementation and monitoring.

Awareness-raising campaigns are a powerful tool for engaging stakeholders and sharing knowledge on SDS sources, risks, and impacts as well as highlighting the role of individual and

community actions in mitigating these hazards. Capacity building initiatives and peer-to-peer learning can further the exchange of knowledge and skills among relevant stakeholders to enhance the prevention, preparedness, and response to SDS events.

Stakeholders can be identified and engaged through a variety of methods, including baseline surveys and the use of participatory appraisals. It is important to identify the full range of stakeholders and assess their respective levels of knowledge and engagement as part of an socially inclusive and gender-responsive approach to SDS management. Firsthand knowledge of the landscape is critical to understand past land use dynamics which may no longer be obvious but continue to influence the current situation. It is important to consider both the biophysical and socioeconomic aspects at the local level; adaptive learning, continuous monitoring, and gender-balanced engagement allow for adjustments to SDS strategies and action plans, when and where necessary.

Building institutional, technical, and administrative capacities is the only way to ensure coordinated SDS policy development and implementation at the regional, national, and sub-national levels. This policy coherence significantly increases the potential to enhance: (i) **absorptive capacity** (the ability to tolerate hazards and minimise exposure); (ii) **adaptive capacity** (the ability to adjust to changing conditions); and (iii) **transformative capacity** (the ability to positively affect livelihoods). The capacity to cost SDS impacts in key sectors – to estimate loss and damage – will help increase synergies with development, climate, and disaster risk reduction finance.

5.1.4 Regional Cooperation

Regional cooperation is essential to address the transboundary nature of SDS events.

Regional SDS management strategies and frameworks can help increase prevention, mitigation, preparedness, response, and recovery by improving risk governance within and across sectors aimed at promoting resilience through coordinated interventions. Regional platforms bring governments and stakeholders together to identify common challenges and boost political commitment to improve SDS management and cooperation. Multi-country networks can also support the regular monitoring and assessment of progress in implementation, strengthen technical partnerships, and provide space to share good practices and knowledge on SDS policies, programmes, and investments.

Regional Plan of Action on Sand and Dust Storms in Asia and the Pacific[37]

As outlined in the Sand and Dust Storms Risk Assessment in Asia and the Pacific, the Asia-Pacific region ranks second globally in terms of mineral dust emissions. There are four primary SDS corridors: (i) East and Northeast Asia; (ii) South and Southwest Asia; (iii) Central Asia; and (iv) the Pacific. Considering the frequent transboundary effects of these storms, the findings of the risk assessment advocate for the development and implementation of well-coordinated initiatives at the national and regional levels to address the socioeconomic consequences of SDS. The Regional Plan of Action proposes a set of specific actions under three operational objectives at national and regional levels: (i) improve the understanding of the socioeconomic impact of SDS with a view to accurately inform policies and investments to reduce their impact and enhance source mitigation; (ii) expand monitoring and improve early warning systems to include an impact-based focus, provide timely forecasts, and enable targeted measures to minimise

[37] UNESCAP, 2022. Regional Plan of Action on Sand and Dust Storms in Asia and the Pacific. https://www.unescap.org/sites/default/d8files/event-documents/ESCAP_78_12%20Add%201_E.pdf.

exposure and risk; and (iii) put in place coordinated regional actions in the most at-risk and exposed geographical areas to mitigate the risk of and exposure to SDS.

Regional Master Plan for the Prevention and Control of SDS in Northeast Asia[38]

Northeast Asia is the world's second largest SDS source, contributing to about 40 per cent of the global dust loading, predominantly from the Taklamakan and Gobi deserts. Emissions for SDS events are transported to other parts of Mongolia and China, and to Japan, Korea, the Pacific Ocean, and as far as the west coast of the United States. The Regional Master Plan for the Prevention and Control of SDS in Northeast Asia was developed by government officials and national experts in collaboration with regional and international organisations with the aim to establish an effective vehicle for regional cooperation in combatting SDS. Achievements, to date, include a regional monitoring and early warning network for SDS as part of the WMO SDS-WAS Asia Node and hosted by the China Meteorological Administration. The implementation of SDS source prevention and mitigation measures in the region has not yet progressed beyond the pilot project stage. Improvements in knowledge capacity are still needed for national staff to design and implement source mitigation measures, including a more robust understanding of the nature of SDS (e.g., source area dynamics), the criteria and indicators used for monitoring and evaluation, and the linkages with other climatic and environmental processes (e.g., desertification, land degradation, drought).

