# Combating the Expansion of the Gobi Desert, Illustrated at the Example of Shaanxi Province (China)

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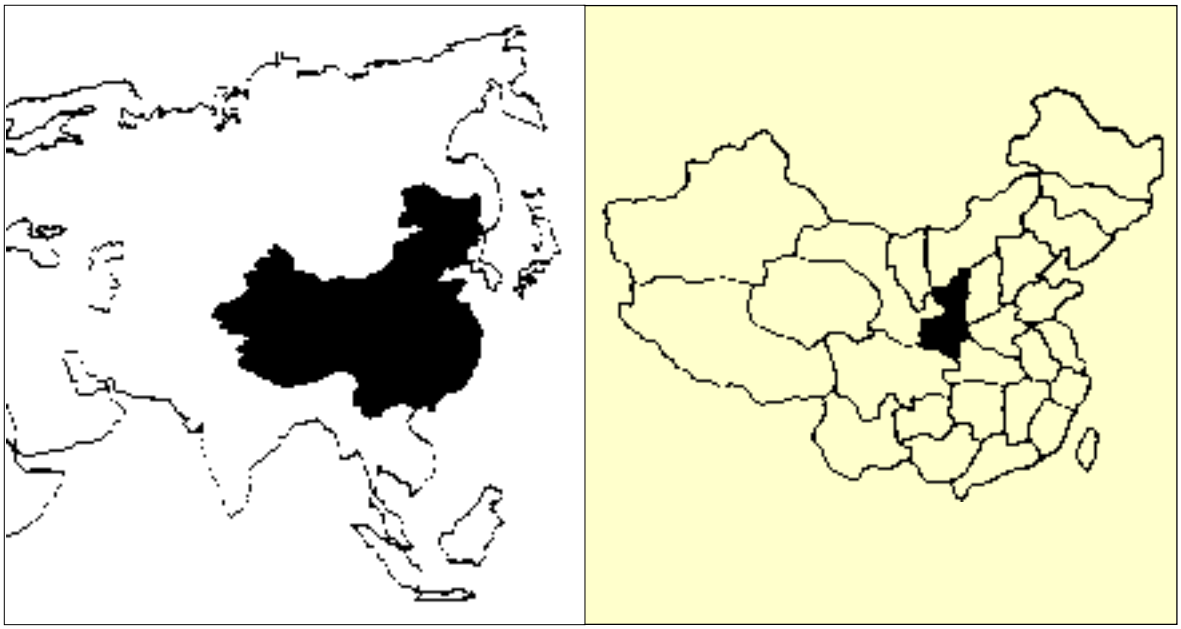
## Location of Shaanxi Province



## 1. Introduction

China is abundantly endowed with a great number of non-renewable resources which are playing an important role in the further economic development of the "Middle Kingdom", but pressure is constantly building up on the land which can be used for agricultural purposes and which only amounts to some 10% of the country. This pressure is caused on the one hand by continuous (even though significantly slowed down) demographic growth, and consequently the necessity to supply an increasing number of individuals with farming products for their daily foods. In the past for example, increased yields in agriculture owing to modernization were frequently completely absorbed by increased demand.

On the other hand, pressure on farmland additionally results from the expansion of urban and commercial-industrial settlements in the process of further urbanization and industrialization of the country. This produces enormous losses of, in particular, areas hitherto used for cultivation because the large areas for human settlement in China, which up to the middle of this century was largely agriculturally-structured, coincide almost exclusively with areas favourable for agriculture as well. Thus continuous urbanization is frequently accompanied by an irreversible degradation of cultivated land of outstanding quality. This process has been further aggravated in the past decades by China's urban planning orientation towards the model of spatially-expansive cities of the Soviet-socialist type. Since the Fifties for example, far in excess of 50m ha of farmland fell victim to the spread of built-up areas.

Another cause to be mentioned is loss of land as a result of the inappropriate use of soil, in other words by ignoring sustainability. Up to the Seventies it was generally assumed in respect of China's agricultural land that : "land is scarce, but sustainably utilized". In fact, a number of examples can be quoted from the scientific literature about China at that time of increased agricultural productivity and simultaneous concern with sustainability. It was only in the wake of more intensive scientific studies after Mao's death that the extent of varying levels of soil degradation in the more remote areas of this huge country became general knowledge.

## 2. Soil-degrading Processes

To start with, it is proposed to give a brief overview on the various forms of soil degradation resulting from inappropiate land cultivation which, in the final analysis, will lead to desertification (defined as human-induced spread of desert land) in the arid areas of the country. Note must be taken of the fact that soil-degrading processes precede or develop in parallel to desertification, but may also occur in isolation in other parts of the country under different climatic and geomorphological conditions.

*a) soil erosion*

Erosion by water and wind are the chief causes of soil degradation in China. This is the result of both more extreme climatic conditions, compared to Western Europe, with greater variability and seasonal fluctuations of precipitation and the extremely mountainous land surface of China. The significance of this problem is highlighted by the following figures which were compiled in the early Fifties and have been repeatedly quoted in various scientific and political publications since: 1.5m $km^2$ of China's surface is exposed to considerable erosion by water, another 300,000 $km^2$ to erosion by wind. This affects, in other words, an area significantly larger than the total area of Chinese cultivated land. The loessic plateau in the central section of the yellow river, which also includes parts of Shaanxi Province, is regarded as by far the most problematic erosion area in the whole of China.

