3. ESTABLISHMENT OF THE REGIONAL NETWORK FOR DUST AND SANDSTORM MONITORING AND EARLY WARNING

3.1 Overview

With the growing social-environmental implication of dust and sandstorms (DSS), the concern to improve DSS monitoring and early warning has significantly increased. In Northeast Asia, countries primarily affected by DSS have conducted DSS forecasting and early warning services through their National Meteorological Services. The People's Republic of China (PRC) initiated its forecasting service of DSS and early warning service for severe DSS for the public in 2001. The Republic of Korea did the same in 2002, Japan in early 2004, and the Mongolian Meteorological Service is presently trying out similar services for the public.

The partner countries are member states of the World Meteorological Organization (WMO) network that works well with a defined purpose[1]. The national Meteorological Services of the WMO member nations have agreed to a free and unrestricted international sharing of meteorological data and products. Although meteorological data and services are essential for DSS monitoring and early warning, they are far from being adequate to analyze and predict a complex phenomenon like DSS.

Based on the review of the current DSS monitoring programs in the partner countries for consideration in establishing a regional network for monitoring and early warning, the following issues and challenges are apparent:

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, these projects are limited to some specific field and national boundary areas. Moreover, these initiatives on DSS between partner countries are presently focused on academic research and are not designed as operational tools to improve public awareness of impending DSS disasters. Despite these agreements, it is still a hurdle for DSS researchers from other agencies in Northeast Asia to get real-time data, particularly the data across countries in the region. 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

[1] The WMO is a specialized agency of United Nations with the purpose to promote meteorology and hydrology and facilitate cooperation for the benefit and protection of humans through, among others, the establishment of networks of observation stations, development and maintenance of systems for rapid data exchange, and standardization of observation and processed products.

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.

3.2 Selection of Monitoring Indicators

To establish a regional network for DSS monitoring and early warning among the partner countries, there is a need to develop a monitoring indicator system. The establishment of the common DSS monitoring indicators should start with the data that is easily available or can be easily acquired at present. It should take into account the technique and method being used for monitoring in each partner country and the long-term observational data status at the regional level in Northeast Asia, and in particular, in the originating source areas of DSS. Moreover, the initial monitoring indicator system should be adaptable to the evolution of DSS monitoring and modeling techniques and should be able to meet the increasing needs of the forecasting and early warning service.

To provide for early warning services, on the whole, DSS forecasting needs the following data or information on weather and surface conditions:

(a) Information about meteorological observation and analysis covering the following:

- Meteorological observation in the northern hemisphere for the analysis of the atmospheric circulation, which will basically cause DSS in Northeast Asia;
- Detailed meteorological observational data in DSS source area and DSS affected area (such as atmospheric pressure, temperature, rain, humidity, visibility, and wind) and its three-dimensional distribution;
- Diagnosis and analysis on atmospheric thermo-dynamic information based on the weather observation data; and
- Numerical weather prediction products from different meteorological centers.

(b) Geographic information and surface monitoring information covering the following:

- Desert distribution and soil texture information (distribution, grain size, etc.);
- Land use/cover change information; and
- Soil moisture status, including snow cover.

(c) Dust related monitoring information as follows:

- Atmospheric optical properties measurement including horizontal visibility (by transmissometers), optical depth and size mode (by solar radiation and sun photometer), vertical visibility and vertical profile (by LIDAR), light scattering (by nephelometer), etc.;
- The mass concentration and size mode of dust including TSP, PM_{10}, and dust deposition, etc.; and
- Satellite monitoring and retrieval data for DSS, which can be acquired from a variety of meteorological satellites.