5.1.5 Early Warning Systems and Technical Interventions

Early warning systems can reduce many unexpected costs that result from SDS events and better inform the application of technical interventions to prevent them.

Considerable progress has been made in early warning and the forecasting of SDS events through the WMO SDS-WAS and its regional nodes, national and local meteorological authorities and, in some cases, private weather forecasting companies. Existing air quality monitoring and early warning systems often do not register or report on SDS events as they are not equipped to monitor relevant particulate matter (e.g., mineral dust). Early warning should be integrated into the forecasting work of meteorological agencies with awareness-raising as one key objective. Moreover, early warning systems must be linked to anticipatory actions which can be implemented ahead of forecasted SDS events to minimise their socioeconomic and environmental impacts and protect lives and livelihoods.[39] The **SDS Compendium Chapter 10** provides further information on early warning systems.

Selecting the most suitable technical on-the-ground interventions for a particular SDS source will depend on the site itself, the surrounding landscape, the feasibility and relative costs/benefits of each intervention, and the likelihood of success. In addition to accurate mapping, the selection process should identify potential negative impacts of a chosen intervention on affected stakeholders (on- and off-site). High impact, context-specific, and cost-effective interventions that have been proven to reduce SDS sources and impacts in the agricultural sector include: (i) conservation agriculture in dryland systems; (ii) drought-tolerant forage species (e.g., Sulla); (iii) mechanised water harvesting and storage; and (iv) aerial seeding of saxaul trees.[40]

Improving disaster preparedness involves a sound understanding of SDS risks and strong linkages with hazard-specific or multi-hazard early warning systems that enhance the capacity

[38] NEASPEC, 2005. Desertification and Land Degradation. "The Regional Master Plan for the Prevention and Control of Dust and Sandstorms (DSS) in North-East Asia". https://neaspec.org/our-work/land-and-climate-nexus/overview.
[39] WMO, N.d. WMO and the Early Warnings for All Initiative. https://public.wmo.int/en/earlywarningsforall.
[40] FAO, 2023. *Sand and dust storms – a guide to mitigation, adaptation, policy and risk management measures in agriculture*. FAO, Rome. https://doi.org/10.4060/cc8071en.

to predict, monitor, and act quickly when necessary. For interventions in the agriculture and natural resources sector, consult the **Dust Mitigation Handbook: One Stop Guide to Dust Mitigation** and **Sand and dust storms: a guide to mitigation, adaptation, policy and risk management measures in agriculture.**

5.2 Integrating SDS Management into Key Policy Areas

Reducing SDS risks and hazards requires policy actions that address those sectors generating source areas as well as those affected by the impacts of sand and dust in suspension and on deposition.

5.2.1 Agriculture and Natural Resources

SDS policies, programmes, and investments involving the productive use of land resources (i.e., soil, water, and biodiversity) should be guided by the integrated management of crops, water, and livestock at the landscape scale to ensure optimal allocations among a mosaic of land uses, including the protection of natural ecosystems. This can take many forms, including well known approaches and practices such as sustainable land management (SLM), sustainable soil management (SSM), integrated water resource management (IWRM), ILUP, conservation, regenerative and climate-smart agriculture, agroforestry, silvopastoralism, and rotational grazing – all of which can play an important role in source mitigation and improved local resilience to SDS impacts.

The use and management of water resources associated with SDS source areas, such as those for irrigation, industrial and household use, should be an important consideration when developing incentives for source mitigation at all scales. The conservation and more efficient use of water resources, including groundwater and surface water bodies, should be based on IWRM principles and practices that avoid over exploitation while attempting to reduce SDS sources. Building resilience to SDS hazards in agricultural societies and other natural resource-dependent communities also requires inclusive land governance frameworks and tenure security to help catalyse technical and non-technical interventions at the local level.