*b) salinization /alkalescence*

It is expected that in the Nineties at least 10-15% of China's total irrigated area, ie more than 6.6m ha, have been affected by secondary salinization and alkalescence. Secondary salinization and alkalescence occur as a result of inappropriate irrigation.

*c) desertification*

Apart from soil erosion (as a single factor), desertification is perceived as the chief cause of the loss of agricultural areas, in particular in the northern parts of the country.

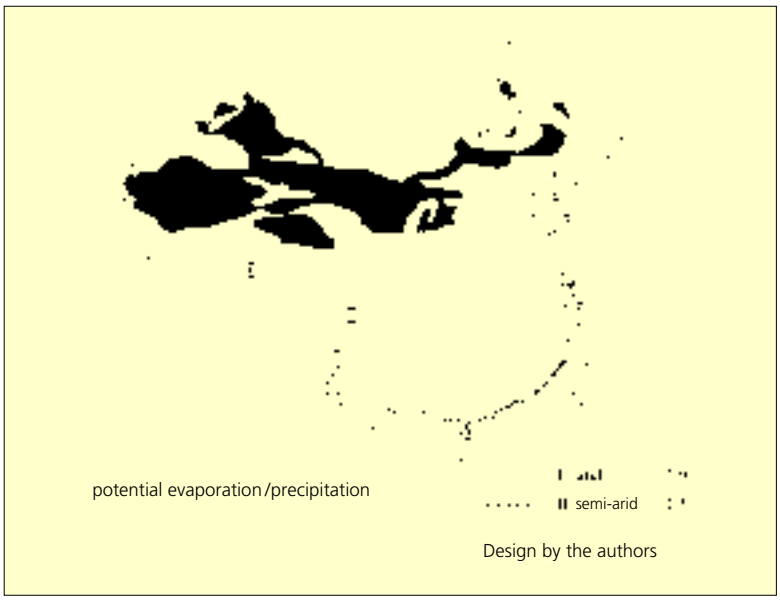
Desertification means the process of degrading the ecological exploitation potential by inadequate methods of land use in zones at the periphery of deserts; it leads to the man-made expansion of deserts. In Shaanxi Province all forms of soil-degrading processes quoted above are occurring; in Yulin District desertification is by far the most serious problem.

## 3. Chinese Deserts and Desertification – an Overview

### The Natural Development of Deserts and their Special Features

More recent studies have shown that the development of Chinese deserts can be traced back to 1,000,000-1,700,000 years (during the Pleistocene Age). Under arid climatic conditions, strong sun exposure and high winds, layers of sand had been uncovered in the course of time and the soil material transported further. Chinese sand deserts, including the sandy areas of the steppes and rocky deserts, cover an area of more than 1m $km^2$, equivalent to 11.4% of the total area of the country. They are mainly found in the north-western, northern and partly the north-eastern provinces, ie the autonomous regions of the country. The soil is unstable, practically devoid of organic matter and contains a high level of salt. The sand deserts consist overwhelmingly of drifting dunes which can be as high as 300 metres. They are transported southward by strong winds from a north-eastern and north-western direction.

*Diagram 1:* **Deserts and Arid Areas in the People's Republic of China**




## Desertification

The desertification process constitutes an important ecological problem which is becoming increasingly relevant on a global scale. In the context of China, desertification means the degradation of sensitive eco-systems on huge areas of land by intensive human intervention. Desertification leads to a rapid decline in produced biomass and in potential plant productivity. In particular animal husbandry, which has been taking place in the arid and semiarid areas over several decades, must be mentioned as a major cause of this process in the whole country. Overstocking of grazing land, the use of shrubs and plants for fuel and finally the cultivation of sandy areas covered with sparse vegetation without simultaneous soil protection measures frequently caused the complete destruction of the vegetation layer. Soil was replaced by wind-borne sand dunes. Sand dunes occur frequently on the ridges of fields, close to human settlements and to wells, ie in places where the extent of human intervention on soil and vegetation has been particularly intensive.

In the arid and semiarid regions in the north of China, the area affected by desertification comprises 334,000 km² (equivalent to a square with a length of 577 km!), of which 197,000 km² have already turned into desert and another 137,000 km² are classified as endangered. It affects a population of more than *35 million people* who are living in these areas. From the end of the Fifties to the mid-Seventies, the desert area has increased from originally 137,000 km² to 176,000 km² today, in other words by 39,000 km² in 25 years, equivalent to an annual loss of 1,560 km². From 1975 to 1985 it has grown by another 21,000 km², which is equivalent to 2,100 km² annually. Table 1 depicts the extent to which humans contributed to the expansion of desert areas in China.

| *Table 1:* **causes of desertification in China** | |
|---|---|
| causes of desertification | percentage of desert area |
| **anthropogenic:** | |
| intensive, inappropiate farming in the steppe | 25.4% |
| over-grazing in the steppe | 28.3% |
| extraction of firewood | 31.8% |
| technical reasons | 0.7% |
| abuse of water resources | 8.3% |
| **total** | **94.5%** |
| **natural:** | |
| drifting of dunes by winds | 5.5% |
| | *source: Zhenda and Tao 1993* |