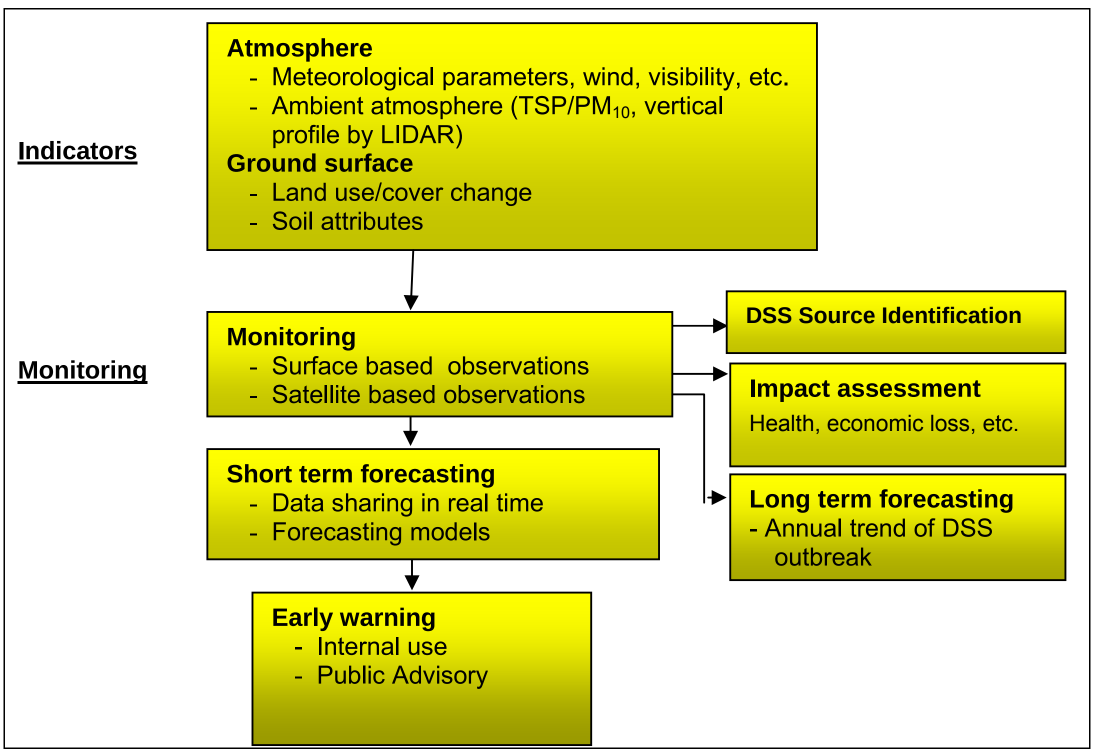
All these information belong to the basket of indicators for DSS monitoring, which are currently collected and utilized differently by partner countries. For instance, Japan and the Republic of Korea, which are relatively far from DSS originating source areas and where DSS is regarded mainly an air pollution concern, attach great importance to air quality indicators like TSP, PM_{10}, dust deposition, etc. Accordingly, significant efforts have been given in developing the monitoring instruments and techniques that can detect and monitor potential DSS impacts on air quality over a long distance for real-time data transmission like LIDAR. The Republic of Korea has also developed a PM_{10} concentration indicator based early warning system for DSS events.

In the PRC and Mongolia, where most of the DSS occurs in Northeast Asia, visibility is considered the most widely used indicator, given the tangible nature of DSS and the meteorological observation capacity in these countries. Collection of relevant meteorological observation started quite early in both these countries and they have established corresponding data sets. Based on such a data set, the PRC has achieved progress in the studies on characteristics and regularities of DSS, which forms the basis of their simulation and modeling of DSS events and early warning services.

3.3 Common Monitoring Indicators

The challenge in establishing a reasonable set of common monitoring indicators rests on the manner of accommodating the different needs (or "preference") among the partner countries without compromising the technical/operational feasibility of the proposed regional network, particularly at its initial stage. The monitoring indicators included in the core basket for cross-country exchange within the network need to be: (a) relevant to forecast models in all the partner countries, (b) readily available or which can be made available with minimal investment, and (c) capable for real time transmission from one country to another along the identified DSS transport routes in Northeast Asia.

The following chart illustrates the course towards establishing a regional monitoring network.



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.

