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The Loess Plateau Watershed Rehabilitation Project

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This Report is based on the work of Dr. Chen Shaojun, Hohai University, who conducted interviews in Beijing with Mr. Juergen Voegele, World Bank Resident Mission in China , Ms Wang Yue, Foreign Capital Project Management Center of the Ministry of Water Resources, and in Taiyuan with Messrs. Xu Maojie and Yanjin Min, Water and Soil Conservation Bureau, Department of Water Resources of Shanxi Province, and a study of relevant documents and materials concerning the Loess Plateau Watershed Rehabilitation Project.. The Xinshuihe River basin and Jixian County project area were visited and project managers and farmers were interviewed.

Executive Summary

Breaking the vicious cycle of environmental deterioration and poverty and realizing nature-friendly development have been challenges for many countries in the world. The successful implementation of China's Loess Plateau Watershed Rehabilitation Project, launched in 1994 and completed in 2002, provides valuable insights on how to meet those challenges. The Loess Plateau covers an area of some 640,000 square kilometers in the upper and middle parts of the drainage basin of the Yellow River. Severe soil erosion from the Loess Plateau produces the vast quantity of sediment carried by the Yellow River and its tributaries. Unsustainable farming practices combined with huge population pressures have led to massive environmental degradation, downstream flooding, and widespread poverty in the Loess Plateau region.

Implementation process

The primary objective of the project was to increase agricultural production and incomes on 1,560,000 hectares of land in the Loess Plateau in nine tributary watersheds of the Yellow River. A secondary objective-- to reduce sediment inflows to the Yellow River--was achieved by locating the project areas in those parts of the basin with severe soil erosion. Factors such as poverty level, strong leadership, commitment at the local government level, and development potential were also considered in the selection of project areas.

Financed by the International Development Association (IDA), the Loess Plateau Watershed Rehabilitation area covers 1,560,000 hectares of the Loess Plateau in 21 counties, 17 of which the government identified as among the poorest in China. Within the project areas there are several distinct types of topography. In Gansu the *gullied plateau* landform is common, where a flat plain with large tracts of level farmland is intersected by deep gullies. In Shanxi, Shaanxi, and parts of Inner Mongolia the *gullied hill* landform is common, where rounded hills several hundred meters high are bounded by deep gullies. Field crops are grown on the plateaus and the upper slopes of the rounded hills. The steeper slopes are uncultivated wasteland. The deeply incised gullies are a major source of the sediment that flows into the Yellow River and its tributaries.

Typical land use in the small watersheds is uncultivated wasteland (40 percent); cropland (40 percent), mostly on low-productivity slopeland; trees and shrubs (10 percent); gullies (5 percent); and roads, villages, and so on (5 percent). Annual precipitation, mostly as rain, ranges from 250 to 550 millimeters. Most of the rain falls in the summer, usually in short, intense storms. Long droughts are common.

The main components of the project were terraces (90,500 ha); forestation (90,900 ha); shrubs (136,000 ha); economic forestation (26,700 ha); orchards (30,890 ha); grasslands (100,140 ha); irrigation (7,100 ha); sediment control dams (149 key dams, 1,140 warping dams, and 1,956 check dams); and institutional support (training centers, vehicles and equipment, computers, and software for GIS and information systems). An IDA credit of $150 million covered 60 percent of the total project cost of $250 million; the cost per hectare was about $160.

Impact analysis

The project aimed to (a) create sustainable crop production on high-yielding level farmland and thereby replace the areas devoted to crops on erosion-prone slope lands; (b) plant the slopelands to a range of trees, shrubs, and grasses for land stabilization and the production of fuel, timber, and fodder; and (c) substantially reduce sediment runoff from slopelands and gullies. These objectives were met and enhanced by a decision by the local authorities to restrict free grazing of sheep and goats, not only in the project areas, but also in large areas outside the project. Farmers have adjusted to grazing bans more readily than expected. Government leaders at all levels have no doubt that the wide acceptance of grazing bans is a direct result of the project, and many believe they are witnessing a revolution in land and livestock management in the Loess Plateau.

The objectives of the project—sustainable and coordinated social, economic, resource and environmental development of small watersheds—are consistent with the poverty reduction strategy of the Chinese government's Eight-Seven Poverty Reduction Program (to eliminate poverty for 80 million people within seven years, from 1994–2000). The shift from *relief* to *development* in the government's poverty reduction strategy enhances the capacity of the poverty population to share in the opportunities brought about by economic reforms. By combining the harnessing of small watersheds with economic development and the improvement of people's living standards, the Loess Plateau project fully reflects the rationale of "sustainable small watershed development."

The project has turned out to be the largest and most successful water and soil conservancy project in the world. It has convinced planners and farmers that land conservation is compatible with sustainable and productive agriculture and, indeed, that they are mutually reinforcing, an approach now being adopted in other parts of the Loess Plateau. It has brought significant benefits to over 1.2 million farmers in the project area. Thanks to the implementation of the Loess Plateau Watershed Rehabilitation Project and the government's poverty alleviation policies, the population living under the poverty line in the project area has dropped from 59 percent in 1993 to 27 percent in 2001.

Driving factors and lessons learned

Among the factors driving the project have been a political commitment for change; public participation, including detailed land-use plans prepared in close consultation with villages; and the government's policy for land tenure. The project worked with China's public administration and developed existing institutions in it. It was inevitable that problems would be encountered and new approaches developed. The World Bank played an important role in project preparation and implementation. Among the specific lessons learned:

- Soil and water conservation in the Loess Plateau is compatible with sustainable and productive agriculture. The project has convinced planners and farmers that land conservation is compatible with sustainable and productive agriculture.
- Integrated and comprehensive land-use plans must be prepared for all small watersheds in close cooperation with the farm households and village leaders. These should delineate the

present situation and the future development plan. Such plans would create sustainable crop production on high-quality terraces, and protect steep slopes with trees and shrubs.