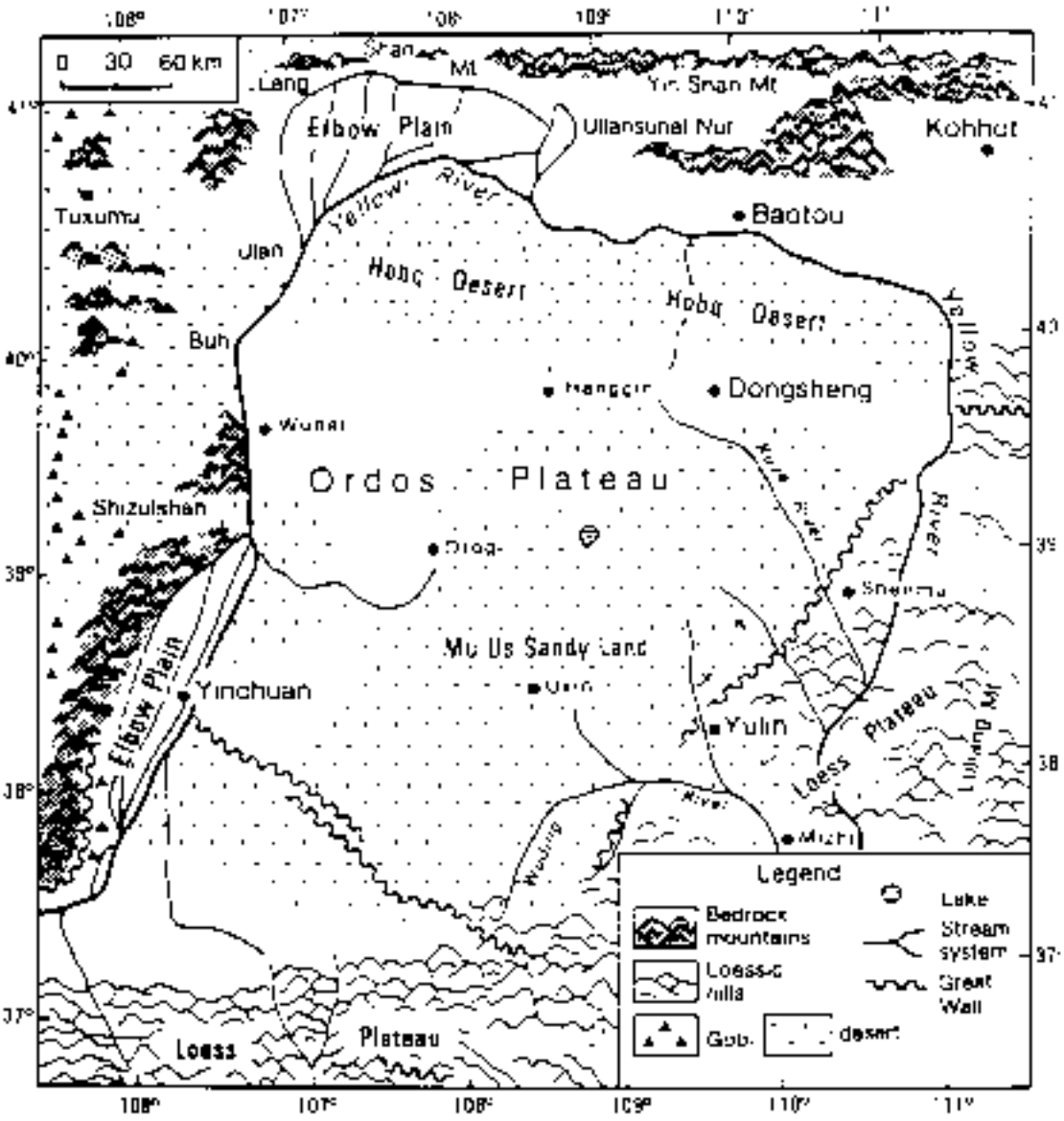
## 4. On the Role of Recultivation of Former Agricultural Sites

In view of the large area covered by arid and semi-arid land and continuous desertification, contemporary Chinese society is facing a twofold task: on the one hand, extensive measures need to be taken in order to protect effectively and for good the presently endangered areas. On the other hand, in light of the small share of land that can be used for agricultural purposes compared to the total territory of China – as mentioned earlier – and of the described land-consuming processes and limited potential for expansion owing to continuous demographic growth, the recultivation of land used in the past – including ecologically-marginal sites – is assuming a special importance.

Apart from the reasons of food security mentioned, the development of sustainable forms of farming in areas affected by desertification is additionally relevant in terms of regional planning policy. Unless a stable agricultural use of land is ensured in ecologically-sensitive areas as well, over-population with simultaneous under-employment will result in further migration into the cities. Even though in China every change of residence needs to be registered with the authorities responsible and permission obtained, the number of individuals who are moving into the infrastructurally-exhausted cities in pursuit of their "happiness" is constantly increasing. Consequently, the creation of stable economic and living conditions in these areas is assuming an additional function in terms of regional planning, because – apart from the ecological requirements – these areas will increasingly serve as a "buffer" against concentration processes in the cities.

