UNCCD Science and Technology Interlinkages Desertification and Disaster

October 2005

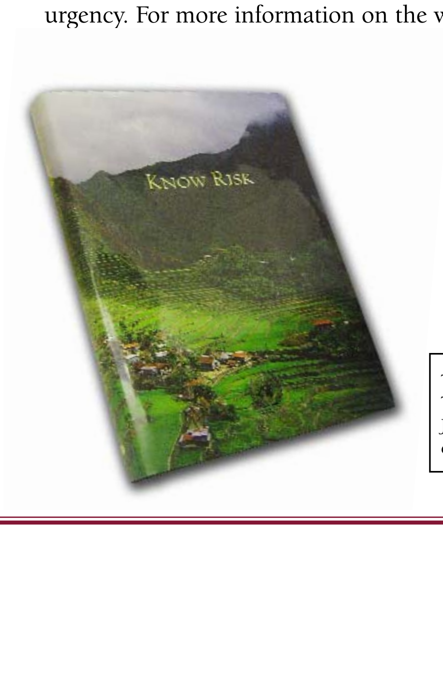
In many parts of the world, disasters caused by natural hazards such as earthquakes, floods, landslides, drought, wildfires, tropical cyclones and associated storm surges, tsunami and volcanic eruptions have exacted a heavy toll in terms of the loss of human lives and the destruction of economic and social infrastructure, as well as severely impacting already fragile ecosystems.

While natural hazards will continue to occur, human action can either increase or reduce the vulnerability of societies to these hazards and related technological and environmental disasters by focusing on socioeconomic factors determining such vulnerability. Knowing about risks that lead to disasters, understanding how they affect our livelihoods and environment, and dedicating collective efforts to manage those conditions are crucial to protect our lives, our possessions, our social assets and indeed the land, water and natural resources on which human life depends.

There is considerable scope for the reduction of risk through combating desertification and the application of disaster prevention and mitigation efforts based, for instance, on modern forecasting technology in terms of the development of early warning systems.

The World Conference on Disaster Reduction was held in January 2005 in Kobe, Japan. In support of the conference Tudor Rose Publishing (U.K.) and the International Strategy for Disaster Reduction (UN/ISDR) collaborated in a unique public-private partnership to advance their shared commitment to reducing disaster risk through the release of *Know Risk*, a fully illustrated, 376-page book with over 160 authors relating their work in disaster reduction at international, regional, national, municipal and local levels. This reprint highlights the work of Riccardo Valentini, Chairman of the Committee on Science and Technology and Kazuhiko Takeuchi, a member of the UNCCD Group of Experts. The reprint also contains a personal statement by UNCCD Executive Secretary, Hama Arba Diallo.

As a result of the Kobe conference a number of priorities were developed under the Hyogo Framework for Action 2005 — 2015. An important key to prevention in the framework is reducing the underlying risk factors related to changing social, economic, environmental conditions and land use, and the impact of hazards associated with geological events, weather, water, climate variability and climate change. Desertification, drought and natural risk reduction need to be addressed by the international community with a sense of urgency. For more information on the web:



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STATEMENT FROM HAMA ARBA DIALLO, EXECUTIVE SECRETARY, UNITED NATIONS CONVENTION TO COMBAT DESERTIFICATION

The loss of lives due to severe natural disasters, the spiralling increases in the cost of reconstruction, and the loss of development assets has put the topic of disaster management squarely on the political agenda.

Natural disasters have reached enormous dimensions, and frequently bring in their wake intra-state tensions and the suppression of human and minority rights. The process of desertification compounds the actual impact of disasters, limits the ability to absorb an impact, and lowers the resilience to disaster recovery. Desertification illustrates the inter-linking nature of environmental degradation, natural disasters, and vulnerability.

Early warning and prevention are of great significance in dealing with natural disasters. There is no doubt that what has been attained in this field to date is partly due to the achievements of the International Decade for Natural Disaster Reduction and the work of the International Strategy for Disaster Reduction (ISDR). But considerably more must be done by way of prevention and improved readiness for possible disasters. In liaison with relevant international agencies, the UNCCD secretariat extends full support to the development and implementation of comprehensive programmes of early warning, including the strengthening of technical capabilities and community-based organizational activities to make the programme operational.