Many of the approaches and practices in the agriculture and natural resource sector (i.e., agriculture, forestry, and other land uses) are described in the **SDS Compendium Chapter 12** (source mitigation). The **Dust Mitigation Handbook** and **Sand and dust storms: a guide to mitigation, adaptation, policy and risk management measures in agriculture** offer further information.

5.2.2 Human Health

The health sector can use epidemiological studies to better understand the link between different types of SDS events (and related weather patterns) on chronic and acute health problems and the groups most affected. These studies can help identify the causal links between sand and dust emissions and ambient temperature which can result in specific health outcomes, such as respiratory and cardiovascular disease. These types of information and data can be used to guide policy and prepare for episodes of increased health risks so as not to overburden the health care system. Early warning systems can forecast and broadcast the likelihood of SDS events so that individuals can take timely precautions, particularly if there is coordination among the health sector and institutions monitoring air quality.

The planning and implementation of health and sanitation interventions should account for potential sand and dust loads which may need to be addressed as part of clean up and recovery. One concern is that collecting, moving, and processing large quantities of sand and dust may overload and damage sanitation systems. For example, sand washed off roads may partially fill drainage and sewage pipes, while sand and dust cleared from built infrastructure may overburden wastewater treatment facilities. The level of risk posed by sand and dust deposition to water and sanitation systems can vary widely and should be fully considered in impact assessments and management plans.

Health sector policies can incorporate these considerations into contingency planning to minimise the exposure to SDS impacts on individuals participating in work, non-paid labour, education, recreation, and other social functions. This planning should be based on the likelihood of specific SDS events and their expected impact on individuals and facilities. **SDS Compendium Chapter 13** (impact response and mitigation) provides guidance on addressing the impacts of SDS on recreation and social activities while **Chapter 10** (early warning) provides guidance on effective warnings that enable protective actions.

5.2.3 Transport, Energy, and Built Infrastructure

Policies, programmes, and investments in the built environment sectors need to consider the impacts of SDS events on physical infrastructure, its operational efficiency, and the demands of users. Policies in the transport sector should give specific attention to the impacts of SDS as they directly impact the safety and efficiency of transport modes (e.g., aircraft, trains, boats) and mechanisms (e.g., rail, roads, canals). These policies and actions should be based on impact assessments for geographic areas prone to SDS impacts with the aim to reduce the overall risks to transport; furthermore, operational assessments can be used to reduce risks to specific transport modes and mechanisms.

One aspect of SDS that is of growing concern to policymakers, decision makers, and investors is their impact on renewable energy sources, particularly wind and solar farms. Not only does SDS deposition reduce the efficiency of wind turbines and solar panels, but sand and dust particles in the atmosphere can also reduce electricity output by deflecting incoming solar radiation. In areas impacted by SDS events, power grids and transmission lines often require additional maintenance to avoid short circuits and power outages. As the share of renewable energy grows in those regions most impacted by SDS, policies and investments must consider proactive measures to avoid major disruptions to the economy and energy security.

Industrial policies and investment should also consider the potential impacts of SDS events on (i) production quality (e.g., computer chips or other items with limited fault tolerance), (ii) production equipment, facilities, and distribution networks where sand and dust can reduce their functioning, and (iii) recurrent maintenance and cleaning costs due to high-intensity SDS events or persistent levels of sand and dust in the atmosphere.

5.2.4 Sectoral Linkages

SDS should be addressed as part of national multi-hazard disaster risk management and reduction strategies and linked to the Sendai Framework, LDN targets, Paris Agreement, Global Biodiversity Framework, and other sustainable development priorities. Combatting SDS should also be integrated into policies, programmes, and investments in and across multiple sectors to enhance national resilience strategies and development programmes. Chapter 5 of **Sand and dust storms: a guide to mitigation, adaptation, policy and risk management measures in agriculture** offers further information.

The large-scale application of SDS source and impact mitigation practices requires enhanced and integrated legislation and policies that rely on institutional capacities and adequate financial resources to facilitate their implementation. Nigeria's National Strategy on SDS Mitigation is one example which highlights the need for a multi-sector approach.