# 5. History and Socio-political Background of the Northern Parts of Shaanxi Province and the Ordos Plateau

Diagram 2: **the Ordos Plateau**




Source: Wang 1993

## From the 19th century to the mid-Seventies

The north of Shaanxi Province appeared to many travellers of the 19th century as being "by far the poorest area outside the actual deserts". For millennia, farmers in the loessic hills had largely been cultivating small patches of land on the slopes. Further north in the area of wind-borne sand along the Great Wall – originally grazing-land – Chinese farmers had penetrated the Ordos Desert along the river valley in successive waves, in greater numbers from the 19th century onwards. The original inhabitants of the region, Mongolian nomadic shepherds, were pushed into the drier central parts of the Ordos as a result of this, sometimes violent, occupation of land. The cultivated areas in these marginal sites were from the start being exposed to excessive drifting of sand.

Both the new settlers in the Ordos and the farmers in the loessic hills had very little left on which to earn their livelihood. Even this was lost during the droughts which occurred cyclically and at times of heavy monsoonal rains in the summer when the loessic fields were destroyed and disastrous flooding took place along the lower reaches of the yellow river. The effect of natural disasters was further intensified in the 19th and 20th centuries in the wake of political and social developments. Warlike confrontations between rebellious ethnic groups and Imperial armies, the concentration of land property (as a result of land purchases following famines and high levels of debt) and the decay of irrigation systems continued to destabilize the rural economy and social fabric. Several million people fell victim to droughts and wars in the period from 1860 to 1930.

Initial deliberations on how to improve the situation took shape in 1920 in connection with regulating the Huang-He (yellow river). All corresponding attempts in the Thirties and Forties never got beyond the planning stage owing to financial bottlenecks and the Civil War. Only when warlike confrontations had come to an end and the People's Republic of China had been founded in 1949 did conditions for political stability, and thus a basis for improved agricultural production, evolve. Again, the Huang-He was the focal point of deliberations because the loss of soil was most serious in this area and subsequent effects on planned industrial projects in the North Chinese Plains were feared.

Yet the important achievements of the Fifties were due less to quantitative fac-tors than to successful efforts of disseminating the idea of soil protection and linking it to the objective of sustainable use of unstable land resources in the rural communities. The long-term implications of soil-retaining measures were established with difficulty only because there was no immediate positive effect. In view of the limited financial resources, the main emphasis in erosion control projects was placed on sponsoring pilot communities. In the winter of 1957/58, the Party attempted to mobilize the rural workers in a show of strength with the socalled "Great Leap" which was intended as a breakthrough towards an industrialized state. The newly-founded People's Communes, comprising several cooperatives and thus the potential labour of several thousand farmers, constituted the organizational framework for this. The main focus of the programmes was to extend the irrigated area to more than 70% of cultivated land. It was intended to reach the objective of erosion protection by, among other things, the reforestation of 755,000 ha of forest area in the entire Ordos region and by improving or seeding 675,000 ha of pasture land in the region. Desertification was intended to be controlled by planting artemisia (mugwort) on a minimum of 1m ha of land.

It cannot be clearly established to what extent these ambitious planning targets were met because the entire statistical service came to a halt in 1958. Even though widely off the original targets, both the farming land and the irrigated area in the Ordos region certainly expanded strongly. In parallel to the beginning of extensive shelter plantations against the winds – the so-called "Great Green Wall" – a wave of expansive development of new land was launched by both the Government (foundation of State farms) and local communities. Both the destruction of the top-layer of natural vegetation on cultivated land and the collection of firewood in the vicinity resulted in the first major spread of wandering dunes since 1949.

In the early Sixties, the Government clearly moved away from the course of mass campaigns on the basis of the "Great Leap". The size of People's Communes was reduced and individual initiative by the farming families was more strongly promoted with the aim of restabilizing agriculture which was then in a poor state. In the context of resource policies, efforts were undertaken to prevent in future the abortive developments resulting from the dynamics inherent in the mass campaign by more comprehensive institutionalization.

The Cultural Revolution of spring 1966 interrupted this development towards institutionalization and professionalism. The movement, which opposed bureaucratization,

class differentiation and domination by experts, made the entire political and administrative machinery inoperable. In the Ordos Plateau, the entire administration and control system for hydraulic engineering and soil protection was dissolved, research and advisory centres had to close down, their academic staff was withdrawn and equipment, libraries and research findings were taken away or destroyed.

After the army intervened, the radical phase of the Cultural Revolution came to an end in spring 1969. At the beginning of the Seventies, the Government was again forced to intensify agricultural policy under twofold pressure: firstly, demographic growth on a large scale left a growing impact domestically. Secondly, China increasingly faced external military pressure: in the south by the presence of the USA in the Vietnam War; in the north by border conflicts with the Soviet Union. It then became the objective of government policy to increase grain production with the aim of increasing self-sufficiency by two measures: by expanding the area for grain cultivation and by intensifying agriculture.

Consequently, simple measures to reduce the level of solids and measures promising immediate increases in yield were the focal points in efforts to enlarge the river area in the Seventies. In contrast, biological measures (the planting of greenery on the slopes etc.) were neglected. In the course of this campaign, grain cultivation was resumed even in the marginal sites of the Ordos. As a result, the area covered by wandering dunes in the inner-Mongolian part of the Ordos expanded from 1970 to 1973 by 200,000 ha annually and in the 25 years from 1950 to 1975 by 2.5m ha.