International treaties such as the UNCCD have a role to play by increasing interaction and cooperation between the natural and social science communities working in disaster reduction. This dialogue should now be centered on the management of disaster risks by reducing the vulnerability of the affected people, increasing their capacity to cope, and tackling the root causes of vulnerability which are the underlying social, economic, institutional, and political structures.

We at UNCCD have given a strong focus to the analysis of the causes of land degradation and on measures for prevention of desertification in parallel with measures for rehabilitation.

The victim of disaster, the suffering human being, is the true focus of this publication, regardless of the social system in which they live. Knowing risk means addressing the issue of risk reduction for the poor, to save human lives when disaster strikes, to alleviate human suffering, and to prevent further disasters from occurring. I trust that this publication will send a signal, even in the deepest of crises, that the victims have not been left to their own devices. The individual contributions to this volume represent a visible sign of hope.

Hama Arba Diallo
Executive Secretary, United Nations Convention to Combat Desertification

This statement was originally delivered for *Know Risk* at the United Nations World Conference on Disaster Reduction, 18-22 January 2005, Kobe, Japan.

STATEMENT FROM PROFESSOR RICCARDO VALENTINI, UNIVERSITY OF TUSCIA DEPARTMENT OF FOREST SCIENCE AND RESOURCES

As early as 1949, the scientist Andre Aubreville noticed land degradation extending north into semi-arid and sub-humid regions of North Africa from the more arid zones of the Sahara. The term Aubreville coined for this process was “desertification”. Today desertification and land degradation is a major threat to every continent, affecting more than 100 nations and 70 per cent of the world’s agricultural dry lands.

Dust storms are increasing globally with far-reaching consequences for the environment and human health. Up to three billion tonnes of dust is blown around the world annually. Dust storms originating in Saharan Africa have increased ten-fold over the past 50 years, threatening human health and coral reefs thousands of miles away, and contributing to climate change. The problem is far worse in Northern China where highly populate areas, such as Beijing, are impacted every year by massive storms, creating health problems and damages to infrastructures.

Most desertification happens as “runaway” phenomena which are irreversible on human timescales. That is to say, once desertification starts it is hard to stop and difficult to remediate in an area. This has major implications for society’s response to desertification, or the threat thereof. Since it is hard to remediate an area that has undergone desertification, it becomes necessary to attempt to forecast arid land degradation in addition to monitoring the soil and vegetation status of deserts. In this respect science and technology has an important role to play both in monitoring and forecasting desertification and land degradation.

The Committee on Science and Technology (CST) of the United Nations Convention to Combat Desertification is a subsidiary body of the Convention whose aim is to promote science and technology to understand, assess and mitigate desertification, land degradation and poverty. In the context of *Know Risk*, where the emphasis on knowledge is particularly appreciated, we are very pleased to present two examples of the work of the CST and its group of experts to fight desertification and land degradation.

Professor Riccardo Valentini
University of Tuscia, Department of Forest Science and Resources

Integration of benchmarks and indicators, monitoring and assessment, and early warning systems

Kazuhiko Takeuchi and Tomoo Okayasu, Department of Ecosystem Studies, Graduate School of Agricultural and Life Sciences, University of Tokyo. Professor Takeuchi is a member of the UNCCD Committee on Science and Technology Group of Experts

THE DEVELOPMENT OF benchmarks and indicators in order to monitor and assess desertification and the establishment of operational and cost-effective Early Warning Systems (EWS) for drought and desertification are among the principal items on the agenda drawn up by the Committee on Science & Technology (CST) under the UN Convention to Combat Desertification (UNCCD).

A pilot study towards the ultimate goal is to develop desertification assessment and to establish an EWS in north-east Asia has recently been launched. The aim is to promote interdisciplinary and international research by:

- employing an integrated model to establish desertification EWS
- standardising observation methods for long-term monitoring of desertification indicators
- assessing land vulnerability through field surveys.

