Soil Erosion, Deflation and Desertification

Challenges and Countermeasures

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The Current Situation in China

According to the Chinese Ministry of Water Resources the situation of soil erosion and deflation in China remains alarming, despite the increasing number of counter measures taken during the past decade. The Ministry states that at least one-third of the country's territory is affected by serious erosion (water-driven), deflation (wind-driven) and thus desertification (loss of soil and fertility, as well as spread of deserts). The problem is evident in every province and autonomous region of the country. It causes a decrease of arable land, increases salt loads in rivers, lakes and reservoirs, aggravates floods, droughts and sandstorms, damages ecosystems, decreases biodiversity, and overall slows down sustainable socio-economic development. As arable land area diminishes, sediment accumulation raises river-beds, increases the potential for floods, and also reduces the storage capacities of lakes and reservoirs. Soil erosion damages roads and infrastructure, while mudflows and rockfalls in mountainous terrain endanger settlements.

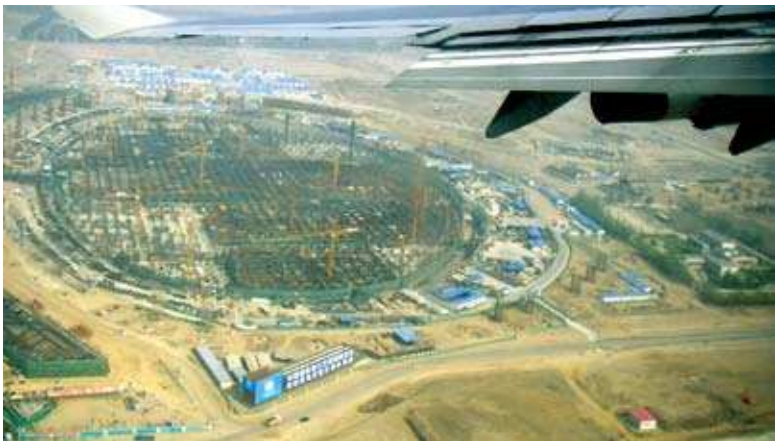
According to a Xinhua News Agency report from 2007, nearly 40 per cent (3.7 million km^2) of the country is affected, with more than 6.5 billion tons of topsoil lost every year. Slightly less than half of this amount is lost due to water erosion, while just over half is lost as a result of wind-driven deflation. A large proportion of the water-induced losses occur in the upper reaches of the Yangtze River basin and the Yellow River basin (see Pics. 1). Deflation mainly occurs north of the Great Wall along the upper reaches of the Yellow River, as well as on a broad scale in Xinjiang, Qinghai, Inner Mongolia and Ningxia – here especially in the loess plateau. Soil erosion and deflation are mainly human-induced effects of the overuse of natural resources – irrational extension of agricultural land into dry areas, excessive grazing on grasslands, clear-cutting, mining (see Pics. 2) and construction (see Pics. 3 and 4). Furthermore, according to the State Environmental Protection Agency, more than 15 per cent of the country's cultivated land suffers additionally from pollution through chemical fertilisers, pesticides, heavy metals, plastic film and toxic water. The resulting loss of cultivated land is especially alarming since only about 12 per cent of the country's total land area is arable.

Countermeasures

On the governmental side many action plans have been passed to establish a framework for countermeasures and conservation projects. The Law for Water and Soil Conservation was issued in 1991 and regulations for

Pic.1: Banks of the Yellow River in Inner Mongolia. Eroded riverbanks and exposed soil lead to increased sediment erosion and deflation. Dust particles in the air limit visibility to less than 3 km.
Photo: Claudia Künzer

Pic. 2: Deforested area in a formerly partly forested region of the Helan Shan Mountains, 2000 m above sea level. The area is nowadays a mining region. Northern Ningxia, China.
Photo: Claudia Künzer



Pic. 3: Construction close to Beijing Airport in 2005 in Germany construction areas bare, uncovered soil and accumulation of construction waste are exposed to wind, leading to regional sandstorms and soil deflation.
Photo: Claudia Künzer

