# EXECUTIVE SUMMARY

## 1. Background and Objective

Dust and sandstorms (DSS) are natural phenomena that have occurred for thousands years in the Northeast Asia Region. During the past 50 years, however, the frequency has increased, geographic coverage has expanded, and damage intensity has accelerated. Now, DSS are considered to be among the most serious environmental problems in the region as a disastrous hazard. It causes considerable hardship, loss of income, disrupts communications, affects people's health and, in extreme cases, leads to human casualties and destruction of livestock and crops over large areas in the affected countries.

To cope with such serious environmental problem, the Asian Development Bank (ADB), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Environment Programme (UNEP) together with the governments of the People's Republic of China, Japan, the Republic of Korea, and Mongolia initiated a joint project on "Prevention and Control of Dust and Sandstorms in Northeast Asia" in March 2003.

The objective of the collaborative project is to promote the establishment of a regional cooperation mechanism for prevention and control of DSS in Northeast Asia. The main outputs expected are: (1) an initial institutional framework for regional cooperation on DSS, and (2) a regional master plan to guide regional cooperation to alleviate DSS in Northeast Asia. The regional master plan has two major components: (a) a phased program to establish a regional monitoring and early warning network for prevention and control of DSS in Northeast Asia, and (b) an investment strategy to strengthen mitigation measures to address root cause of DSS in source areas.

This report contains the outcome of the study on "a phased program to establish a regional monitoring and early warning network for prevention and control of DSS in Northeast Asia." The report has been prepared by a team of consultants in cooperation with national experts under the technical guidance and supervision of the Technical Committee chaired by UNEP and reviewed by the participating parties at the Steering Committee.

## 2. Issues and Challenges

Transboundary environmental problems such as DSS can most effectively be solved through regional cooperation. The merit of regional cooperation is that it will be possible to achieve much more through a network than by each country acting alone. There is considerable value-adding when neighbors combine their efforts to establish a regional monitoring and early warning network. Early warning of impending DSS events based on a regional monitoring network will be facilitated by data sharing with rapid communications on the progress and geographic extent of any DSS outbreak.

The following points were identified through the review of the current DSS monitoring programs in the partner countries for consideration in view of establishing a regional network for monitoring and early warning:

*Firstly,* the perception, terminology, definition, monitoring method, current capacity, needs and expectation, etc. are all different from country to country. For example, there is a perception gap among the participating countries. DSS is considered as a phenomenon of natural disaster for countries in the source areas (upstream countries) while DSS is a

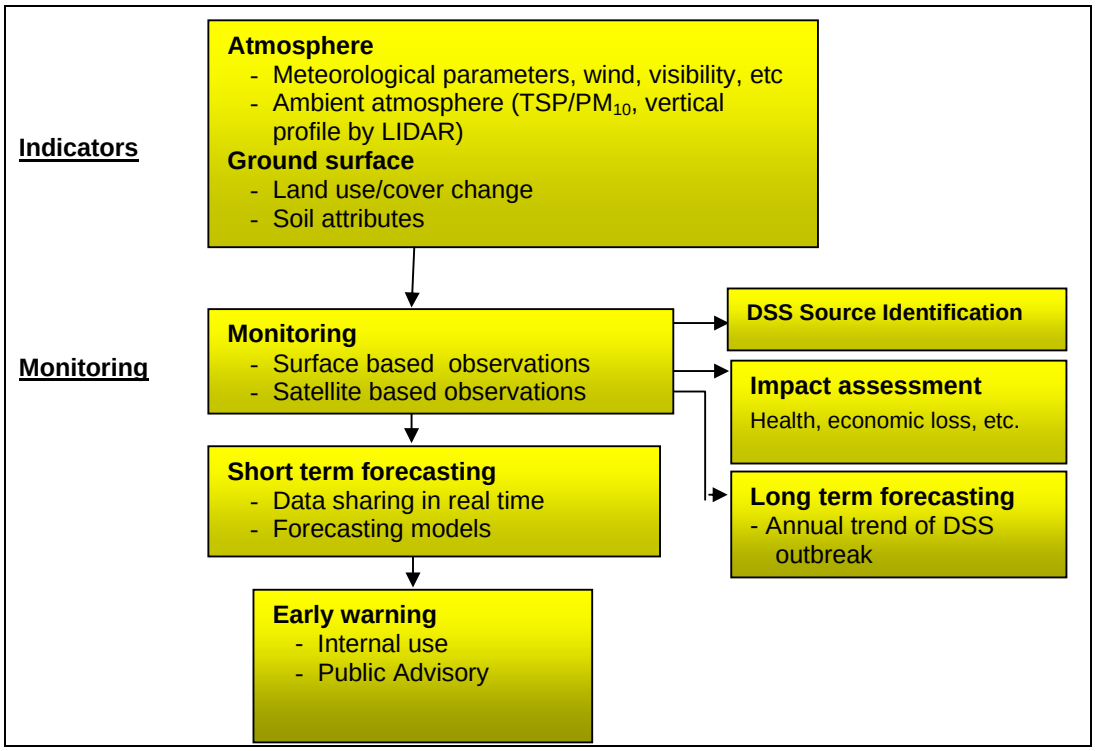
problem of air quality concerning public health for downstream countries. The definition of DSS is also different from country to country depending not only on monitoring method but also threshold value. In addition, needs and expectations are also different from country to country, even from agency to agency within a country. Accordingly, optimization and flexibility with step-by-step approach is needed in formulating a feasible program for a regional monitoring and early warning network.

