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An approach to erosion control in North China

By Dr G. A. Robertson, Commissioner of Soil Conservation

In May 1983, six scientists from Western Australia visited China as part of a scientific exchange agreement between the University of Western Australia and the Chinese Association of Science and Technology. The purpose of this particular visit was to examine saltland reclamation and arid farming techniques.

Dr Marcus Blacklow, Dean of the Faculty of Agriculture, Dr Alan Robson and Mr Robert Hebbert of the University, and Dr Adrian Peck of CSIRO were members of the mission, along with two officers of the Department of Agriculture, Mr Norman Halse, Deputy Director of Agriculture and Dr Graeme Robertson, Commissioner of Soil Conservation. The following is the first of several articles recording the observations made by Mr Halse and Dr Robertson on aspects of their visit relevant to Western Australian farming.

Massive gullies showing active erosion in China's loess country.
**Background**

The Huang Ho—China's Yellow River—and its tributaries flow through massive loess deposits for a large part of their long route to the sea. Loess is very fine soil of wind-borne origin that has been deposited in blankets over the original landscape during the last million years. The loess is also a very fertile soil and may be up to 200 metres thick.

However, its fine nature and its relatively young age make it highly prone to erosion. Where natural vegetation has been removed from sloping country by excessive clearing for cropping or grazing, water run-off has caused massive soil erosion.

In an attempt to reduce soil erosion, several projects have been developed, involving land levelling, gully filling, retiring croplands, establishing permanent pastures or orchards, reforestation and water control with dams.

One such project is in Chun-Hua County in Shaanxi Province, central north China.

**The project area**

The Chun-Hua County has a population of 148,000 organised into 19 communes. The 984 square kilometre county can be divided into four major land systems (see table).

The county has 38,660 hectares of cultivated land. The climate is semi-arid. Most of its annual 600 millimetres of rain falls in the summer—July to September—often during intense thunderstorms. The main crops are traditionally wheat and rapeseed, generally grown in a rotation of two or three years of wheat followed by one of rapeseed.

The county was assessed as the most seriously eroded area within the Huang Ho region, with 87 per cent of the total area suffering from erosion. Gullies criss-crossed the landscape at a density of 2.8 kilometres of deep gully every square kilometre of land.

**Project planning**

Land restoration in the Chun-Hua County started in the mid 1970s and involved a co-ordinated approach by Chinese agronomists, foresters, engineers, soil scientists and physiographers. The first step was a land classification and capability assessment involving agricultural, biological and engineering methods.

The research team identified that cropping was being attempted on unsuitable land and that this was affecting many aspects of the region's stability.

The four major classes of land were delineated and their stable uses identified:

- Mountainous regions. Should be planted to trees and grasses and developed as a forest and animal husbandry resource.
- Plains. Suitable for grain and oilseed crops providing specific engineering and agricultural practices were implemented.
- Hill slopes and gully sides. Should be planted to grasses and trees to achieve urgent stabilisation rather than production goals. Some of the gentle slopes were suited to orchards.
- Valley floors. Suitable for intensive, irrigated production. Engineering structures could be required to prevent flooding and to store water. Dams and reservoirs could be developed for fish production.

The programme was planned to meet national objectives of increasing fuel and timber production, increasing animal production and improving agricultural productivity.

**Approach**

*Mountainous area.* The northern area of the county is mountainous, up to 1800 m above sea level. The barren slopes were contributing runoff and were being eroded by gullies, slippage and tunneling. A major tree planting programme was organised, but first the slopes were contoured into narrow terraces to provide some protection for tree seedlings.

One area of 750 ha was planted to trees in five days at a density of 6600 trees per hectare. This was accomplished by organising 10,000 people on each of the five days to come to the area and each plant 100 trees. In five days, five million
trees were planted, of which 3.3 million survived. The organisation of such a labour force, transport, trees, hoes and the like is an outstanding feat, one which the Chinese are repeating continuously in the interests of soil conservation.