Pic. 4: Construction and development in the centre of Kunming city, Yunnan Province. Large areas of bare, uncovered soil are exposed for many months.
Photo: Claudia Künzer

implementation passed in 20 provinces in 1993. Law enforcement teams were set up to supervise and promote erosion and deflation control. Law and soil conservation actions were included in regional economic and social development plans. The National Plan of Eco-environmental Improvement was passed in 1998, enlisting strategies for key river basin management, landscape planning and erosion control measures aiming at controlling erosion and creating eco-environmentally sustainable environments by 2050. Large-scale governmental projects were first implemented in the river basins of Wuding River in Shaanxi Province, Sanchuan River in Shanxi Province, Dingxi County in Gansu Province, Xingguo County in Jiangxi Province, and the Three Gorges area. Furthermore, the seven major basins of the Yellow, Yangtze, Songliao, Hai, Huai and Pearl Rivers, and the Taihu Lake basin were declared as key areas for protection and conservation. Demonstration projects were successfully completed in more than 800 counties in 26 provinces, and their second and third phases are currently ongoing. Measures taken include afforestation, planting of trees and forage grass, erosion-controlling tillage, terracing of farmland, introduction of drought-resistant crops, education of farmers, green technology such as engineering efforts to harness gullies, collecting rain water and improving irrigation techniques, mud-flow control engineering, improved construction management, the establishment of Nature Reserve areas, and programmes to raise public awareness. Of the whole area affected by erosion and deflation, about 900,000 km^2 is currently being dealt with under comprehensive erosion control measures.

Project Examples

The largest afforestation project in the world is the "Green Great Wall", officially known as the "Three-North Development Shelterbelt Program". The programme calls for over 35 million hectares of land to be newly planted with trees by 2050. The green belt, running parallel to the Great Wall, is intended to act mainly as a barrier against dust storms from the north, and will extend 4,500 km from east to west and 100 km from north to south. The mixed forests are dominated by the undemanding poplar, which grows very fast and can handle the limited precipitation in the area. One-third of the Green Great Wall has already been planted and is slowly becoming established. However, there has been criticism of the project, because trees are planted in areas that are originally not suitable for tree growth. Irrigation measures during the first growth period of the trees have lead to a decrease in the already reduced groundwater reservoirs. Moreover, most planted species lose their leaves in the winter season, which is the most common time for sandstorms in China. Thus, programmes funded by the Chinese government, as well as the Asian Development Bank, Global Environment Facility and United Nations Development Programme now seek to adopt countermeasures against erosion and deflation more suited to local circumstances. Such measures include planting of locally adapted

Pic. 5: Car in Beijing after a sandstorm in April 2006.
Photo: Shi Zhao

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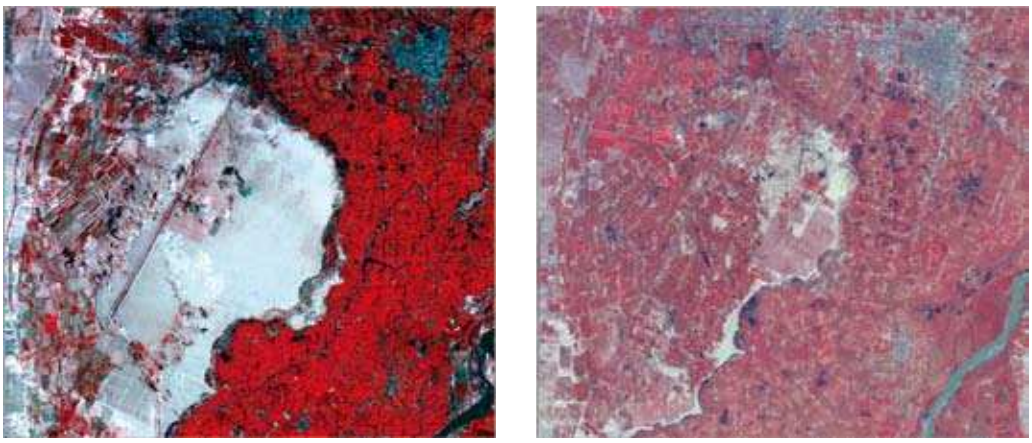

Pic. 6: Area south of Yinchuan, the capital city of Ningxia Hui Autonomous Region as seen in satellite imagery from 1987 and 2002 (30 km x 25km). In 1987 (left) large areas south of the city (dark grey) are covered by desert sand (light colour). Red tones indicate vegetation (agricultural fields). The Yellow River can be seen in the lower right corner. In 2002 the desertified area has been reclaimed through the planting of trees along north south traversing roads, keeping the deflated sand coming from the West outside of the city districts. The introduction of adapted species and further deflation control measures within an extensive countermeasure programme has contributed to this success.

species and the introduction of new agro-forestry schemes, accompanied by education to increase acceptance by the local population.

