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CHINA: Western Poverty Reduction Project

Environmental Information Package

This package of documents comprises an Environmental Summary and Evaluation of the above project prepared by World Bank staff plus English language translations of three Environmental Impact Assessments (EIAs) commissioned, in accordance with relevant EIA requirements of the Government of the People's Republic of China, by the Provincial/Regional Governments participating in the project. The Environmental Summary and Evaluation provides a concise summary and evaluation of the main environmental implications of the proposed investments and is based on the contents of the EIAs and the results of additional environmental and technical evaluations undertaken as part of project feasibility assessment.

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CHINA: Western Poverty Reduction Project

Environmental Summary and Evaluation

A. Overview

Introduction. The objective of the proposed Western Poverty Reduction Project (WPRP) is to alleviate chronic poverty for the absolute poor living in remote and inaccessible villages of Gansu Province, Qinghai Province and Inner Mongolia Autonomous Region within the People's Republic of China. The proposed project is the third in a series of World Bank-assisted poverty reduction projects in China that support the government's Eight-Seven Poverty Reduction Plan (the 8-7 Plan). In all three of the Participating Provinces (PPs), project supported interventions would enable poor households to raise their incomes through increasing grain and livestock production sufficient to meet their basic food needs and in many cases also generating a marketable surplus to improve their living standards. This report summarizes the main relevant findings and recommendations of three province specific environmental impact assessments (EIAs) prepared for the proposed project as well as results of additional environmental and technical evaluations undertaken as part of project feasibility assessment, and outlines the World Bank's evaluations of the main, substantive environmental issues.

The objective of the proposed Western Poverty Reduction Project (WPRP) is to alleviate chronic poverty for the absolute poor living in remote and inaccessible villages of Gansu Province, Qinghai Province and Inner Mongolia Autonomous Region within the People's Republic of China. The proposed project is the third in a series of World Bank-assisted poverty reduction projects in China that support the government's Eight-Seven Poverty Reduction Plan (the 8-7 Plan). In all three of the Participating Provinces (PPs), project supported interventions would enable poor households to raise their incomes through increasing grain and livestock production sufficient to meet their basic food needs and in many cases also generating a marketable surplus to improve their living standards.

Strategic Context. The proposed project supports several of the World Bank's key Country Assistance Strategy objectives including: targeted poverty alleviation investments, support for primary education with a particular focus on girls and minority nationalities, support for environmentally sustainable agricultural and livestock development and enhancing access to basic services for poor people. Access to health, education and other rural services would also be improved for the poor households. Although the proposed project will be implemented in three PPs, this report focuses mainly on proposed developments in Qinghai Province, which will involve new land reclamation and development in areas not presently utilized for crop production and, as such, offer the greatest potential for environmental impact. Developments in the other two PPs are substantially confined to modifications and improvements to existing land uses and mainly represent intensification rather than major changes in land use.

B. Environmental Review Process

Applicable Environmental Procedures. Consistent with the "*Environmental Protection Law*" of the People's Republic of China and Operational Directive (OD) 4.01, "*Environmental Assessment*" of the World Bank, each of the three components has been the subject of an Environmental Impact Assessment (EIA). These documents have been prepared to meet Chinese requirements for an EIA and World Bank provisions for activities placed in environmental screening category "B," which includes an Environmental Management Plan. The EIAs were prepared by the Environmental Protection Research Institute of Gansu Province, the

Environmental Sciences Institute of Inner Mongolia Autonomous Region, and the Qinghai Institute of Environmental Science. All three institutes hold the “Environmental Impact Assessment Certification of Class A,” issued by the State Environmental Protection Agency and the scope of the EIAs was substantially in compliance with that required for the World Bank’s environmental Category A, including public consultation. However, the bulk of the environmental analysis associated with the proposed project was of an essentially technical nature and designed to ensure that all relevant environmental considerations were taken into account in project design. The EIA documents identify the key environmental risks, and mitigation and environmental monitoring measures with their associated costs, and specify implementation responsibilities. English language translations of these reports have been placed in the Public Information Center at the World Bank.

Environmental Screening Category. The proposed project was reviewed and placed in World Bank environmental screening category “B” in accordance with the provisions of Operational Directive 4.01 and taking account of past practice with classification of a large number of similar integrated agricultural development projects financed by the World Bank in China over the last 10 years. Review of the scope and proposed activities of the project by Chinese and World Bank environmental staff indicated that the potential impacts were not unusual or unprecedented in terms of other large scale rural developments being undertaken in China, whether financed solely by the Government or co-financed by the World Bank and other donors. These activities generally have limited risk of adverse effects that could be addressed through design, mitigation and/or monitoring measures. The land reclamation and improvement activities supported under the project are of a kind that have been widely and successfully applied in other arid and semi-arid development projects in both the Project Provinces/Regions and other Provinces/Regions in central and western China. Previous interventions of this type by the World Bank have included the Gansu-Hexi Corridor Project and the Tarim Basin I and II Projects. In addition, the proposed activities would be implemented in a large number of dispersed sites with most of the anticipated negative environmental impacts being of local nature. The mitigation measures and methods to be utilized are well known and established in China. It should be noted that during project preparation the overall scale of the proposed project, particularly the scale of developments in Qinghai Province, was substantially reduced with an incremental decrease in potential environmental impacts.