Further, through extensive and comprehensive discussions by the experts and researchers from the partner countries involved in the project, the partner countries agreed that the initial monitoring indicators for an effective short-term forecasting for the regional network should comprise of:

(a) Instrument-measured visibility;
(b) PM_{10} (particulate matters with diameter smaller than 10 μm); and
(c) LIDAR-based observation data[2].(vertical profile of dust cloud by Light Detection and Ranging)

There are differences in the relative importance each partner country has given to individual monitoring indicators. The existence these differences do not prohibit, however, the partner countries from reaching an agreement on working with such a set of the commonly agreed DSS monitoring indicators for the regional network.

3.4 Regional Network of DSS Monitoring Stations

The objective of the regional monitoring network is to have a hierarchy of monitoring stations from the source areas in Mongolia and northern provinces of the People's Republic of China (across the Yellow Sea and the Democratic People's Republic of Korea area) to the 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. The network would also be 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.

Real time data that can be used for short-term forecasting or early warning comes from the results of monitoring the identified three common indicators 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 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

[2] An agreement reached during the Second Workshop on DSS Regional Monitoring and Early Warning Network in November 2003.

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 is none capable of monitoring PM_{10}.

The list of monitoring stations of each partner country that is proposed for the regional DSS network is shown in Table 3.1. In phase one, all the stations have been identified for the network 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.

3.5 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 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.

Table 3.1 Proposed Monitoring Stations for the DSS Regional Network

Phase	Country	Site	Class[1/]	Current Instrumented Capacity[2/]				
				Visibility	TSP	PM_{10}	LIDAR	AWS
Phase 1	PRC (Upstream Country)	Jiuquan	B		✓			
		Minxian	B					
		Germud	B					
		Lanzhou	B					
		Yinchuan	B					
		Houma	B					
		Datong	A					
		Zhangjiakou	B			✓		
		Erlianhaote	B		✓			
		Huhehaote	A			✓	✓	
		Neimeng-Zhurihe	B					
		Dianjiang	B					
		Nanyang	B					
		Shenyang	B			✓		
		Changchun	B			✓		
		Beijing	A		✓	✓	✓	
		Qingdao	B			✓		
		Zhengzhou	A					
		Lianyungang	B					
		Akesu	B					
		Bayannuoergong	A					
		Xingzi	B					
		Baicheng	B					
		Donggang	B					
		Suniteyouqi	B					
	Mongolia (Upstream Country)	GobiAltai – Altai	B					✓
		Dornod – Choibalsan	B					✓
		Dornogobi – Sain Shand	A					✓
		Umnogobi – Dalanzadgad	A					✓
		Uvs – Ulaangom	B					✓
		Ulaanbaatar	A					✓
	Japan[3/] (Down-stream Country)	Sapporo	A	✓	✓	✓	✓	✓
		Toyama	A	✓	✓	✓	✓	✓
		Tsukuba	A	✓	✓	✓	✓	✓
		Fukue	A	✓	✓	✓	✓	✓
		Nagasaki	A	✓	✓	✓	✓	✓
		Miyako	A	✓	✓	✓	✓	✓
		Matsue	A	✓	✓	✓	(✓)	✓
		Niigata, Maki	B	✓	✓	✓		✓
		Tateyama (Toyama)	B	✓	✓	✓		✓
		Inuyama	B	✓	✓	✓		✓
		Fukuoka	B	✓	✓	✓		✓
		Ryori	B	✓			✓	✓

1/ Class A stations should be equipped with visibility-measured instrument, PM_{10} equipment, and LIDAR. Class B stations should be equipped with visibility-measured and PM_{10} instruments.

2/ ✓means with existing equipment, and (✓) are to be equipped in 2005. It should be noted that the designated monitoring indicators for the regional network are only visibility, PM_{10}, and LIDAR. TSP and AWS are shown here as references for current capability.

3/ The number of stations for Japan are subject for increase in the near future.