Large afforestation efforts have also been undertaken in Hebei Province, surrounding Beijing, which has World Bank funding. Protection in the area is especially crucial because the 14 million inhabitants of Beijing and over 65 million of Hebei are affected by heavy sandstorms (see Pic. 5). There are also smaller bilateral and multilateral projects such as the reforestation project aimed at increasing protective forest to the north of Beijing jointly undertaken by the Chinese and Japanese governments under the "Sino-Japanese people-to-people cooperation" programme. Half of the funding for the forest was provided by Japan. Overseas private companies also support such activities. For example, Toyota Motor Corporation has been a member of the 21st Century Greater Beijing Reforestation Model since April 2001 – an initiative that aims to prevent the expansion of desertification in and around Beijing and is currently actively funding further reforestation in the area.

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Another cooperation project, undertaken jointly with Oregon State University, addresses the introduction of special forage grass species in the overgrazed plateaux of China's semi-arid rangelands. Many of these plateau areas experience overpopulation and livestock pressures and thus show serious signs of overgrazing, exhausted forage grass resources and related desertification. Currently one of the major objectives is to introduce species that are better adapted to the extreme climate of the affected region and to support the growth of grasses so that they achieve adequate coverage in the shortest possible time. Species suitability modelling, the setting up of online available soil and climate information systems, related decision-making support systems and planting trials are currently ongoing.

"Success stories in desertification control", a United Nations Environment Programme (UNEP) report, describes how measures such as the banning of destructive goat farming, development of appropriate farming techniques and crop rotation, and improvements in living conditions to lift farmers out of poverty have led to increased crop diversity, successful introduction of pig and poultry farming, the improved utilisation of rain- and well-water, and self-sufficiency for farmers through cash-generating innovations in semi-arid Naiman Banner County, Inner Mongolia. Previously a serious decline in the resource base had occurred due to high human population pressure, poor grazing and cropping practices, ineffective desertification control techniques and a lack of resource management consciousness.

Also, in an agricultural oasis at the southern margin of the Taklamakan Desert in Xinjiang Uygur Autonomous Region in western China, 2,100 km southwest of Urumqi, diminishing resources and poverty were the result of the advance of sand dunes onto agricultural land (the country town was relocated three times), increased population pressure, limited water resources and over-exploitation of woodland around the oasis. The implementation of a protection system using physical and biological barriers to reduce wind speed and sand movement (see Pic. 7), rehabilitation

of fuel wood and forestry, horticulture and agriculture, and new labour models allowed for great improvement in living conditions.

Today, sand dune movement has been controlled, 11,000 hectares of land have been treated and transformed into vegetated areas, and the economic conditions of farmers have greatly improved. The measures were made possible by the local county government's allocation of an annual budget for long-term sustainable management.

Over the past decade it has been demonstrated through many different projects such as the above that small-scale locally adapted countermeasures often lead to better and more sustainable long-term results (Pic. 6) than large projects that seek to solve the soil loss problem of a whole province at once. Large projects often lead to unwanted and unforeseen side-effects, including changes in groundwater level, salinisation, introduction of badly adapted species, and low acceptance by the local population due to limited or no economic benefits. A large demand exists not only for "green technology" from the fields of erosion control and ground stabilisation, but also for adjusted species seedlings, and especially international consultation. ■

Pic. 7: Wheat straw buried in squares to control the movement of sand – a method applied in many areas in China.
Photo: Wu Weicheng

PROFILE

Dr. Claudia Künzer holds the position as University Assistant at the Institute of Photogrammetry and Remote Sensing of Vienna University of Technology, Austria. She received her MSc degree in Physical Geography with majors in Remote Sensing and Soil Science from the University of Trier, Germany, in 2001. From 1997–1998 she had a one year fellowship at Huxley College of Environmental Science of Western Washington University, US. From 2001 to 2006 she worked as full time project scientist at the German Aerospace Center, DLR, conducting research and project management for the Sino-German Coal Fire Research Initiative. She received her PhD on the topic of coal fires in China early 2005. Next to numerous field campaigns into mining regions of China, in 2005 she spent four months as a visiting scientist in Beijing. Currently she is involved in geo-science capacity-building projects in Asia and research project acquisition in China. Together with her Chinese partner she has founded Sign5-Consulting (www.sign5.de), offering intercultural trainings and network support in China for smaller European companies. Her current interests focus on the development of the Chinese energy industry as well as natural resource management in China.

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