- Farmers should receive long-term land contracts. All land developed under a rehabilitation project should be contracted out to farmer households. New land contracts should explicitly state the land-use rights and obligations under which farmers' interests will be legally protected. Typically, contracts should be for a minimum of 50 years for slope and waste land, 50 years for forestry plots, and 30 years for orchards, terraces, and warping land. After tree planting, the wasteland should be auctioned to farmers and successful bidders given a long-term contract.
- Costs should be recovered from the beneficiaries. In the IDA project, about 60 percent of the project cost was recovered from the beneficiaries, providing incentives to maintain and develop the land and reduce the burden on public funds.
- Counties should make a detailed physical check of progress and quality; prefectures and provinces should make periodic spot checks. Funds should be disbursed only for work inspected and approved.
- Project management offices should be set up at all levels and staffed with experienced personnel.

Components for future projects

In many villages in the Loess Plateau, villagers have to haul water for domestic use from long distances. Underground water tanks should be a part of future projects. They can be located to collect runoff from the roads and from flat surfaces in the villages and homesteads. More support should be given to farmers to switch from free grazing to pen feeding, especially by introducing improved breeds of sheep and goats and seeds for improved pasture.

2. Implementation Progress

2.1 Project Background

China is making the transition from an agricultural society to an industrialized and modernized one, and from a planned economy to a socialist market economy. However, China remains a country with a large agricultural population. Agriculture provides the basic daily necessities for 1.3 billion people and agriculture is the main source of income for 200 million farm families.

Soil erosion causes the loss of about 5 billion tons of surface soil annually. The amount of organic fertilizer lost due to soil erosion in the past decade was equivalent to the total fertilizer production in the same period of time. Located in the west of China and in the middle reaches of the Yellow River, the Loess Plateau covers an area of some 640,000 sq km in the upper and middle parts of the drainage basin of the Yellow River. Severe soil erosion from the Loess Plateau produces the vast quantity of sediment carried by the Yellow River. The Plateau was heavily forested about 2,000 years ago, but forest cover now ranges form 5 to 15 percent. The causes of deforestation are complex. The Plateau was the scene of vast population movements and conflicts as well as climatic cycles marked by decades of severe droughts. Unsustainable agricultural practices have also accelerated erosion and deforestation and the people living in the more remote parts of the plateau are caught in a poverty trap. Silt transported to the lower reaches of the Yellow River over the years continues to raise the river bed. As a result, the flood dikes have to raised and river training works strengthened.

Within the project areas there are several distinct types of topography. In Gansu the "gullied plateau" landform is common, where a flat plain with large tracts of level farmland is intersected by deep gullies. In Shanxi, Shaanxi, and parts of Inner Mongolia the "gullied hill" landform is common where rounded hills several hundred meters high are bounded by deep gullies. Field crops are grown on the plateaus and the upper slopes of the rounded hills. The steeper slopes are uncultivated wasteland

Since the 1978 reforms in China, the poverty population in China has fallen dramatically... According to the standard of poverty of the Chinese Government, the poverty population has dropped from 250 million to 42 million in 1998 and further to 28.2 million in 2002. There were 592 poverty counties listed in the National Eight-Seven Poverty Reduction Program in 1994. The Loess Plateau Watershed Rehabilitation Project involved 21 counties in four provinces and autonomous region of Shaanxi, Shanxi, Gansu and Inner Mongolia accounting for 25.7 percent of the total number of counties. Among the total poverty population of 80.6 million, there were 14.5 million in the four project provinces and autonomous region. However, the more they farmed the infertile soil, the poorer the farmers became: and the poorer the farmers became, the more they farmed the soil, forming a vicious cycle from which the farmers could not escape.

Over the 40 years since the founding of new China to the early 1990's, the Chinese government has implemented many programs to control soil erosion in the Loess Plateau areas

and made significant progress. However, the quantity and magnitude of soil erosion in this area is enormous, the ecological environment is fragile, agricultural production is extensive and backward and the economic base is poor. Therefore, the annual rate of harnessing in the past 40 years was only about 0.8 percent. In order to effectively control and harness soil erosion in an overall manner in the Loess Plateau, the investment must be increased and the quality of harnessing should be improved.

2.2 Rationale and Objectives

Since the problem of soil erosion in the Loess Plateau is severe and the people there live in poverty, the Chinese government used a Credit from the World Bank Group for the Loess Plateau Watershed Rehabilitation Project, a large-scale project for water and soil conservation, The Loess Plateau is located in the western region of China and the upper and middle reaches of the Yellow River It covers parts of the seven provinces and autonomous regions of Qinghai, Gansu, Ningxia, Inner Mongolia, Shaanxi, Shanxi and Henan, and covering an area of 640,000 km^2. The Project area is located in nine river basins in Shanxi, Shaanxi, Inner Mongolia and Gansu. The total project area while the total area is 15,500 km2, of which soil erosion area is 14,000 km^2 accounting for 90 percent of the total area. The Project involves 2,137 administrative villages in 22 counties in seven prefectures with a total population of 1.24 million, of which the agricultural population was 1.21 million. The total investment of the Project was Yuan 2.1 billion, of which the IDA Credit was US 150 million dollars The Project was launched in October 1994 and completed in 2002.

The primary objective of the project was to increase agricultural production and incomes on 1,560,000 ha of land in the Loess Plateau in nine tributary watersheds of the Yellow River. A secondary objective-to reduce sediment inflows to the Yellow River-was achieved by locating the project areas in the parts of the Basin with severe soil erosion. Factors such as poverty level, strong leadership and commitment at the local government level and development potential were also considered in the selection of project areas.