It can be assumed that in the course of the popularization campaigns in the last 50 years, the basic principles and methods of soil protection have become known to all communities in the areas concerned. The fact that the resolution of problems of erosion and desertification was primarily expected to result from administrative-organizational and technical measures, yet was largely planned without regard to existing conditions, explains not least the lack of large-scale implementation and the limited effect of successful pilot projects. What most communities in effect lacked was some discretion in economic matters in order to get through the "lean periods" in light of the medium-tern effect of soil protection measures. It is only in some parts that this economic shortcoming can be blamed on demographic growth.

At the end of the Fifties and from the mid-Sixties onwards, national development and agricultural policies have also, and not inconsiderably, contributed to it. Their aim of skimming off part of the farmers' production by centrally-controlled methods and thus providing food for a continuously growing urban population was achieved. Agriculture in areas favourable to cultivation also registered a considerable in-crease in productivity owing to selective investment. However, in the ecologically-sensitive and poor rural areas, agricultural policy measures, which were schematically implemented, frequently had a very damaging effect.

Inflexible and excessive tax rates for agriculture (in kind) and compulsory quotas for grain sales not infrequently produced the ludicrous situation in which villages which had met the planning targets had to repurchase grain from the State in order to meet the most urgent needs of their own people. National priorities forced them to increase the cultivation of grain and gradually replaced local flora and entire branches of the economy which had developed by adapting to the natural conditions and which constituted an important source of income to the local population on the basis of a regional division of labour. The destruction of such traditional production systems weakens the village economy concerned, increases pressure on scarce resources of soil and thus leads frequently to a marginalization of the countryside.

### More Recent Developments

In recent times, particular attention has been paid at all levels to soil protection. The experience of the last few decades has been reflected in a number of measures, such as the adoption of new soil protection regulations and the establishment of new institutions. The decisive incentive, however, came from agricultural policy which had been radically changed in the meantime. The most important shifts in policy, at least those indirectly affecting soil protection, include the following:

*a) the introduction of the so-called "system of production responsibility"*

This means returning the final authority over the land to the agricultural producers. The important point is that this system ensures the long-term use of fields by means of contracts which can also be passed on to the next generation. The duration of these contracts is in most cases limited to 15 years, in individual cases more. A special arrangement is made for the poor, less populous mountainous and hilly regions, such as the loessic area: in these cases larger areas, often even small valleys or parts of catchment areas, are transferred into the hands of families or groups, under soil protection conditions, for a period of 30 to 50 years and more (see section 8, page 25).

*b) reduced levies on surpluses in farm production*

This involves measures such as reducing agricultural levies (in particularly poor areas even suspending them for a transitional period) and repealing the obligation to sell grain. In the context of price policy, the prices of agricultural produce are being increased on the one hand, and on the other, lower prices of industrially-produced farming inputs (fertilizers, fuel, machinery) are being enforced.

*c) direct assistance*

This means both supplying grain to local communities which are living in the critical regions of the area affected by erosion and giving grants and soft loans to farmers involved in soil protection.

*d) promotion of local markets and small-scale industry*

The promotion of local markets and small-scale industry provides a "support structure" for increasing supplies of agricultural produce locally.

*e) the dissolution of the People's Commune. Separation of administration and production*

This involves a limited withdrawal of the State because these measures have changed structures in the countryside. Rural cadres now have a considerably more complex function: they are not only responsible for the implementation of Government directives, but must also justify their actions vis-a-vis their village clients.

These measures are intended to increase the possibilities of accumulating capital in the rural areas, and consequently the motivation and ability of individual farming units to undertake investment which has no immediate productive effect, as required for soil protection.

## 6. Concrete Measures Against Desertification

It is only by means of comprehensive planning that further desertification can be controlled and in some cases permanently halted. Several aspects need to be taken into account in this context

- levelling and stabilizing sand dunes
- setting up shelter plantations
- decreasing the impact of wind and sand
- restoring soil quality (melioration) and the layer of vegetation
- using and developing water resources rationally
- preventing excessive use

## Shelter Plantations

There are essentially three types

- a shelter belt and clumps of trees at the edge of cultivated areas
- reticular rows of trees within the cultivated areas
- large-scale regional plantations of shelterwood at the edge of the desert area.

Provided irrigation is possible and the height of the sand dunes does not exceed 10 metres, a combination of a row of trees and clumps of trees is used: first a shelter belt is planted of 50 to 60 metres in width at the edge of the desert alongside an irrigation channel. At the bottom of the dunes, clumps of trees are then planted which have to be irrigated artificially if there is no connection to the ground water table. In the lower parts, gusts of wind are slowed down once the area between the sand dunes is reforested; in the upper parts, the unabated velocity of wind removes the top of the dunes so that in the course of 3-4 years dunes of 4-5 metres in height can be reduced to 1-2 metres.

**Rows of trees alongside an irrigation ditch within cultivated fields**

Trees are selected on the basis of longevity and fast growth with special attention being paid to ensuring varying tree-top levels so as to improve wind resistance. Monocultures are not regarded as desirable and, where possible, are avoided because of the fast spread of tree pests. In addition to the shelter belt planted in front, the planting of reticular and often rectangular shelters of trees within the cultivated fields constitutes the sole effective protection against wind and sand. Wind velocity in fields subdivided by rows of trees can be reduced by up to 25%. The range of the protected area depends primarily on the height of the tree rows.