(Cont. Table 3.1)

Phase	Country	Site	Class[1/]	Current Instrumented Capacity [2/]				
				Visibi-lity	TSP	PM_{10}	LIDAR	AWS
Phase 1	Republic of Korea (Down-stream Country)	Incheon – Incheon	A				✓	✓
		Chungcheongnamdo – Gwangdeoksan	B		✓	✓		✓
		Incheon – Bakryengdo	B		✓	✓		✓
		Seol – Gwanaksan	B		✓	✓		✓
		Chungcheongnamdo – Anmyundo	A		✓	✓	✓	✓
		Chungcheongbukdo – Chupungryeng	B		✓	✓		✓
		Jeollabukdo – Gunsan	B		✓	✓	✓	✓
		Gwangjusi – Gwangju	B		✓	✓		✓
		Jeollanamdo – Heuksando	B		✓	✓		✓
		Jejudo-Gosan	B		✓	✓		✓
		Incheon – Gangwha	A		✓	✓	✓	✓
		Chungcheongbukdo – Chunan	B		✓	✓		✓
Phase 2 [2/]	PRC (Upstream Country)	Xinjiang-Hetian	B		✓			✓
		Xinjiang-Hami	B		✓			✓
		Xinjiang-Kashi	B		✓			✓
		Xinjiang-Wulumuqi	A			✓		✓
		Xinjiang-Ruoqiang	B					✓
		Neimeng-Ejimaqi	A					✓
		Neimeng-Xilinhaote	B					✓
		Neimeng-Chifeng	B			✓		✓
		Neimeng-Wulanhaote	B					✓
		Neimeng-Hailaer	B					✓
		Qinghai-Xining	B			✓		✓
		Qinghai-Waliguan	A					✓
		Gansu-Zhangye	A		✓			✓
		Gansu-Xifeng	B					
		Shandong-Jinan	B			✓		✓
		Liaoning-Dandong	B			✓		✓
		Jiangsu-Nanjing	B			✓		✓
		Jilin-Tumen	B	✓				✓
	Mongolia (Upstream Country)	Bayankhongor – Bayankhongor	B					✓
		GobiAltai – Tooroi	B					
		Dornogobi – Khuvsugul	B					
		GobiSumber – Choir	B					✓
		Dundgobi – Mandalgobi	B					✓
		Uborkhangai – Arvaikheer	B					✓
		Umnogobi – Saikhan	B					
		Umnogobi – Gurbantes	B					
		Umnogobi – Khanbogd	B					
		Sukhbaatar - Baruun-Urt	B					✓
		Khovd – Zereg	B					
		Zavkhan – Durvuljin	B					

1/ Class A stations should be equipped with visibility-measured instrument, PM_{10} equipment, and LIDAR. Class B stations should be equipped with visibility-measured and PM_{10} instruments.

2/ ✓ means with existing equipment, and (✓) are to be equipped in 2005. It should be noted that the designated monitoring indicators for the regional network are only visibility, $PM_{10,}$ and LIDAR. TSP and AWS are shown as references for current capability.

3.6 Organizational Set Up

On the whole, the establishment of a regional network for DSS monitoring, forecasting, and early warning entails the introduction of a fundamental structure within the national level of the four partner countries (i.e., the PRC, Japan, the Republic of Korea, and Mongolia) as well as on the regional level. On the national level, the Meteorological Administration (MA) and Ministry of the Environment of each partner country should be the designated national focal point where all DSS-related data will flow and be shared on real time basis. Smooth collaboration with non-MA agencies will be encouraged and improved. On the regional level, a decentralized organizational set up is deemed practical since it allows various stakeholders in the region to participate under a formal operational structure of data sharing and reporting and under the coordination and supervision of partner countries' respective national focal agency.