The integrated model created by this research project will make it possible to use land vulnerability as a criterion to assess local-scale desertification, so that land managers and decision-makers can identify the most appropriate land use and establish ecosystem management plans.

The integrated model will also enable local assessment results to be extrapolated across a wide area, and the data thus derived to be included in the respective National Action Programmes (NAPs), which have hitherto often lacked scientific and technological information. At present, there is no operational desertification EWS in the world which provides coverage over more than a few years, although some EWS for seasonal droughts have been used on a regional basis.

Methodologies

A quantitative integrated model is needed to conduct desertification impact assessment and for implementing countermeasures. Solutions cannot be produced by focusing on one isolated problem from a single angle, and creating the most effective formula only for this particular problem. Desertification countermeasures consisting exclusively of revegetation provide a good example. This method often causes degradation of local residents' living and water environment.

Desertification assessment should identify the most suitable compromise choice through which a balance can be maintained among the various constituent elements, and whereby the overall system can be preserved while the land is used to support life, vegetation coverage is maintained to prevent land degradation and the ecosystem is conserved on a long-term basis. Development of a quantitative integrated model is a prerequisite for tackling such a problem.

Based on the PSR (pressure, state, response) Framework, proposed by OECD as a basic framework for environmental assessment, the pilot study aims to grasp the relevant phenomena, to construct a model and to apply this model, while paying constant attention throughout to the connection between indicators for land degradation and those for its causes and effects.

But at the same time, the phenomenon manifests itself on a larger scale. Assessment on this larger scale provides the indispensable basis for policy formation and decision-making; however, the difficulty of combining breadth of scope and depth of complexity in a single examination has meant that conventional desertification research has been compartmentalised according to the different spatial scales involved in each respective project.

Desertification assessment requires arguments built upon diverse indicators, which are obtained by field surveys. For example, the vegetation coverage rate itself cannot reveal ecological stability. Unfortunately, the application of diverse indicators for large-scale observations and estimates capable of supporting an assessment of the desertification process at present remains, and will also remain for the near future, impossible in practice.

Therefore, we need to focus upon the specific processes involved in land degradation in each particular place. Through field surveys, we will identify the stages involved in the degradation/restoration process. Subsequently, the stability of the ecosystem during each of these degradation/restoration stages will be assessed. In this way, at each spot, it will become possible to assess sustainability through a small number of indicators, which can also potentially be obtained on a large-scale basis. Moreover, because similar environments will most likely follow similar degradation/restoration processes, it will be possible to organise the environment spatial groupings, which will enable large-scale assessments to be conducted by using the landscape ecology method and multiplepoint field surveys. By following such an approach, emphasis will be given to observation/estimation through indicators on a large-scale basis, and to understanding the details of the desertification process and benchmarks on a regional scale; the advantages of both spatial scales will be harmoniously integrated.

Constructing an integrated model for a desertification EWS

Initially the pilot study will focus on the development of an integrated model and assessment methods which will use this model. First of all, for developing the model, data relating to degradation /restoration processes of desertification, the critical amount of grazing at each stage, stability and resilience against climate change and human interference, and decisive points for stability and resilience (that is, benchmark stages), will be included.

To explore the universal applicability of models over spatial variability, empirical parameters, or models, will be constructed individually for each landscape type. Adjustment of the parameters will allow the results calculated for a separate type to be combined in an appropriate way, and account to be taken of any variability in the background environmental elements.

At the same time, macro-socioeconomic information should be collected, both statistical and non-statistical, and an appropriate interpolation method should be found whereby this information could be included in spatial mapping. This information will be managed according to the Geographical Information System (GIS).

Finally, by integrating the models created and the information collected, a large-scale mapping system will be developed to include past environmental changes and grazing pressure changes, and also the degradation/restoration stages which have followed desertification prevention countermeasures, grazing capacity and benchmarks.