The objectives of the Project are consistent with the poverty reduction strategy of the Chinese government's "Eight-Seven Poverty Reduction Program" (solve poverty for 80 million people within 7 years from 1994-2000). The shift from "relief" to "development" in the Government's poverty reduction strategy enhances the capacity of the poverty population to share in the opportunities brought about by economic reforms. Meanwhile, the Government's objectives are in line with that of poverty reduction strategy agreed by leaders of states during the Millennium Summit of September 2000. The Project does not aim solely at soil erosion control, and not solely at poverty reduction either. It is aimed at sustainable and coordinated social, economic, resource and environmental development of small watersheds; it integrates harnessing of small watersheds with economic development and the improvement of people's living standards, and it fully reflects the rationale of "sustainable small watershed development".

2.3 Project components

The Loess Plateau Watershed Rehabilitation Project has two parts: one is to conserve land, control sediment, and enhance farm incomes through terracing, afforestation, and orchards, grass-growing, construction of sediment control dams; the second is capacity building such as training, scientific research and technique promotion. The main components of the Project are: terraces (90,500 ha), afforestation (90,900 ha), shrubs (136,000 ha), economic forest (26,700 ha), orchards (30,890 ha), grasslands (100,140 ha), irrigation (7,100 ha) sediment control dams (149 key dams, 1,140 warping dams, and 1,956 check dams), and institutional support (training centers, vehicles and equipment, computers and software for GIS and information systemsThe Project began in 1993 and was completed in 2002. An IDA Credit of US$ 150 million covered 60 percent of the total project cost of U$ 250 million; a cost per ha of about $160. The proceeds of the Credit were on-lent to the provinces.

3. IMPACT ANALYSIS

3.1 Component Effectiveness Review

3.1.1 Terracing

Terracing of slopeland can increase farm income effectively control soil erosion and realize sustainable land. It makes it possible to take steep slopelands out of agriculture. In Xinshuihe River basin, 12,630 ha of terracing were completed. At the same time the terraces are constructed, farm roads and village roads were built... In the project area, roads connect all villages and farm fields. Thanks to the road network, farmers can now use small power implements and vehicles for transportation, cultivation, and harvest.

The cultivated land area in Xinshuihe River basin was reduced from 45,496 ha in 1994 to 39,938 ha in 2001 due to terracing of slopeland... The proportion of terrace increased from 24 percent in 1993 to 60 percent in 2001. We visited some farmers in project area, who told us: “Before the project, the wheat output per ha was about 100 kg per mu (one fifteenth of a ha) and 150 kg at the most, just enough to feed the family. But now, the ordinary output is above 2000 kg. This year, because of good rainfall, the output of many households is between 250 kg to 300 kg. You could not imagine this in the past. Therefore, our income increased Yuan 100 per mu. In the past, the corn output was 150 to 200 kg, but now the output increases to 400 to 450 kg. And this year, it’ll be above 500 kg. Terracing makes it possible to grow crops with plastic film, which is impossible with slopelands.”

Most importantly, terraces not only increased grain output but also reduced farmers’ labor input. The wider and better farm roads mechanized farming possible so that farmers could find some new living methods like livestock production and off farm employment.

But in the non-project area, Mr. Liu (at the age of 30) of Lanjiahe Village, Shangyangzhuang, Ji County said:” many farmers in the village want to convert slopelands into

terrace because the slopelands can't keep rainwater and moisture is easy to evaporate so that the output is hard to increase."

Zhang Kejian (male: 46 years old), Su Qiuzhu (male, 37 years old), Taohyuan Villagers' group of Huigong Village of Tunli Township of Jixian County

Now, we are using machines to cultivate their cropland, we can cultivate over 20 mu in a day. However, in the past, it usually took about 20 days to plough twice the area of land. If I wanted to plough 2 mu in a day, I needed to work extremely hard, using an ox drafted the plough while I applied some fertilizer and seeds behind the plough.
Now, we use three-wheel vehicle to send fertilizer to the field, but in the past we used our shoulders and ox cart. In the past, it took about 20 days to harvest wheat manually, when we used shoulders or ox cart to carry the wheat... Now, we use four-wheel tractors to propel the thresher harvester while the cost is 10 RMB Yuan/mu. Several hours are good enough to harvest the field. It takes about 3 to 4 days from harvest, to drying and storage. Labor input has been greatly alleviated and we have more free time to look for other avenues to earn more income.

3.1.2 Afforestation

It is sometimes difficult to convince farmers to engage in an undertaking if they can't see the immediate benefits of it. But many farmers in the Project Area showed interest in acquiring contracts and assuming loans for economic trees such as kernel walnut, walnut and Chinese dates. There was a also interest in contracting and paying for areas planted to trees such as black locust, Chinese pine, and willows. The land forested by the Project was allocated through auctions with preference given to local villagers. The farmers must have permission from the local authorities to harvest trees, and in the meantime they are responsible for tending and protection.

This component established some 290,000 ha of arbor trees and shrub. 'Arbor trees", such as black locust, Chinese pine, spruce and poplar, were established on wastelands. Severe droughts caused low survival rates requiring replanting, in some cases several times. The arrangements for taking up contracts on the arbor tree plantations by households varied from county to county. In some counties the land was contracted before plantation and the farmers were involved in tree establishment. In others the PMOs undertook planting and also kept control for a few years. Households were motivated to take up contracts for tree plantations from a sense of pride of ownership and participation in what they see as sound environmental practice, even though the timber bearing trees will yield no financial return for many years.