The review of current conditions of the four partner countries for DSS monitoring and early warning has revealed that the downstream countries of Japan and the Republic of Korea have better infrastructure and capacity for DSS monitoring and early warning. Therefore, development of the regional network at their end would entail more of the national and regional organizational arrangements to strengthen data sharing for all aspects of forecasting and early warning. The upstream countries of the PRC and Mongolia, on the other hand, are where most of the DSS events originate and occur. And yet, their infrastructure and capability (especially for Mongolia) are apparently insufficient. As such, the development plan for a Northeast Asian DSS regional network for the prevention and control of DSS initially focuses on improving and upgrading the network of monitoring stations as well as on capability building for DSS monitoring and early warning in these countries.

3.7 Implementation Plan

Speedy operationalization and quality performance of the network will depend on the level of skills the national coordinators possess and the efficacy of the communications between the national coordinators and the members, partners, and other stakeholders and the regional support structures including the UNEP, the UNESCAP, and others. The operationalization of the network would also depend on the commitment of the various country parties on the formulation of well-focused program of work. As such, the key elements of a program to implement the regional network for DSS are set out in Box 3.1 while Table 3.2 lists the recommendations for the overall phased development with the corresponding action plan involving all four partner countries within the purview of a regional network.

Box 3.1 Key Elements of a Program to Implement the Regional Network for DSS

(a) Develop the framework for the conduct of assessment and monitoring of DSS related events (including early warning) at regional, sub-regional, and national levels using in combination the various systems of information technologies and space-based technologies;
(b) Support a national focal point/agency to enhance and improve the linkage of national databases with regional and sub-regional databases applying digital and communication technology;
(c) Develop a regional framework for the conduct of joint or collaborative information gathering and database consolidation for scientific information on DSS related matters, including desertification control;
(d) Formulate programs that will provide for analysis and interpretation of data into usable form;
(e) Encourage the use of information generated by the network and devise systems for the transfer of this information to decision makers and relevant end users (including citizens of affected areas); and
(f) Develop training and research programs for capacity building at the national level.

Preliminary discussions during meetings with scientists and administrators in each of the four partner countries formed the basis of the proposed action plan. Some actions have a suggested time-frame while others are a continuing concern. Some require considerable reorganization while others would be relatively simple to implement.

Table 3.2 Development Program for a Regional Network for DSS

Phase	Recommended Projects	Action Plan
Phase 1 (6 – 12 mos.)	Establishment of Data Sharing Mechanism in Real Time for Short Term Forecasting	(a) Determine the national focal point/agency within each partner country's national DSS monitoring network; (b) Get agreement on the proposed hierarchy of monitoring stations to designate Class A and B stations and assess the cost of upgrading equipment and data transmission (where required). (c) Develop a set of common guidelines to govern the linkages among the national participating institutions and delineate the scope to which the DSS network can utilize the information. All national network members should bear the responsibility for providing their respective DSS monitoring and assessment information to the national focal point. (d) Hold a region-wide technical workshop regarding the construction of DSS network technologies to get agreement on which to use and how. Agree on the common language(s) to be used. (e) Conduct a survey within each partner country to determine the types and patterns of fields in the database to define the content and format of the information to be exchanged in the Meta databases with uniform criteria and formats for DSS monitoring and early warning. (f) Organize one Asian regional workshop with the objective of exchanging information and comparing notes. This workshop should be followed by a study tour of the PRC and Mongolia to allow participants to visit the field monitoring stations and view local conditions in the source areas.
	Enhance Scientific and Technological Cooperation and Exchange	(a) Organize an international symposium aimed at facilitating the exchange of ideas and experiences regarding monitoring and assessment and early warning. (b) Organize a study tour of selected country that is advanced in DSS monitoring modeling. The study tour participants should be relevant personnel of the network. (c) Capacity building such as training, dispatching of experts, or other activities (though already included in Phase 3 of the current phased development configuration) should be launched as soon as possible if and when resources become available.
Phase 2 (3 years)	Expansion of the Regional Monitoring Network	(a) Identify potential funding sources from national and international (including bilateral and multilateral) agencies and private sector. Identify mechanisms and manner to raise and distribute funds (e.g., Trusts, Foundation, etc.). (b) Expand the network by identifying new sites and upgrading others through the installation of new dust monitoring equipment.
Phase 3 (3 - 5 years)	Capacity Building	(a) Upgrade the forecasting technology and modeling capacity in all partner countries, especially in Mongolia. (b) Improve infrastructure and support facilities to support national DSS related activities (training courses, study tours, production of manuals, etc.). (c) Strengthen data management capacity and improve efficiency of network communication of the national DSS centers. Specific activities will include: i) increasing the response speed and information handling capacity of the web servers; ii) expanding data storage capacities of the database servers as well as increasing rate of e-connectivity; and iii) securing authorization from relevant authorities for the designated agency to take charge of the national network's day-to-day operation.