*Secondly*, although a few bilateral initiatives are already in place as mentioned in the main text, these projects are limited to some specific field and national boundary areas. Since DSS is one of the transboundary environmental problems at a regional scale, multi-lateral cooperation mechanisms can solve the problem effectively and this is true for a regional monitoring and early warning network.

*Thirdly,* although Mongolia is one of the major source areas of DSS, there is no special monitoring site for DSS in the country. Moreover, most meteorological stations in Mongolia do not have any direct relation to DSS. In this regard, from a regional perspective, helping Mongolia develop its national capacity is one of the key tasks in terms of establishing a regional monitoring network, particularly on data sharing among participating countries.

## 3. Common Monitoring Indicators

The following chart illustrates the course towards establishing a regional monitoring network. First of all, the purpose of the regional monitoring network was confirmed to focus on short-term forecasting for early warning. It was agreed that other purposes for a regional monitoring network such as long-term forecasting would be the focus in the next step with necessary expansion of the network.



Next, common monitoring indicators for the regional monitoring network were selected from a basket of indicators for an effective short-term forecasting through data sharing. Availability of real time data is the most important criterion for selecting a set of common indicators. These indicators are:

(a) Visibility (instrumented)
(b) $PM_{10}$ (particulate matters with diameter smaller than 10 μm), and
(c) LIDAR (vertical profile of dust cloud by Light Detection and Ranging)

## 4. Regional Network of DSS Monitoring Stations

The objective of the regional monitoring network is to have a hierarchy of monitoring stations from the geographically important areas in Mongolia and northern provinces of People's Republic of China (across the Yellow Sea and Democratic People's Republic of Korea area) to Republic of Korea and Japan for effective early warning. Ideally, such network could make it possible for leeward forecasters to make "rolling" forecasts by incorporating data from windward monitoring stations. It would be also advantageous for windward forecasters because the validation of their short-term forecasting methods will be greatly enhanced if there is progressive feedback from leeward forecasters.

The real time data that can be used for short-term forecasting or early warning comes from the results of monitoring the three common indicators identified above as well as the basic meteorological observation data. Based on these four data sources and the geographical importance of the stations for forecasting and early warning, a hierarchy of network monitoring stations[1] was proposed as follows:

*(a) Class-A Network Monitoring Stations*

Class A stations are the *key stations* of the regional network since they are geographically important (e.g., located in DSS source areas). These stations have (or are going to have) the capability to measure all four data in real time. There are currently a few stations in this category that are fully equipped in the People's Republic of China and none in Mongolia. Visibility, $PM_{10}$, and LIDAR allows Class A Stations to provide real time data on spatial distributions and vertical profile of an ongoing DSS, which have special importance for the remote forecast centers to capture the physical details of a DSS event for simulation and early warning. It is crucial for the regional network to ensure data exchange in real time between the partner countries, or among these stations that are fully equipped.

*(b) Class-B Network Monitoring Stations*

Class B stations comprise of the *general stations* in the regional network that can monitor and report $PM_{10}$ data in real time over a long distance, in addition to reporting visibility data. The important feature of these stations is their capability to measure suspended particles like $PM_{10}$ (and TSP by batch sampling). $PM_{10}$ data is essential to measure air quality. The data from these stations together with those from the Class A stations are vital for DSS simulation and modeling at remote forecast centers because it can be monitored in real time. Not all the designated Class B stations in the network have the capacity to measure dust particle concentration. It will take time to upgrade the monitoring capacity of these existing stations, particularly those in Mongolia where there are none capable of monitoring $PM_{10}$.

[1] The hierarchy of stations is not correlated with the proposed phases of development.

## 5. Proposed Phases of Development

A phased program offers a practical approach for the development of the regional monitoring network especially under the circumstance of limited funds and resources. Moreover, the phased development need not be thought of as a rigid sequence where each phase is completed before the next begins. An alternative way to look at the phased approach is to acknowledge that the priority is to implement each phase's activities as soon as possible. Each phase described below has its own time span to reach its specified goal and the opportunity for equipment upgrades, capacity building, and network augmentation is a continuing one. The proposed three phases of development are as follows:

***Phase-1 (short term): Data sharing with the existing monitoring capacity***

In this phase, the network of monitoring stations is identified (25 in the People's Republic of China and 6 in Mongolia, plus designated stations in the Republic of Korea and Japan) and arrangements will be finalized to allow data sharing in real time. A decentralized network is preferred with data sharing for the purpose of short-term forecasting. Priority is given to gathering instrumented visibility reading, $PM_{10}$ data and LIDAR at selected stations in a step wise approach in accordance with each country's national priorities.

***Phase-2 (medium term): Strengthening of monitoring capacity***

This phase involves the expansion of the number of monitoring stations in the network (additional of 18 in the People's Republic of China and 12 in Mongolia) and upgrading of equipment at selected monitoring stations of the network.

***Phase-3 (long term): Strengthening of forecasting and early warning capacity***

This phase will focus on improvement in forecasting methods (including software development, training, and capacity building) to provide both short-term (early warning) and long-term (seasonal) predictions. Long term forecasting will depend heavily on data derived from ground surface monitoring and on verification of prediction model output.

In phase one, all the stations have been identified for the network by the partner countries while the proposed stations for the Republic of Korea and Japan for phase two are still to be identified and confirmed by authorities of each country. For the PRC, selected stations with LIDAR capacity/potential would be included in the DSS monitoring network, but the time of their inclusion will be decided based on resources availability and agreement with concerned parties.