It was originally intended that wastelands would be planted with shrubs, mainly for erosion control. However, most farmers preferred trees and there was a trend toward planting trees on the steeper slopes, sometimes together with shrubs in alternating rows. In the later years of the Project, the counties saw less justification to plant shrubs for erosion control (except in desert areas) because of the success of grazing bans, which generated in many areas a dense natural vegetation cover.

The planting of desert willow has proved particularly successful in Inner Mongolia for stabilizing sand dunes, as well as providing an alternative source of income for farmers, through the sale of the woody stems for the production of particle board... Despite these setbacks, the

planting has proved successful with the fruit being sold for the production of juice, providing an additional income source for farmers.

3.1.3 Economic Trees and Orchards

Some 27,000 ha of kernel apricot, chestnuts, walnuts, and Chinese date trees were planted on wastelands and more than 30,000 ha of orchards, mainly apples and some pears, were planted on terraces. The land was contracted to farmers, mostly before the trees were planted. The common practice was for farmers to interplant with vegetable crops while the trees were young. Standards of development were high and the farmers have had access to high quality seedlings. There are good market prospects for the output of the orchards.

A fruit tree technician Qing-taishan, Yahoo Village, Toil Town, Jig County was sent to learn fruit tree cultivation in Shanxi Agriculture University at the age of 15 by his father working on the roads. Then he worked for nine years in a forestry center and became his own boss after the center closed down. Now other farmers often consult him on fruit tree management technique and he often helps them with pruning. He can earn Yuan 3,000 a year. He has 7 mu apple trees and the net income per mu was Y 1,300 last year.

Apples and pears were planted on some of the large terraces and also on smaller terraces on slopeland. Most of the farmer households interviewed had no fruit trees. But now many apple and almond trees have been planted in terrace and along the some slopes in the areas of returning cropland to forest. Jixian County PMO, Fruit Industry Bureau and Shanxi Agriculture University and other related institutions organized many technical training and on-the-spot demonstration activities to train fruit production technicians. The technicians not only provides guidance to farmers in their own village, but also visited other villages to provide such guidance.

3.1.4 Grasslands

The original plan was for planting some155, 000 ha of artificial grasses mainly astralagus and alfalfa. Before grazing restrictions were widely adopted, planting of grasses was only attractive in some areas. After the widespread adoption of grazing bans, 100,000 ha of astragalus's and alfalfa were planted as apart of the project mainly on flat or gently sloping wasteland, and large areas were planted by farmers using their own funds.

3.1.5 Grazing Bans

Free grazing of goats and sheep has been a major cause of soil erosion in the Loess Plateau. Grazing bans were not specifically a project component, but new plantings and adjacent areas were protected from animals by the farmers. This led to natural regeneration of vegetation that was a visible demonstration of the dramatic effect that the bans could have. This led to grazing bans being imposed in areas surrounding the Project areas until some counties imposed county-wide bans. This had a dramatic effect on the vegetative cover even in drought-affected areas. Despite the droughts, natural shrubs, grasses and trees are now well established on steep slopes that had previously been grazed bare. The provincial authorities are confident that all counties will soon adopt this practice.

Farmers have adjusted to grazing bans more readily than expected. Government leaders at all levels are in no doubt that the wide acceptance of grazing bans is a direct result of the Project, and many of them believe they are witnessing a revolution in land and livestock management in the Loess Plateau. Indeed, rather than leading to a reduction in livestock numbers, the grazing ban has led to the development of a range of diversified and intensive livestock activities at the homestead. These new enterprises and their associated fodder crops have begun to alter the existing farming systems and restructure the use of land and labor. They are offering the farmer the opportunity to substantially increase his income at a time when his traditional cash crops (e.g. wheat and maize) are declining in value.

Farmers have invested in animal sheds and pen construction, fodder processing equipment, and animals suitable for pen feeding. Informal credit and some project loans were the main sources of financing. Under the project, some 116,000 square meters of sheds we reconstructed, 10,800 heads of livestock procured and 125 small feed processing units were set up.

Mr. Feng Zhenqian of Shangguta Team, Yaotou Village, Tuoli Town, Ji County, borrowed 1,000 yuan to set up pen feeding of sheep in 1999, he now has 13 sheep and annual income is Yuan 2,000 to 3,000 yuan. He said "the cost of pen feeding is time, you have to cut clover. He fed 3 or 4 sheep before the grazing bans but now has 23 sheep. He said "the problem of pen feeding is cutting grass. Since I have clover land, it only takes me half an hour while grazing usually takes half a day". Therefore, clover plantation also saved farmers' working hours and decreased their labor intensity.

3.1.6 Sediment Control Dams and Gulley Head Protection

The construction of silt retention structures included three types of dams: key dams, warping dam and check dams. The purpose of constructing these dams is to avoid silt flowing into the lower reaches of the Yellow River while the major beneficiaries are the residents in the lower reaches of the Yellow River. Gullies are not inhabited and are therefore ideal locations for constructing various types of dams. The edges of the gullies are subject to erosion in a way that can destroy farm land. Gully heads can be effectively stabilized by brush wood and earth barriers.

For local people, the silt incepted by dams can turn into fertile cropland in two to three years and the water flow incepted can be used for irrigation and for living purposes of people. In addition to the environmental benefits of sediment control described below, there are local benefits. Key dams provide water supply for irrigation and domestic use in the villages, and both key dams and warping dams create new arable land on the sediment deposits. Also, in many cases warping dams served as crossings of deep gullies and became a part of the road built by the bulldozers employed in its construction. Nevertheless, farmers did not see the returns from dams to be competitive with other components, and the objected to paying for them when the downstream beneficiaries had no repayment obligations.