Undoubtedly, shelterwood measures alone cannot solve the problem of wind-borne sand and dust storms, especially since – in reducing the sand content in the air by 60-70% – the remaining 30-40% continue to descend on agricultural fields. Moreover, sand gathers both in the tree and shrub vegetation open to the desert and in the ditches dug for irrigation so that a maximum level of care is required unless the front line of sand dunes have been stabilized.

## Sand-Retaining Measures

In the semi-deserts and steppes, conditions (annual precipitation of 200-450 mm) are relatively favourable for stabilizing drifting dunes and fields of wind-borne sand because an appropriately thick layer of vegetation can stay in place for good once suitable conditions and protection against degradation have been established at the start.

Consequently, measures can be taken to isolate individual sand dunes. On the leeward side of lower fields of sand dunes, different varieties of willow are planted. The thicker layer of vegetation protects the lower parts of the sand dunes so that only the tops of the dunes are removed and levelled out by wind. A wave-like, relatively stable sandy area, half of it

Levelling of dunes by hydropower

covered by vegetation, is the result of this process. Wind velocity at 20 cm above the ground can be reduced by up to 26% compared to unprotected sand surface.

The amount of organic matter in the soil can be increased in this manner. In order to complete the process of stabilizing the dunes, a layer of grass is sown to prevent the gathering of sand in the shelterwood. Provided sufficient water is available from nearby rivers it will be channelled into the sandy areas in order to level out the dunes by hydropower.

## Kuluns

Kuluns are fenced-in areas in semideserts and steppes to protect, on the one hand, against wind and sand and on the other, to develop the pasture- and wasteland. They make possible a more balanced feeding of herds and assist in protecting the natural grazing fields against overgrazing. The main function of these fenced-in pastures depends on the specific conditions on the spot. Within areas with drifting dunes, Kuluns have largely the function of stabilizing sand and, to a limited extent only, of supplying animal feeds.

Measures required for creating a vegetation layer are comparable to those described for halting the sand. On the leeside, behind the crescent-shaped dunes (which should not exceed 10 metres in height), different varieties of willow and buckthorn are planted. On the windside, a row of artemisia is initially planted in the first third of the dunes – across the main direction of the wind – which will be supplemented year by year towards the dunetop. After five years, the vegetation layer (previously some 5%) reaches 50-80 %, provided no wood is cut nor animals brought in during this period. Tree seedlings are planted 4 meters apart in sandy locations with limited soil depth. 3-4 year old seedlings which can penetrate the soil by one third are used for preference in order to reach ground water at a depth of up to 2 metres.

## Anti-Erosion Measures in the Loessic Area

The North Chinese loessic plateau is a region which was once very fertile and largely covered by forest area; the land use problem emerged only as a result of the destruction of the vegetation layer. The natural conditions – fluctuation between months-long droughts and extreme downpours of rain and very erosive rock – add to the destruction process to an extent almost unknown in other parts of the world.

If the problem of erosion is to be resolved, reforestation of endangered slopes is indispensable: the soil is stabilized by the tree roots, while the foliage reduces the effects of raindrops on the ground surface.

In general, terraces are built which follow the line of the mountains and are arranged in rings around the mountain for anti-erosion purposes – and then woody plants are planted on them. In order to ensure their taking root in large numbers in a short period of time, irrigation, and sometimes fertilization are required in most cases.

On the most unfavourable sites where erosion has exposed the bare rock, the following, extremely labour-intensive method is used: first of all, crevices are located or holes dug in the porous rock and these may have to be enlarged by blasting. The hollows can then be filled with soil in which to plant the seedlings.

### Irrigation

The possiblities of putting a halt to desertification and of stabilizing economic development by means of recultivation of wasteland are closely linked to the tapping of water resources. Even though short of organic matter, desert soil is, as a rule, relatively fertile owing to various nutrients coming from the rocks. This fertility can, however, take effect only if sufficient amounts of water are added. The level of precipitation in arid climates is neither sufficient to generate an income from agricultural cultivation nor to establish a close network of shelterwood systems. In these areas addional water resources need to be made available.

A pump extracts ground water close to the surface

Those Chinese deserts which are encircled or delimited naturally, such as the Ordos Plateau, have abundant supplies of ground water in some localities. By means of sometimes very labour-intensive techniques, these water resources can be tapped for desert cultivation or the reconstruction of oases.

## 7. The Replanted Green of Yulin

*Diagram 3:* **Map of the Area Affected by Desertification**


*Source: Rebuild the Green. Self-presentation of the Shaanxi Province Forestry Board*

The Yulin District of Shaanxi Province is situated in the south of Mu-Us Desert. The desert area (some 24,400 km² in size) is equivalent to 56.1% of the district area and is distributed over seven counties with a population of some 1.1m inhabitants. The history of Yulin reflects the struggle of humanity against the desert. 1,500 years ago, Yulin was completely covered by grass and trees. Later, vegetation was severely damaged in the course of wars of past

dynasties and as a result of over-cultivation; the environmental situation deteriorated continuously. By 1949, the forest and pastures had almost completely disappeared. Wandering dunes moved continuously southward and buried a number of villages and farmland. The wan-dering dunes and the windborne sand caused enormous damage to local agriculture and related industries.