Once the system is established, an assessment will follow. First, a simulation covering the last several decades will be carried out to understand long-term desertification trends. At the same time, the politics, economy and environmental policies in the target areas will be taken into account so that their negative impacts on vegetation can be assessed, and the assessment results will be fed back into the integrated model as impacts caused by macro socioeconomic factors.

Various environmental scenarios will be examined in connection with the current desertification conditions, and their benefit evaluated. Each scenario will be checked for its feasibility. In evaluating the effects of a given policy, consideration will also be given to land use regulations, cost-effectiveness (including the human and economic costs of introducing eco-technological measures), and the most appropriate spatial distribution pattern of the numbers of cattle for grazing in order to avoid land degradation and keep a healthy grazing capacity.

Desertification indicators for long-term monitoring

Climate indicators (mainly rainfall quantities) and vegetation indicators such as the Normalised Difference Vegetation Index (NDVI) have hitherto dominated the field of large-scale monitoring for desertification assessment. Assessments based on these two sets of indicators have been effective for short-term EWS such as for drought, but they are not sufficient to provide an accurate assessment for the whole desertification process, which does not become apparent for several years or more. Soil is an important indicator, because there are direct correlatives for changes over time and the order of desertification, and soil also has a strong influence on land productivity resilience.

The widespread use of remote sensing has made possible an accurate grasp of vegetation indicators; as for vegetation cover and biomass, NDVI has been found capable of producing accurate results. In this pilot study, by estimating the community height as well as using such two-dimensional information, we will aim at an accurate estimation of biomass, determination of vegetation types, and improvement in parameterising models for soil erosion estimates.

Wind and water erosion will be estimated by model simulations. Another aspect to be considered is the impact of snowfall in the target areas; there has been no previous attempt systematically to assess soil freezing and related erosion. Through field surveys, we will develop a method to assess the impact, which snowfall and frozen soil have on erosion.

Land vulnerability assessment

If desertification indicators are to be used for land vulnerability assessment, clear benchmarks are necessary. But the lack of clear definition on desertification is causing confusion in discussions of desertification benchmarks. To overcome the current problem, the pilot study should take the position that whether or not desertification is occurring depends on whether or not conditions are sustainable, and therefore we need to develop instruments which will enable sustainability to be assessed scientifically. Desertification research on sustainability-related benchmarks is almost non-existent, especially in large-scale projects.

In the target areas, the relationship between natural resources and sustainability returns to the digestible nutrients in plants. The amount of digestible nutrients which can be consumed (grazing capacity) depends upon vegetation types, species composition, the current amount of nutrients and productivity. These factors vary largely according to natural conditions such as climate, topology, geology and soil type, and the changes caused by human interference are also clearly apparent.

More concretely, apart from such direct consequences of human interference as cattle grazing, reduced productivity and the diminished luxuriance of species composition/vegetation types, indirect influences are being strongly felt, in terms of physio-chemical changes in soil (soil nutrient degradation, salinisation), physical changes (aggregate formation restriction, crust, compaction) and soil erosion. Resilience especially has a strong connection with soil degradation, which not only restricts the recovery of land productivity, but also leads to accelerated and irreversible land degradation. In a desertification assessment, the different stages of the desertification process should be assessed comprehensively.

On the basis of a thematic map of climate, topology, geology and soil, we will first divide the target areas into several landscape types in accordance with their respective landscape ecology, and will then establish an observation station in each of these districts in conjunction with researchers from the counterpart-countries. Here, monitoring of weather, and soil erosion, will be conducted, and the degree of erosion will be estimated based on the activities of radionuclides in the soil. Fences will be established for experiments with different landscapes and different grazing densities, in which there will be a thorough examination of desertification-related indicators, and an investigation of the relation of the degradation/restoration process to the land use burden, the dynamic equilibrium state, and the rate of change from one level to another.

Parallel to these studies, an extensive survey of the surrounding area will be conducted, in order to gain more knowledge on the longer-term processes of degradation/restoration, to identify similarities in the spatial variabilities involved in these processes, and finally to categorise the environment into groups based on similarity in their background environmental factors. This combination of experimentation and monitoring will reveal the critical point of grazing capacity, and its stability/resilience against climate change and human interference for each environmentally categorised group.