3.1.7 Irrigation

Irrigation was a small part of the Project, only 7,100 ha mostly in parts of Inner Mongolia with very low rainfall, where it is not possible to increase crop production and achieve sustainable development of agriculture without irrigation. What is worth mentioning here is the project of

"one dam and one pond and lifting water to the hills" in Inner Mongolia. Water is incepted and retained behind the dam, then a pipeline is used to lift water from the pond to the nearby terrace. Corn production in terrace with irrigation can reach 7 to 8 tons. In dry years, comparing with upland without irrigation, high rate of return/yield of the terrace with irrigation is very significant. This method of irrigation also avoided over exploitation of groundwater by deep wells which is not sustainable.

3.1.6 Institutional Development

In addition to providing funds to the construction of provincial, city and county training centers and to project management facilities, the implementation of the Project has provided models for future projects and programs... First, it has introduced a set of completely new monitoring and control methods for the government and the public sector. Second, the Project Management Offices (PMOs) managed and guided joint efforts in various disciplines of water and soil conservation, agriculture, livestock and forestry. Third, modern tools such as computerized MIS, GIS were employed. Fourth, implementation of the Project promoted stakeholders as farmers and institutions to actively participate in the protection of the ecological environment, which changed the operational model of institution from planned to market-oriented approach. Fifth, it improved the research and development capacity of related research institutions.

3.2.7 Impact on Women

Studies have shown that inequality of gender exists in different degrees all over the country. In the project areas of the Loess Plateau, since most of the males work in cities and urban areas rather than their homeland, about 70 percent of the labors working on farmland are women. The implementation of the Project provided good opportunities for rural women to improve their status. Thanks to diversified income sources and improvement of production efficiency, rural women have more opportunities to engage in other work employment. Along with income growth, their living conditions have been improved as well. In field studies, women generally said "Life is much better than before. In past, our lives depend very much on weather conditions, now we have terraces so grain production is secured. Even though, there were severe droughts in the past several years, but the crops in our farmland were much better than that of the neighboring villages, which was the results of terracing". "In the past, only in Spring Festival, could we have meat. And even that was the little remaining after selling the slaughtered pig raised by the household, while the main part of the pig was sold in the market in order to get some cash for the Festival. The little meat was given to the children to satisfy their curiosity about meat. Now, we can have meat all year around, even in summer time we can buy fresh meat from the market".

The educational level of women has also risen to some degree. This can be seen from the higher enrollment rate of girls and the lower dropout rates. "In the past, it would be an achievement for girls to complete primary school. Now, most of them can go to senior high schoo.l" From this aspect, we can see that the status of gender has changed in the attitude of the people. Furthermore, it shows that the better-off farmers can afford the fees of education of their kids and there is no need to have the kids working in the fields or taking care of household chores. In addition, through technical training, women have learned more about better practices

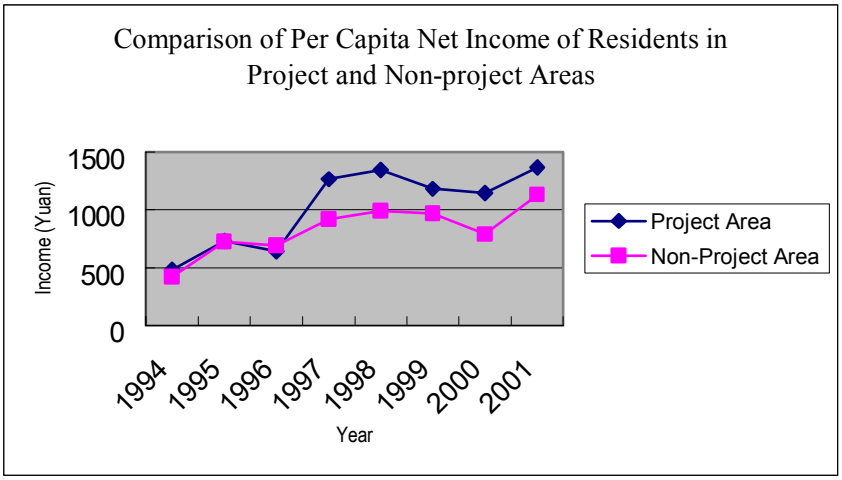
for crop farming, fruit production and animal raising, which play an important role in production activities. With higher family incomes, and the women's' own efforts, their social and economic status have been improved. The health care of women has been upgraded. According About 60 percent of rural women go to township clinics or county hospital for delivery, and 30 percent gets doctors to the homes of the women to assist delivery. But in the past, rural women themselves assisted most of the deliveries.

3.3 Poverty Reduction Effectiveness

The annual grain output had been increased from 427,000 tons to 700,000 tons, fruit production had been increased from 80,000 tons to 345,000 tons and the farmer's net income per capita had been raised from Yuan 360 to Yuan 1,263.. At the same time, soil erosion from Loess Plateau area has been reduced by annual 57 million tons annually. On the whole, the Project was one of China's biggest and most successful water and soil conservation projects that brought huge benefit to farmers in project areas and residents in the lower reaches of the Yellow River. It combined sustainable agricultural development with comprehensive water and soil conservation in a way that can be applied all over the Plateau. The economic rate of return (ERR) was 29 percent if environmental and downstream benefits are included and 19 percent, if only on-site benefits are considered.

A case where project implementation fostered the development of agriculture from solely relying on grain crops to diversified production in the poverty-stricken areas is in the Xinshui River Basin. There the agricultural production value went from Yuan 87 million in 1993 to Yuan 577 million in 2001, while the share of crop farming decreased from 50 percent to 31 percent, forested area grew from 12 percent to 24 percent, fruit production went up from 15 percent to 20 percent. As to the farmers' social life, the enrolment rate of children at schooling age increased from 86 percent to 97 percent. According to the farm household monitoring data of the Project, the living standards of farmers in Xinshuihe River basin have been significantly improved. The per capita grain output increased from 636 kg in 1993 to 838 kg in 2001, per capita cash crop production rose from 49 kg to 77 kg; per capita net income from agriculture increased from Yuan 647 to Yuan1,062, while per capita net income increased from Yuan 671 to Yuan 1,254 during the same period.