After the proclamation of the People's Republic of China, the population of Yulin commenced their continuous extensive fight against desertification. It is taking place by means of modern technology, more recent scientific findings and under changed political conditions generally. The measures taken have resulted in enor-mous changes in the areas threatened by the desert. The forestation rate has increased from 1.8% at the time of foundation of the People's Republic of China to 39.8% at present. The woodland has been enlarged to 937,000 ha in total. Four large shelter belts (with a total length of 1,500 km) were planted to protect against the wind and to retain the sand. 159 large sand-retaining patches of forest were established. 400,000 ha of the area once covered by wandering dunes has been consolidated or largely controlled in the meantime. Consequently, the tendency of the sand of moving southward could to a large extent be stopped. 100,000 ha of cultivated land is surrounded by forest belts. 90,000 ha new agricultural land and 150,000 ha grazing land could be recultivated and improved in quality. Furthermore, a kind of forest protection system has been established which collects a major part of the sand, ie an interlocked network of forests or dispersed patches of woodland is established within a stabilizing frame of forest belts.

40 years of action against desertification have thus decisively improved the environmental conditions of Yulin. The proportions of natural disasters are decreasing from year to year. The annual frequency of sandstorms has decreased from 70 days in the Fifties to 20 days a year nowadays; the height of dunes has been reduced by one third, and their wandering movement gone down from the original 5-7 metres to presently 0-1 metres per year. The level of solids in the six rivers which cross the desert area has fallen by 51% on average. Some species of game and birds are beginning to settle and reproduce in the former desert area. Experts estimate that Yulin is the only administrative unit in China which has successfully halted the spread of the desert by 1.62% a year.

Four large wind-breakers and sand-retaining structures (total length 1,500 km) are in place along the border to Shaanxi and Inner Mongolia, the Great Wall, Lingwu and the Yulin Highway and at the foot of Baiyu Mountain. An area of 120,000 ha is covered by forest. These four large shelter belts prevent strong winds and stop the southward movement of the wandering dunes; they therefore constitute the most important ecological defense of the Yulin region.

Turning deserts into oases is no longer pure legend. In the central desert of Yulin, 159 dune-stabilizing woodland patches on an area of a little in excess of 1,200 ha each and a total forested area of 200,000 ha have resulted in many new oases. A large number of former inhabitants are now returning and rebuilding their homes.

So far, some 14,000 ha of natural forest have been preserved in the Yulin desert, including 6,400 ha of juniper trees and 8,000 ha of Sabina vulgaris. These natural forests bear witness to the historical development and constitute pre-cious treasures which are being looked after carefully by the inhabitants of the region.

The inhabitants of Yulin have reclaimed 90,000 ha of farmland in the desert area by levelling dunes mechanically or hydraulically. In the last few years, a State-sponsored investment programme was introduced and implemented in Yulin for more than 40,000 ha of grain and additional produce. This programme creates an important basis for a better standard of living and is the motor for developing the local economy.

The planting of trees and grass on a large scale ensures good conditions for agriculture in the desert. Artifical grass plantations, pastures with shrubbery and the sowing of greenland enormously increase potential yields. There are at present 330,000 cattle and horses

and more than 2.4m goats in the Yulin desert. An expanding agriculture is the critical trigger for further industrial development of the region.

Up to today, 100,000 ha of woodland have been created by seeding by aircraft. They are playing an enormously critical role in combating desertification.

A great number of different methods for controlling the desert have been applied by local technical experts. Including: diamond-shaped plantations of trees and shrubbery to stabilize slopes and tree nurseries with reticular shelter plantations.

Although deserts are expanding worldwide and the resulting destruction is becoming increasingly serious, Yulin has succeeded in reclaiming land from the desert by means of science and technology and human labour in the region and has initiated economic progress on the basis of local conditions.

**Seeding by aircraft**

As a result of this successful fight against desertification, spring wheat and rice can nowadays be cultivated on the reclaimed areas. Total yield of grain has increased sixfold compared with the Fifties. Table 2 demonstrates the interaction between successful anti-desertification measures, increasing agricultural production and generated income in a town which is equally affected by expanding deserts.

*Table 2:* **Anti-Desertification, Food Production and Development of Earnings in the Town of Shabianzhi (Yanchi County) for Example, Presented by Means of Selected Data**

| Shabianzhi / Yanchi county; (Mu-Us Desert) | **1984** | **1988** |
|---|---|---|
| desert area (in absolute numbers) | 1,472 ha | 1,005 ha |
| area covered by vegetation | 7% | 30% |
| grass yield on semi-stabilized desert areas | 240kg/ha | 1,320kg/ha |
| total grain yield | 146,000 kg | 214,000 kg |
| annual average earnings | 399.8 Yuan/year | 893.8 Yuan/year |

*Source: Tao 1998*

# 8. A Chino-German Tree-Planting Action in the Vicinity of Yulin

The government reforestation programmes can only be implemented with the support of the local population and volunteers: how this is done in practice will be illustrated with an example from the Yulin area. Special mention needs to be made of the fact that 10 school students, both girls and boys, from Sinzig, Bonn and Viersen were involved in it in July 1998. They flew to Beijing with teachers and journalists in order to plant 4,000 pine-seedlings in the vicinity of Yulin at the edge of the Gobi Desert, in cooperation with 70 members of the non-governmental ecologists' group "Friends of Nature" (FON).