In addition, through identification of the decisive points at which stability and resilience undergo significant changes, the combination of indicators necessary to serve as a baseline will be determined. From the degradation levels established as a baseline, various elements capable of observation by local residents (for example plant species composition, vegetation coverage) will be chosen, and benchmarks for diagnosing local land conditions will be suggested. We will focus especially on indicators for the plant species, and through growth experiments, will analyse the impact of soil elements on the physiological and ecological character of plant species.

Furthermore, we will explore the appropriate restoration /management (ecosystem management) methods for each degradation stage. For example, taking land productivity and biodiversity into consideration, a judgement based on the degree of land degradation will be made on whether to restrict grazing density in order to promote vegetation rehabilitation, or to introduce technological methods for soil stabilisation and plant cultivation.

We carry out growth experiments in laboratory where environments are controlled, by using the samples collected in the target area. Under the environments, where weather condition (radiation intensity, air temperature and humidity) and soil condition (particle size distribution, moisture and nutrient) are controlled so that the environment in the target area is simulated in the laboratory, the activity of the plant physiology, such as transpiration rate and photosynthesis rate, of the major indicator plant species (for example Artemisia intramongolica, A. ordosica, Caragana spp.) are analysed in relation to soil characteristics.

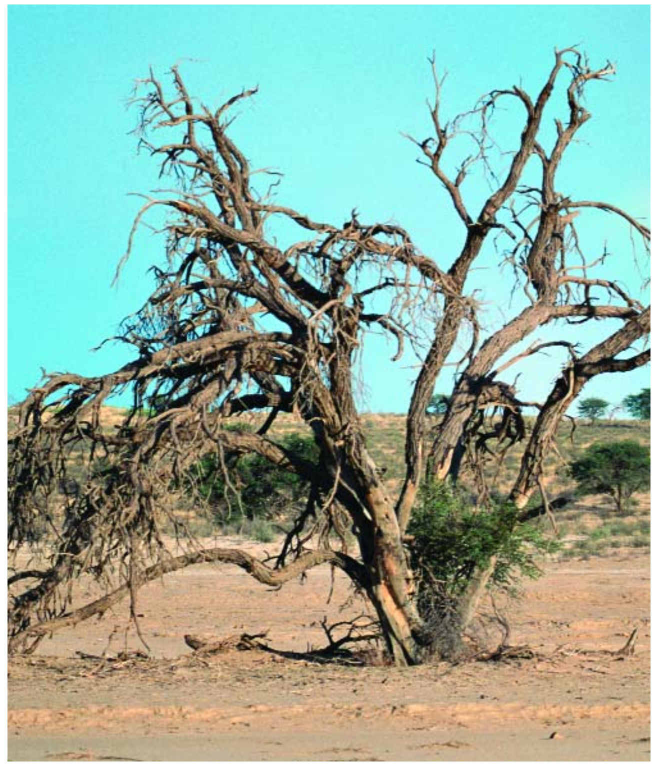
We will provide a model explaining the relationship between the soil factors to the plant physiological and ecological characteristics, as well as the inter-species effects. The validity will be discussed by comparing the model results with the data of vegetation and soil in the target area. Moreover, we will estimate the change in the species composition and the productivity in the cases when the soil is more degraded and the restoration measures take place. The diagnosis measure for soil degradation by surveying vegetation indicators will also be provided.

Observation points will be established in four areas: an area sandy land in Naiman county of the Inner Mongolia Autonomous Region, China; an example of Gobi steppe, in the Southern Gobi Province, Mongolia; a case of the marginal area of steppe and Gobi steppe, Dund Gobi province; and for a case study of steppe, in Hentiy Province, Mongolia.

Specific examples of expected results

When the desertification EWS has been established, it shall be used to conduct a simulation of the last several decades, and it will be possible to assess long-term desertification trends, on both a large-scale and a regional-scale basis including the socioeconomic background. The results will mark an unprecedented achievement for desertification research in north-east Asia.