Compared to non-project areas in the same river basin, these changes are significant. According to the monitoring data of Xinshuihe River basin Xixian County, grain production in non-project area was 90 kg higher than in the project areas in 1994 and 1995, however, grain production in project areas has been 100 kg higher than t in the non-project areas since 1996. There was no significant difference in per capita net income of farmers between project and non-project areas before the implementation of the project, but since 1996, it has been RMB 200 higher in the project areas than that in the non-project areas. The following figure demonstrates these changes.



3.4 Project Concept and Sustainable Development

The project concept is simply explained. The Project is designed to finding a way to raise incomes in a poor drought-prone area and at the same time to combat the soil erosion that creates major problems in downstream river management. It replaced unsustainable crop cultivation on steep slopes with broad flat terraces, and it planted trees and shrubs on steep erodible wastelands. It introduced pen-feeding in place of free grazing with such success that the policy is now being widely adopted beyond the Project area. Sustainability is ensured by giving farmers a long term contract to their land. Freedom to fell trees has always been severely restricted in the rural communities of China, even when trees were on common land. But now trees are owned by farmers who have paid for them. Terraces and farm roads will be maintained by farmers in their own interests. Farmers owning orchards and economic trees have a strong interest to preserve their investment. The grazing bans will lead to permanent increases in vegetative cover on steep wastelands and, most importantly on the beds and sides of gullies (major sources of sediment) that have been denuded by years of grazing.

4. Driving Factors

4.1 Commitment and Political Economy for Change

China is moving from a planned economy to market an economy system, and from a traditional agricultural society to a modern industrialized society... The establishment of socialist market economy system rendered prerequisites for poverty elimination and economic development in the Loess Plateau where the environment was deteriorating. In order to fit into the social transition, the Project relies on the market to raise the efficiency of resource utilization, and depends upon technology progress and improved labor quality to increase the economic benefits. It adopted market-oriented operational model. For instance, public tendering was used in terrace construction, replacing the appointing method under the planned economy system. The

specialized teams, instead of the collective behavior, undertook afforestation, which guaranteed the quality of project implementation.

The economic restructuring of China started first in rural areas. In 1978, the household contract system was introduced to replace the collective cropping system during the People's Commune period. The central government decided in 1984 to extend the contracting period to 15 years, and in 1993 to 30 years, and farmers were allowed to subcontract or transfer their contracted land to others. In recent years, the resources development work, such as development of barren hills and wastelands, has been under going in some areas. Because of these changes in land-use system, farmers in the Loess Plateau, while terracing the slopeland, signed land use contracts r for 30-50 years.

Along with the reform in land use system, great changes have been taking place in China's market system and employment system. These changes enabled farmers to break away from the shackles of People's Commune, and the state monopoly for purchase and marketing of grains practiced in the planned economy period. Farmers obtained "free floating resources" and "free moving space" for development. The freedom of choice and freedom of action are basically indispensable for farmers to cast off poverty (The World Bank, 2001; Marty Sen., 2002).

Since 1990s, in order to help farmers in rural areas to cast off poverty as soon as possible, the Chinese government introduced in 1994 the Eight-Seven Program of Poverty Reduction (1994-2000)), the Decision on Resolving Food and Clothing Problem of the Poverty Population in 1996, and in 2001the Development Outline of Poverty Reduction in Rural China (2001-2010). China's poverty reduction strategy hence started transferring from government relief to self-development stressing "sustainable development and poverty reduction must be integrated into resources protection and ecological development so as to achieve the benign cycle of resources, population and environment". Attention was paid to improving infrastructure and community environment, tapping the resources of the poor areas and building up the capacity of the poverty population to access resources for sustainable development so as to promote economic development and finally achieve the objective of poverty elimination.

4.2 Public Participation

The project area contains about 1,000 small watersheds with areas ranging from 1,000 ha to 3,000 ha. Typically, a watershed includes several villages. A watershed plans that define in detail the changes in land use to be realized as a result of the Projects were prepared in close consultation with the villagers. The first step in making a watershed plan is to prepare a map of present land use. This is done by taking a 1/10,000 topographic map into the field and marking it up to show the main categories of land use such as cultivated slopeland, terraces, forest, shrubs, wasteland, villages, roads, etc. A team made up of technicians from the County Project Management Office and leaders and farmers from the villages and townships did the mapping. The result is a present land use map and an inventory of present land use. The next step is to produce a preliminary plan of land use with the project.

In most cases the plan reduced the area used for crop cultivation and compensates for this by new high-quality terraces. The plan also specifies which areas are suited to trees, shrubs and grasses and also determines which varieties are appropriate for the different locations. It takes into account grazing management issues including: (i) existing grazing areas; (ii) ownership and numbers of livestock and their fodder demands. This plan is then reviewed in detail with the township and village committees and villagers. An amended plan is then agreed and this is portrayed on a project land use map at a scale of 1/10,000. This is an iterative process that continues throughout implementation. During planning and implementation, the maps are digitized and Geographic Information System (GIS) software was used.

The PMOs at various levels all consulted with farmers at all stages of the Project. In Xixian County, Shanxi Province fro example, the village committee first submitted an application. The county PMO then worked with them to draw up a plan. After it was finalized, the villagers committee would hand over to PMO the contract for loan repayment. All parties with a clear responsibility implemented the Project in cooperation. After completion of the Project, the PMO, townships and villagers committee singed contract for loan repayment with individual farmers...