It all started with a visit of 15 FON-members to the Sinzig grammar school in November 1997 when FON-President Liang Congjie, who was present to give a lecture, invited students to a return visit in order to participate in one of their annual events, a tree-planting action. A number of factors combined to turn the tree-planting action into a very successful event which was covered by a number of media in both China and Germany: the special efforts by the teacher Klaus Karpstein and the support of the school principal Dieter Lehmann, lithographies which had been made available by the Bornheim painter René Böll whose pen-and-ink drawings were also used for selling shares in the tree-planting event, the technical advice by the resident of Bonn, Dr. Ng. Hong-Chiok and the student Lirong Liu from the same city, who both accompanied the tour.

After a 20-hours bus trip from Beijing, the Chino-German group arrived in the slightly hilly Yulin area. 4,000 pine-seedlings had already been delivered by government agencies. The local population had finished digging most of the holes on the slopes to the appropriate depth and, above all, with the right spacings. It was said that the farmers were motivated in getting involved in this, not directly profitable, exercise because they had been promised that they could "lease" the fertile land in the valley for 50 years for free once the pinetrees had stabilized the slope which would take a number of years.

It was then up to the 80 persons or so from Beijing and Germany to plant the seedlings in just a few days. It was tedious work at a temperature of 36°, with dust and limited space to stand on the steep slopes.

The pine-seedlings had to go into the soil at a considerable depth so that they did not rise above the ground surface. Since there is no rain in this area for 9-10 months, followed by frequently very heavy rains, a variety of Chinese pine had been selected which could survive without water for almost an entire year. The pines which will take root if initially watered will then have to survive the flood-like downpours of rain after a long dry season. This is why the small trees cannot be planted directly to the slope.

Experience has shown that some 70% of seedlings will take root. The results of a number of previously successful tree-planting actions could be seen in the immediate vicinity and further afield. Planting poplar-trees has proved effective in the valleys because the roots of these deciduous trees grow into the ground water relatively quickly.

Local farmers praised the assistance given by "Friends of Nature" and extended a special word of gratitude to the "long-noses", as Europeans are frequently called in China, but of

whom they had not met a single individual up to that point. The fact that the group had not shied away from making the extremely long journey was especially appreciated. It showed the farmers how important the fight against desertification is for all humanity. After the last day of planting came the tedious work of watering the seedlings. Yet rather unusually for this time of the year, it began to rain; this was attributed to the "good spirits" of the foreigners.

## 9. Prospects

In spite of the successes presented above there is no cause for euphoria. As a result of the revitalization of agriculture, industrial and crafts businesses have been increasingly settling in the area in the more recent past; this has produced "renewed soil erosion": construction and civil engineering activities, stone quarries, small coal mines and factories, which have started up in the hilly region and again are leading to loss of vegetation, sliding slopes and slag-heaps. Since these are unprotected and unstable, they are extensively exposed to soil-degrading processes. This results not only in loss of agricultural land; a growing number of pollutants also leaks into the cultivated area via the various water channels.

Some 60 years have gone by since the first plans were made for North Shaanxi in respect of its water system and a resolution of the problem of poverty in the loessic area; it was the view of the experts of the "Yellow River Project" of the Forties that the erosion control programme should be successfully concluded by the end of the Nineties; according to the "integrated plan for the control of the Huang-He", the content of solids in the yellow river should have been reduced by 50% by 1967. In the euphoria of the "Great Leap" it was even assumed that the problem could be resolved with a special effort within 5 years.

Past experience has shown that soil erosion constitutes not only a technical problem but a complex function which can be completed successfully only if the interaction of many different factors is taken into account. Apart from establishing adequate general conditions in the political arena, creating an ecological awareness at the local level is of critical importance. The independent ecologists' group "Friends of Nature" is doing excellent work at both levels. Its annual tree-planting actions make the local population aware, while the resulting media attention considerably contributes to establishing a sense of responsibility for the ecology at national level as well.

# 10. Literature

## Scientific Literature:

Albrecht, D.; Dewitz, U.; Goedecke, M.-K.; Müggenburg, N. und Schneider,T.: Landnutzungsplanung in China – Ein ökologischer Entwicklungsweg? Berlin 1979.

Tao, W.: Desertification in Western China. In: Akiner, S.; Tideman, S. und Hay, J.: Sustainable Development in Central Asia. Richmond 1998. p. 140-149.

Walls, J.: Combating desertification in China. United Nations Environment Programme. Nairobi 1982.

Wang, F.: Human-induced Environmental Changes and Societal Responses in the Ordos Plateau of Northern China as a Typical Critical Environmental Zone. In: Freiburger Studien zur geographischen Entwicklungsforschung (1993). Vol.1, p. 165-182.

Zhenda, Z. and Tao, W.: The Trends of Desertification and its Rehabilitation in China. In: Desertification Control Bulletin (1993). No. 22, p. 27-30.

## Material from the Field:

Rebuild the Green. Self-presentation of the Shaanxi Province Forestry Board. Year of publication unknown.

Interviews:
- Prof. Liang Congjie,
  President of the non-governmental ecologists' group "Friends of Nature"
- Mr. Zhao Bing Zheng,
  Vice-Minister of Forestry of Shaanxi Province

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