The desertification EWS will make it possible to assess various policy options objectively, which will enable the formulation of proposals for the most appropriate and feasible land use methods, and for an ecosystem management plan, with quantitative information concerning cost-effectiveness provided for each option. Such a system will be the first example in the world of a desertification EWS capable of policy option assessment as well.



Desertification is a particular problem in Mongolia

Through the desertification EWS, there can be a large-scale assessment of desertification progress in arid regions of North-East Asia and of land vulnerability distribution, and preparation for developing a desertification map which includes such factors as soil erosion and grazing capacity. An objective desertification map has been an important priority for the Asian region, and its completion can be expected to have widespread and ramified consequences.

Benchmarks and indicators for local land vulnerability assessment can be proposed for application in fieldwork, which could contribute to the establishment of a technique to diagnose the level of land degradation. Such benchmarks and indicators, usable for on-site diagnosis, are an international desideratum, and can be expected to be both highly useful and highly functional.

Scientific and technological significance of the pilot study

The closest existing system to a desertification EWS is DeMonII (Hill et al, 1998) which the University of Trier, Germany, has been developing in the Mediterranean. But this still remains at the level of assessment conducted through desertification indicators (de Jong et al, 1999; Hill and Schutt, 2000). If our research agenda is recognised as one of the pilot studies based on the CST recommendation, it is likely to yield results unparalleled anywhere in the world.

By using the integrated model, the research will suggest a system by which different options for countermeasures against desertification and their cost-effectiveness can be assessed. Since the drought EWSs which currently exist have not yet introduced such a system this can be expected to be a highly original contribution to the desertification research field.

Dust storms and rural development in North China

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20 March 2002, Beijing

Dust storms are among the most astonishing and scaring manifestation of the earth's power. These extreme meteorological events originate in the big deserted areas of the world and are characterised by huge amounts of high-concentration dust particles transported at high speed by winds.

As a natural phenomena, dust storms have plagued the planet all through its history; nonetheless, there are raising evidences that anthropogenic disturbances are affecting the delicate desert ecosystems in a way that is leading to an increase in frequency and intensity of these events.

The main direct human threats are related to over-exploitation of natural resources: livestock over-grazing, intense agriculture, extraction activities and tree-cutting for firewood leave loose, dusty soils, susceptible to wind erosion. Indirect human impacts are related to over-exploitation of water leading to partial or complete drying up of water basins and exposure of erodible soils to the wind action. Finally, enhancement of desertification processes is also a consequence of the changes induced by human activities.

By this point of view, dust storms are a symptom of desertification, but they are a cause of desertification as well. Indeed, sand, transported at high speed by winds, plagues the lands on its path, burying agricultural and range-lands as well as water courses, thereby enhancing the desertification processes, particularly in lands already threatened by intense human activities. On the local scale, another problem is related to dunes shifting that can lead to dune displacement of even one to two metres per day, depending on the wind power. Such dunes invade roads, threaten buildings and infrastructure, and cover entire vegetated lands, thus enhancing desertification.

Dust here refers to fine particulate, with diameters ranging from 0.1 to 100 micrometre, thus involving fine sand particles. The finest components of this dust (PM10) are lifted by wind and transported over long distances at the continental scale; they contribute to the global dynamics, acting as an aerosol, reducing the solar irradiation at the ground, indirectly contributing to global climate changes.

At the same time, under the influence of global climate change, warm winters and dry springs occur more seriously in the arid regions where large areas of vegetation are impacted. It causes serious water and soil losses, secondary salinisation and deterioration of the physical structure of the soil and hence amplifies the effect of wind erosion.