The policy of restricted grazing and pen-feeding were first put forward and carried out in the Project in consultation with the village committees. The grazing bans played an extremely important role in soil conservation and at the same time guaranteed sustainable development of livestock industry. It was found that the livestock industry was not affected by the implementation of grazing ban and other measures for vegetation protection.

The approach adopted for implementation of the project components exploited local skills and resources, ensured competitive pricing, and placed quality control in the hands of the beneficiaries who are responsible for loan repayment. The construction of over 90,000 ha of terraces involved the excavation and compaction of about 100 million cubic meters of earth. Private bulldozer operators according to designs prepared by the County PMOs carried out the work. Typical contracts were on the order of 20-30 ha. Each county advertised its annual work program for terraces and bids were invited for a number of contracts each working season. As the project progressed, bidders from outside the project area showed interest and this led to more competitive prices.

4.2 Land Tenure

The Government's policy for land tenure in rural areas was of crucial to the success of the Project. All land developed under the project was contracted out to farmer households. New land contracts were signed between farmers and local governments to explicitly state the terms, land use right and obligations under which farmers' interests are legally protected. All farmers participating in the Project received properly signed, sealed and registered contracts, copies of such contracts are held in the township or county registries. Land contracts in all project areas were for a minimum of 30 years.

4.3 Institutional Innovation

The Project took the approach of working with and developing the existing institutions in China's public administration. This is in fact a novel approach since many externally financed projects require new special purpose organizations. Central Government oversight was through the Ministry of Water Resources (MWR), the Yellow River Conservancy Commission (YRCC). The Upper and Middle Reach Bureau (UMRB) of the YRCC played a major role in managing project preparation and supervision in close cooperation with the four provinces. Project Management Offices were established at each level-- the province, prefecture, county and township. Management at the village level was through a Village Committee. At each level there was leading group, composed of senior officials and specialists. The PMOs were staffed by experienced staff seconded from the specialist bureaus. The leaders in the Central Government down to the village chiefs are all dedicated to improve the lives of farmers, especially in the poorest areas, to reverse land degradation, and to raise farm incomes consistent with conservation. The Township PMOs were the links with the Village Committee who, as explained below, played a major role in the design and implementation of the Project. Strong leadership at the village level was a vital factor in the success for the Project.

Other institutional innovations were as follows:

- The Project introduced a complete system of quality control and checking at every level. Detailed maps, with all project activities clearly located and coded, allowed effective random checking of all project components at any time. This system has proven highly effective in supervising a very large and scattered project. Quality was assured by assigning clear responsibilities within the PMOs management structure.
- Standards were set for all works such as plant densities of trees and shrubs, survival rates in relation to planting time, size and depth of water harvesting pits, height and width of terrace lips, maximum slope tolerance. Frequent and well recorded checking system, that also carried the names of the responsible officers, were defined for each management level and each disbursement was subject to following those rules.
- Disbursement was against unit prices per ha for the various components that were agreed with IDA at appraisal. Some of the unit prices were adjusted during the course of the project. Before disbursement claims were forwarded to Central PMO, a detailed field check of the physical quantities was made by the provincial and prefecture PMOs based on 1/10,000 maps of the agreed components. IDA missions did spot checks to ensure that the process was being followed. This procedure worked well and was far superior to a simple record of expenditures since there was a close link between disbursements and verified physical progress:
- Periodic meetings of the project staff of the provinces and prefectures to report on progress, problems and new ideas, often using visual aids such as PowerPoint.
- The use of modern office equipment for data processing, reporting, and the use of GIS and GPS technology for mapping.
- Records of loan agreements of individual farmers were kept in the township offices.

4.4 Learning and Experimentation

In a project with so many components in so many counties, it was inevitable that problems would be encountered and new approaches developed. Some of these are summarized below:

- Initially it was thought that most of the terraces would be built by hand, but it was soon discovered that it was quicker and less costly for most of the earth moving to be done by the local small bulldozers. As described above, a process was developed to procure the services of local operators through competitive bidding and to have work supervised by selected villagers.
- For tree plantations, the land development was a communal effort by the villagers with planting done by special teams. For example, in Pianguan county of Shanxi Province, three specialized afforestation teams were established when the Project started. The members were all graduates above junior high school level and they were given special technical training. The PMO selected technicians from the Forest Bureau to be in charge of the technical work of the afforestation teams. The survival rate of trees planted by the specialized teams was high. New technologies were developed in the nurseries and in planting techniques to solve the ever present problem of seedling survival during droughts.
- With more widespread pen feeding, new breeds of sheep and goats were introduced that fetched much higher prices in the markets.
- Shrubs planted on wasteland often had low survival rates and this component was cut back... However the grazing bans led to revegetation of the steep slopes and gullies.
- Grassland component was initially aimed to plant large areas for communal use. This failed but once the need for fodder arose from pen feeding, the planting of alfalfa and other fodders by individual farmers on small plots became widespread. In fact some farmers grew fodder as cash crop.

4.5 External Catalysts

The World Bank not only provided financial support through an IDA Credit of US$ 150 million, but it also worked closely with the Chinese government in the whole course of the project. The World Bank played an important role in project preparation and implementation. The Bank helped to formulate the project concept, and guided the Chinese experts in detailed documentation of physical targets and cost estimates, and in the design of a unit-price based disbursement system. The Bank also introduced project staff to GIS and GPS systems for project planning and monitoring. The Bank's staff played a significant role in project establishment, feasibility study and project implementation thanks to the professional knowledge, conscientious hard-working attitude, and close cooperation with the MWR, YRCC, URMB, the PMOs and experts at all levels.

Advanced techniques and experience in project management introduced by the Bank improved the quality of the management. Computer technology was widely used in cost analysis, economic benefit analysis, engineering planning, and project monitoring and evaluation. The

funds management model was also changed, and the spirit of realism was cultivated. The successful implementation and the far-reaching influence of the project aroused the awareness of the relationship between soil conservation and poverty alleviation at various levels in the Government...