Nigeria's National Strategy on SDS Mitigation[41]

The northern part of Nigeria has witnessed the impacts of SDS phenomena (*harmattan*) for centuries. The resulting depositional effect, primarily creating sand dunes, have now become drivers of secondary SDS sources in Nigeria. The goal of the proposed national strategy on SDS mitigation in Nigeria is to reduce SDS impacts and help achieve LDN targets by:

- harnessing the appropriate SDS data;
- promoting the essential linkages between the three pillars of sustainable development;
- raising awareness of early warning systems and encouraging the communities to participate in SDS mitigation processes;
- building partnerships among all stakeholders; and
- adopting good practices for SDS mitigation.

A multi-sector approach, involving the ministries of environment, agriculture, health, water, disaster management, and the National Aerospace Research and Development Agency, is envisioned to support the implementation of the national strategy which is expected to include:

- legislation that encourages the development of a national SDS programme;
- an institutional framework and funding mechanism to operationalise the programme;
- enhanced international and regional cooperation; and
- the creation of a SDS Monitoring and Evaluation Unit.

5.2.5 Finance

There are currently no specific international funds that focus on SDS-related risk financing. Given the range of activities involved in addressing SDS sources and impacts, identifying and deploying targeted financial resources can often be a challenge. An initial consideration is whether to pursue dedicated funding for SDS management measures or its integration into

[41] UNCCD pilot project, unpublished.

existing sectoral or development budget allocations. For example, projects and programmes promoting more sustainable land and water management practices in the agriculture sector can be adapted to deliver SDS source and impact mitigation as a significant co-benefit. There also may be opportunities to advocate for and finance SDS management measures as part of broader national policy implementation focused on climate, development, environment, or disaster risk reduction.

As with SLM, SSM, IWRM and other regenerative approaches to land management, innovative financing streams can be developed through payments for ecosystem services and land conservation schemes which create incentives for SDS management. Likewise, there are significant opportunities to fund SDS management measures through government budget reallocations within policy-driven projects and programmes focused on nature conservation, reforestation, ecosystem restoration, and rangeland management. Climate adaptation, rural development, and disaster risk reduction programmes also offer prospects for the inclusion and financing of SDS-related interventions to achieve mutually reinforcing objectives of planetary stability, food security, and poverty alleviation.

Disaster risk reduction funding generally fills a gap in development funding by directly addressing the causes of disasters which can include SDS management as well as early warning, awareness raising, preparedness and response capacities. As such, this type of funding can more directly reduce the overall risks posed by SDS events. Given the range of hazards and good practices as part of a multi-hazard approach to disaster risk management, countries may wish to explore funding for SDS management as part of an integrated approach.

Finally, without the involvement of the private sector, it will be difficult to achieve the expected results of SDS source and impact mitigation. Therefore, it is critical to enact SDS-related policies, legislation, and regulations which facilitate private sector investments as part of the enabling environment for SDS management as well as encourage innovative financing through for example green infrastructure, green bonds, or corporate social responsibility.

6. Conclusion

As the impacts of SDS on people and key sectors of the economy are growing, investments in SDS management responses should increase proportionally. The Guideline provides essential advice for designing and implementing strategic frameworks, policies, and actions to combat SDS at national, regional, inter-regional, and global levels. The coherence of national policies with those at regional and global levels can accelerate action to address the transboundary nature of SDS.

It is anticipated that the Guideline will raise awareness, help mobilise political will, spur international and regional collaboration, and attract the financial resources needed for concerted and informed actions to better manage SDS. Alignment and coherence with regional and national development priorities will help promote and support integrated SDS management approaches, proactive risk reduction, and cost-effective interventions that are context-specific, gender-responsive, and better predictive, including early warning mechanisms linked to anticipatory actions that protect lives and livelihoods.

The UNCCD, FAO, members of the UN Coalition on Combatting Sand and Dust Storms, and other partners stand ready to continue their efforts, according to their respective mandates, to assist regions and countries in developing or revising their SDS policy and implementation frameworks (e.g., strategies, action plans, projects, programmes, investments) in and across key policy areas (e.g., agriculture, natural resources, human health, infrastructure).