Dust storms are a direct threat for human health as well: during the storms and for several days later on, fine particulate matter is suspended in the air. When breathed by men and animals it creates severe problems to the respiratory system. These problems are not limited to the regions where the storms arise. For example, storms originating in the Gobi desert rapidly move eastward, reaching the great cities of eastern Asia, like Beijing, Tokyo and Pyongyang, bringing the same problems of health risks to millions of people. Indeed, the China Environmental Monitoring Centre showed a correlation between sandstorms and the increase of the Total Suspended Particles (TSP) in the towns downwind of the sandstorms' origin

During sandstorms, visibility is reduced to few metres or less, disturbing terrestrial and aerial traffic, and dramatically increasing risks of accidents

regions. The typical dimension of the suspended particles are inversely proportional to the distance from the sand storm source. Concentration of the smaller fractions (PM10 and PM2.5), is increased to 4-5 times the normal concentration and it is known to be responsible for the worst effects on human health. During sandstorms, visibility is also reduced to few metres or even less, disturbing terrestrial and aerial traffics, and dramatically increasing risks of accidents.

The situation in north China

Sandstorms appear sporadically around the world, mainly in the major desert areas of North Africa, Middle East, North America, Australia and particularly in central Asia, where China is one of the countries most severely plagued by desertification. With up to 58 per cent of the country's land area being classified as arid or semi-arid, nearly one-third of China's land suffers the effects of desertification and is responsible for the biggest dust storms in the world.

The desert areas of Inner Mongolia, in particular of the Alashan Prefecture, are considered one of the most intense sources of dust storms in the world. All through the year, though mostly in spring, strong and persistent winds blow from Siberia and impinge on the lands of the Gobi region; springtime is also the driest period of the year, when most of the lands are naked and the lack of humidity makes soils even more susceptible to wind erosion. The presence of such factors leads to the formation of the most powerful and destructive dust storms in the world.

The finest components of the lifted materials are transported through the atmosphere, reaching North Korea and Japan, sometimes even the west coast of the US.

A step toward control of dust storms

As already recognised by the United Nations Convention to Combat Desertification (UNCCD): "…there is a need to document the nature, extent, causal factors associated with the severe sand and dust storms experienced in China and to look for methodologies to face them…. Combating sand and dust storms demands political, social, biological, economic, educational and engineering approaches as well as the physical effort that has dominated efforts in the past."

As a step toward the comprehension and the fight against Dust Storms, the Environmental Protection Bureau of Beijing Municipality and the Italian Ministry for Environment and Territory are promoting an ambitious project named WINDUST, which also contributes to the main scope of the United Nations Convention to Combat Desertification (UNCCD).

The project is located in the Alashan Prefecture of Inner Mongolia. This is an arid and semi-arid plateau where the continental climate and the distance from the sea bring cold and dry winters and warm and relatively humid summers where rainfall rarely exceeds 150 mm/year). The population living in the region is sparsely distributed, mainly comprised of shepherds breeding goats, sheep, horses and camels; people typically live in family farms, fed by subsistence agriculture.

The rationale of the WINDUST project is to propose and test methodologies of intervention aiming at preventing and mitigating dust storms' impacts.

The distinctive idea characterising the project is to join scientific research, experimentation and practical implementations for rural development into an integrated effort of co-operation and mutual exchange, in order to develop and propose a comprehensive and participatory methodology rather than "a single solution for a single problem". Due to the unstable equilibrium governing environment and socio-economy in those critical regions, dealing with desertification and wind erosion can only be effective if carried on with an integrated approach, taking into account all the consequences of any action.

Far from being only an environmental project, WINDUST has introduced the concept of sustainable development in the rural areas of Alashan, limiting human pressure on natural resources, thus leading to prevention of anthropogenic enhancement of dust storms and mitigation of natural hazards.

Due to substantial lack of knowledge about the phenomena involved, the enormous dimensions of the problem and the extreme environmental conditions of the concerned region, several objectives had to be reached in order to assess feasibility and reliability of any prevention/mitigation action. First, knowledge about the processes and their interactions has to be significantly improved and systematised, strengthening the efforts of the scientific community in this direction. Effectiveness and reliability of technologies and methodologies have to be assessed, as well as people's acceptance of such technologies. Furthermore, an integrated intervention approach should be proposed to take into consideration the multidisciplinary nature of the topic.