5. Lessons Learned

Soil and water conservation in the Loess Plateau is compatible with sustainable and productive agriculture Early efforts to treat the Loess Plateau were not integrated with efforts to raise agricultural productivity and farm incomes. The Project has now convinced planners and farmers that land conservation is compatible with sustainable and productive agriculture and that they are mutually reinforcing.

Integrated and comprehensive land use plans must be prepared for all small watersheds. A key element in the above strategy is the implementation of detailed land use plans that are designed to (a) create high-quality terraces for field crops and orchards to compensate for taking steep slopeland out of crop production, (b) take slopeland that is too steep out of crops and plant trees, (c) ban grazing by goats and sheep, (d) plant pasture for cut-and carry feeding of livestock, and (e) plant trees that can generate incomes in the long term.

Farmers should be given long-term land contracts. All land developed under a rehabilitation project should be contracted out to farmer households. New land contracts should be signed between farmers and the townships to explicitly state the terms, land use right and obligations under which farmers' interests will be legally protected. Typically, contracts should be for a minimum of 50 years for slope and waste land, 50 years for forestry plots, and 30 years for orchards, terraces and warping land. After tree planting, the wasteland should be auctioned to farmers (competition limited to villagers unless there is lack of demand) and successful bidders should be given a long term contract.

Costs should be recovered from the beneficiaries. In the IDA Project, about 60 percent of the project cost was recovered from the beneficiaries. This provides incentives to maintain and develop the land and to reduce the burden on public funds

Quality and Financial Controls. A detailed physical check of physical progress and quality should be made by the counties, and spot checks should be made periodically by the prefectures and provinces. These should be based on detailed maps of the land use plan for each watershed. Funds should only be disbursed for work inspected and approved. Disbursement for most forms of land development is best made against unit prices (costs per hectare)

Project Management. Project management offices should be set up at all levels and staffed with experienced personnel.

Components for Future Projects. In many villages in the Loess Plateau, villagers have to haul water for domestic use from long distances. Underground water tanks should be a part of future projects. They can be sited to collect runoff from the roads and from flat surfaces in the villages and homesteads (water tanks have proved popular in the Second Project). More support

should be given to farmers to switch from free grazing to pen feeding, especially the introduction of improved breeds of sheep and goats and seeds for improved pasture.

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Annex 1. Results Index of the Loess Plateau Project (from the ICR)

Key Performance Indicators/Log Frame Matrix

Outcome/Impact Indicators		
Indicator/Matrix[1]	Projected in SAR	Actual/Latest Estimate
Annual cropped area (28 percent)	21 percent	21 percent
Perennial plants (37 percent)	54 percent	48 percent
Forest cover (14 percent)	38 percent	41 percent
Wasteland (28 percent)	17 percent	15 percent
Annual sediment discharge reduction	60 mm^3	57 mm^3
Annual Grain output (427,000 tons)	660,000 tons	698,600 tons
Annual Fruit production (80,000 tons)	320,000 tons	345,000 tons
Annual per capita grain output (357 tons)	507 kg	532 kg
Annual per capita net incomes (Y360)	Y900	Y1,263
[1]Numbers in parenthesis indicate actual estimate at project appraisal.		

Output Indicators:		
Indicator/Matrix	Projected in SAR	Actual/Latest Estimate
a) Terracing/Irrigation/land formation (ha)		
Terrace	83,200	90,446
Irrigated land	5,500	7,098
-- Warping land[2]	3,400 ha	4,010 ha
-- Land formed by dams/gully ctrl works[2]	2,000 ha	2,214 ha
b) Afforestation (ha)		
Arbor tree	106,600	90,951
Shrub tree	163,400	136,041
Economic tree	27,000	57,687
c) Grassland and livestock support (ha)	155,000	100,411
d) Silt retention structures (no.)		
Key dam	236	149
Warping dam	2,208	1,140
Check dam	3,417	1,956
[2] Estimates for warping land and land formed by dams and gully control works will be completed in the future when the process of sediment deposition is completed.		

ERR Comparison						
	SAR			ICR		
	Without sediment reduction and global benefits	With sediment reduction benefits	With sediment reduction and carbon sequestration benefits	Without sediment reduction and global benefits	With sediment reduction benefits	With sediment reduction and carbon sequestration benefits
Terracing	17	18	N/A	23	26	26
Dam/Warping Land	4	17	N/A	5	26	26
Irrigation	17	28	N/A	32	32	32
Afforestation	18	19	N/A	10	13	17
Orchards	26	26	N/A	25	26	26
Economic Trees	N/A	N/A	N/A	22	22	22
Livestock	N/A	N/A	N/A	33	36	36
Total Project	17	19	N/A	19	22 [a)]	29[a)]
[a)] Include benefits from grazing ban not covered individual components						

ERR Comparison						
	SAR			ICR		
	Without sediment reduction and global benefits	With sediment reduction benefits	With sediment reduction and carbon sequestration benefits	Without sediment reduction and global benefits	With sediment reduction benefits	With sediment reduction and carbon sequestration benefits
Terracing	17	18	N/A	23	26	26
Dam/Warping Land	4	17	N/A	5	26	26
Irrigation	17	28	N/A	32	32	32
Afforestation	18	19	N/A	10	13	17
Orchards	26	26	N/A	25	26	26
Economic Trees	N/A	N/A	N/A	22	22	22
Livestock	N/A	N/A	N/A	33	36	36
Total Project	17	19	N/A	19	22 [a)]	29[a)]
[a)] Include benefits from grazing ban not covered individual components						

Annex 2. Organization Chart