DSS forecasting and early warning system in source areas play an important role in coping with the disaster impact of DSS in advance. On the other hand, in downstream partner countries of DSS should assess the impact on air quality by DSS. Therefore, the predicting system for the concentration and deposition in PM_{10} in the Republic of Korea and Japan during DSS event or afterward should be implemented and developed in line with forecasting and early warning system.

Getting the structure right includes training and other capacity building measures. As such, capacity building is an ongoing or continuing action found in all phases of developing the Northeast Asia DSS network. This includes training, experience sharing workshops, and field visits to the monitoring sites. While the exchange of data and ideas through networking is an important element of the network, exchange visits will be crucial because there is simply no substitution for human interaction.

3.8 Estimated Cost

As mentioned, the physical development of the monitoring network focuses on developing and improving the monitoring stations in the PRC and Mongolia. Table 3.3 presents the recommended phased development of the stations in these two partner countries with corresponding preliminary costs.

Table 3.3 Estimated Costs for the Development of Network Monitoring Stations in the PRC and Mongolia

Country	Phase[1]	No. of Stations Covered	Recommended Activities	Estimated Cost ('000 US$)
PRC	1	Initial 25	• Establish national focal agency and integrate identified monitoring station in the network. • Purchase and install needed hardware and software for instrument-measured visibility, TSP, PM_{10}, and LIDAR for identified stations. • Upgrade communication network.	4,916.90
	2	Add'l. 18	• Expand network of monitoring stations. • Purchase and install needed hardware and software.	3,260.10
	3		• Introduce long term DSS forecasting capacity by remote sensing (annual trend).	3,130.00
Mongolia	1	Initial 6	• Establish a national focal point and integrate identified stations in the network. • Purchase and install AWS, TSP, PM_{10}, visibility sensors, soil moisture sensors, and LIDAR for identified stations. • Construct ground monitoring stations. • Establish and improve communication facilities/network.	8,340.95
	2	Add'l. 12	• Expand network of monitoring stations. • Purchase and install AWS, visibility sensors, soil moisture sensors, and PM_{10}.	1,611.60
	3		• Capability building for DSS modeling, simulation and forecasting by remote sensing.	1,923.80

[1] Phase 1 – short term; Phase 2 – medium term; and Phase 3 – long term.

3.9 Cooperation with Other Regional and International Organizations

As a transboundary problem it is clear that government-to-government agreements could be put in place. One of the important obligations of the regional network for DSS and its host institution(s) is to coordinate network-building efforts and provide specific technological assistance and guidance. Programs will be designed for promoting the role of science and technology in preventing and controlling DSS, on the one hand, and blending indigenous knowledge and modern science and technology, on the other, especially in the early warning system.

The launching of the proposed regional network for DSS would provide opportunities for members of the international community to put in concrete terms scientific cooperation against DSS in Northeast Asia. In particular, interested, affected, and developed country parties will be able to work more closely and effectively, within the framework of the regional network, with international regional and sub-regional organizations. Reference can be made to the existing WMO network and to the Acid Deposition Monitoring Network in East Asia and the contributions that each of the partner countries makes now. Opportunities exist to further enhance these linkages and extend them to cooperation in the Asia-Pacific region (including Australia and other relevant countries), the USA and Central Asia. Close cooperation with existing networks and programs on long-range transboundary air pollution in Northeast Asia should be maintained.