**Hill slopes.** About 10 per cent of the Chun-Hua County is classified as hill slopes. The slopes were actively eroding through gully ing and slippage. The reclamation project included retirement from cultivation, restrictions on grazing and replanting with trees and grasses. Contour works and gully control works were required in many cases before trees could be planted. In several areas fruit orchards, mainly apples and apricots, were established, both on gently undulating hills and on man-made terraces on the steeper slopes. Lucerne, a perennial cover, was often grown between the fruit trees.

**High plains.** These areas, comprising 50 per cent of the county, were considered the main agricultural resource of the region. However, erosion was serious. Both gully ing and sheet erosion were greatly reducing productivity.

A major redevelopment programme was started on the plains, comprising redesigning of farm layout, gully filling and land levelling. In a typical area, 110 ha of land was levelled by manual labour in a month. Three thousand people from two communes combined to remove the topsoil, fill a major gully fully 6 m deep and 30 m wide, level and terrace the land and restore the top soil. In another area 1200 people levelled 80 ha in a month. The land was levelled to a slope of less than 0.33 per cent.

In addition to the earthworks, a major tree planting programme provided both windbreaks and a source of fuel for cooking. Using twigs and sticks for fuel allows the traditional fuel source—crop straw and residue—to be converted by composting or feeding to pigs into an organic manure. The return of the organic manure to the soil in turn improves soil structure and reduces erosion. In Chun-Hua 1600 km of tree shelter belts have been planted since the project started.

**Valley floors.** The main action in the valley floors has been to build dams to impede water flow and trap silt. Many major dams and small reservoirs have been built. These dams have not only conserved water, but also have greatly reduced flooding of the valley floors and permitted areas of fertile alluvial soil to be cropped with vegetables and other crops. The dams provide irrigation water and are used intensively for fish production.

**More than 15,000 ha of previously bare mountain country has been reforested. In addition, 1200 ha of apple and other fruit trees have been planted on the hill slopes. The county now has 18.5 per cent of its total area under trees, compared with 3.5 per cent when the project began. A total of 32,200 ha has been treated by either tree planting or grass planting to reduce runoff and erosion—about 35 per cent of the total area of the county. The dams and reservoirs have increased the amount of irrigable land by 5500 ha. Almost all of the plain is now planted to tree windbreaks, the main trees being *Paulonia*, poplar, honey locust and oak.**

**Economic impact**

The project cannot take advantage of the timber production yet because most trees are still very young. However, twigs and prunings already are providing a valuable fuel resource. Moreover, the honey locust trees on the mountains are prolific flowerers and have allowed a major honey producing industry to develop in the region.

Fruit production, like timber production, has yet to develop fully but already the apples and apricots, together with the varieties of carp from the reservoirs, are providing both a variation in the diet and an additional income to the county. Grain production has increased as higher productivity is achieved on the restored plains with better husbandry and supplementary irrigation from water pumped from reservoirs in the valleys.

In one catchment region being monitored, erosion has been reduced to less than 30 kg/ha/year.

**Remaining problems**

Despite valiant efforts, some of the gullies and hill sides are still eroding, and may be impossible to control.

A potential problem remains in the farming system which is based on winter wheat and rapeseed. After the wheat is harvested in July, the soil is bare-fallowed until September when it is replanted. Bare following is practised for several reasons. The straw of the previous crop, if not required for fuel, is used to feed livestock. Cultivation is required to control weeds during the warm wet months and to allow adequate moisture storage for successful germination and establishment of the following crop in September/October, when rainfall may be scarce. Also cultivation improves nitrogen mineralisation and reduces fertiliser requirements. This farming system unfortunately exposes the soil to a high erosion risk as heavy thunderstorms are common while the soil is bare. The risk is being reduced by land levelling but minimum tillage systems may reduce the risk further. Some research is being carried out in this area.