To achieve these goals, the WINDUST project is structured in three conceptual phases: a study phase, a pilot projects phase and a modelling phase; joining the outputs of this three packages leads to the final large-scale intervention planning phase.

The study phase

In this starting activity, any available information concerning the environment and the socio-economic features of the region will be


14 March 2002, Bayanhaote County No.6 Middle School


14 March 2002, Alashanzuo County, Alsahan Prefecture

collected and integrated in a comprehensive database. A complete GIS of the case study region will be compiled. All the information about the structure of the society will be included in a report, possibly integrated with *in situ* interviews of local population and regional authorities.

The main activity linked to this assessment phase is the development and testing of an innovative technique to measure dust emission caused by wind erosion. Based on the so-called eddy covariance methodology, this new technology will help to throw some light on the dynamics associated with the erosion processes. Furthermore, it will be one of the first attempts to directly quantify the actual amount of matter emitted during the erosion events. When used on a large scale, this would be of great help in focusing the intervention strategy in the most critical areas.

The pilot projects phase

Human activities are known to be one of the harming factors enhancing dust storms. For this reason, any environmental action dealing with desertification has to be a social action as well. Introducing the concept and the pragmatism of sustainable development is thus mandatory, in order both to reduce anthropogenic impacts and to *use* human activities to fight problems, instead of creating them.

By this point of view, several pilot projects have been proposed to test effectiveness, reliability and potentiality of innovative agriculture technologies and methodologies.

State-of-the-art Italian methods will be joined to traditional practices, in order to gradually turn local economy toward a sustainable one, while mitigating and preventing dust storms.

Low-energy, low-water demanding soil working technologies (for example, irrigation by wind water pumps and the so-called Vallerani System) will be tested, to assess the possibility to use re-vegetation (including afforestation/reforestation) as a large scale action to contrast wind erosion.

Clean, renewable energies (basically wind and solar) will be used to supply both traditional cultivations and new-concept nurseries of local species (mostly Saxaoul and Artemisia). While helping alleviating wood demand for heating houses (thereby reducing pressure on forest resources), high efficiency burners will significantly reduce indoor pollution due to combustion residues. Introduction of alien species suitable to local climatic and environmental conditions will be evaluated, as well as enhancement of traditional cultivation with market potentialities (for example ginseng cultivation).

The setup of the pilot projects has been inspired by the participatory approach. Indeed, each activity has to be implemented and carried on by teams composed of Italian experts, local experts and local population: the families (including women and youths) will be involved in all the phases of the project, maintenance of infrastructure will be up to the farmers and for this reason training courses for the high technology introduced will be planned. The underlying idea is to make the foreign presence unnecessary in the management phases of the projects.

The modelling phase

The pilot projects are intended to test local effectiveness of several mitigation/prevention interventions. Indeed, the dimension of the source region makes any small scale project ineffective in reducing the total dust emission. Quantitative measures of dust emission are also 'punctual' information and need to be extended at a regional scale, in order to be useful.

This is why a modelling phase has been introduced in the project as a necessary step toward a large scale intervention plan. An integrated model , based on remotely-sensed images of the region, on the measures of actual dust emission and on process-based schemes, will allow simulation of the dust cycle (production, suspension, transport, deposition). By virtually simulating the impact of possible scenarios of intervention, such a model will be of great support in planning large scale action to broadly use the most effective and reliable technologies tested in the pilot projects phase.

The overall project has been designed and will be developed by a consortium made up of governmental institutions, universities, public and private research centres, private manufacturers and agencies, both Italian and Chinese. Such a varied team is needed to face tasks spanning from theoretical modelling to working the soil , the success of the project being strictly linked to a continuous interface and co-operation between the parts and with a balanced importance given to all the components.

Dust storms are not a challenge that can be faced and resolved in few years. Nonetheless, such a multi-disciplinary project could be an important kick start and a point of reference for future actions, showing the benefits and the limits of an action aiming at controlling such a big environmental problem.

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