Preparation and Review Process. Project preparation has included the participation of a highly experienced international environmental consultant as an integral member of the interdisciplinary project team used by the World Bank. This specialist participated in the preparation, pre-appraisal and appraisal of the project. The work of this individual was complemented by World Bank environmental staff who reviewed the environmental documentation prepared for the project. The environmental design of the project represents the combined work of these different experts. The EIA documents were submitted to Chinese authorities and the World Bank prior to appraisal and have been reviewed and approved by the State Environmental Protection Agency of China. They have been made available in the PPs to government agencies and project affected persons upon request. The EIA work was carried out in close coordination with the Social Assessments and the preparation of the Voluntary Resettlement Implementation Plan (VSIP) and the involuntary Resettlement Action Plan (RAP) for the Qinghai sub-project.

Consultation Process. Public consultation activities were also undertaken as part preparation of all three EIAs. In Qinghai, these consultations were undertaken in both the ‘move out’ and ‘move in’ areas in conjunction with the social surveys carried out as background to the resettlement program, while in Gansu and Inner Mongolia, specific surveys were carried out to gauge project awareness and opinions on various aspects including environmental issues. The

surveys were quite large; 1,800 questionnaires were distributed in Qinghai 'move out' areas and 120 in the 'move in' area, 5,000 questionnaires were distributed in Gansu supplemented by face to face interviews, and 4,650 questionnaires were distributed in Inner Mongolia. In Qinghai, environmental issues were only mentioned by respondents in the 'move in' area and the main issue of note was universal concern (i.e. expressed by 100% of respondents) that the new settlers would cut vegetation and destroy the ecological environment. In Gansu, there was a high level of awareness of the project and about 80% of respondents considered that the project would have beneficial or neutral environmental effects. In Inner Mongolia, there was a high level of awareness of the proposed project and the great majority (93%) of respondents felt that the environmental effects of the project would be neutral or beneficial.

Approach to the Analysis. The environmental analyses and related project documents have been reviewed from two main points of view: i) to determine whether there were any particular environmental aspects within the proposed project areas which would justify modifications or adaptations to the proposed development plans to enhance environmental sustainability; and ii) to define the environmental management and monitoring procedures which should be implemented as part of the implementation plan. The main environmental risks associated with the project relate to the fact that the poverty alleviation benefits arise from land use intensification in arid and semi-arid agro-ecological zones that are intrinsically sensitive from an environmental point of view. It should be noted that no pesticides are planned to be procured with the proceeds from this loan/credit. Although the project is primarily a poverty alleviation project, it also provides some opportunities to produce environmental benefits through reduced land use pressures particularly in Qinghai and Gansu and promotion of more environmentally sustainable agricultural practices in Gansu.

Potential Environmental Risks. More particularly, the main environmental risks include: i) possible acceleration of desertification; ii) possible agro-chemical pollution due to excessive application of fertilizers and pesticides; iii) solid waste generation from small rural enterprises and plastic film used in cropping; and iv) possible impact on wild vegetation and animals due to direct displacement or indirect effects of proposed land development activities. A review of these potential impacts and proposed design, mitigation and monitoring measures are described below. It should be noted that Chinese government agencies and research institutions have established a substantial track record of environmentally sustainable development of similar areas in other Provinces/Regions under very similar biophysical and geographical circumstances. The World Bank is investing in similar, although much larger scale, land development programs in very similar environments in Gansu Province (Gansu-Hexi Corridor Project) and in Xinjiang Uighur Autonomous Region (Tarim Basin I and II Projects) and project preparation and implementation experience in these projects has provided a substantial basis upon which to evaluate the feasibility of the proposed developments.

C. Project Setting, Development Alternatives and Proposed Interventions

Project Setting. The target population in the three PPs live in fragile agricultural and pastoral lands. In Qinghai, crop yields are low due to poor soil quality, low rainfall, recurrent drought and undeveloped farming techniques. Increasing cultivation and grazing pressures in mountainous areas are having devastating ecological impacts and there appear to be limited and possibly even no environmentally sustainable development options available in those areas. In Gansu and Inner Mongolia crop yields are low largely due to a comparatively harsh agro-ecological environment which is characterized by poor soils, steep topography, recurrent drought, short growing period, and significant grassland degradation combined with the lack of access of the targeted poor population to productivity enhancing technologies and capital for planting higher value crops or forages. As in Qinghai, this situation is already resulting in severe

environmental degradation and, without intervention, this trend will continue and worsen. However, and in contrast to Qinghai, there appear to be some options in both Gansu and Inner Mongolia for introducing productivity enhancing and environmentally sustainable crop and livestock development packages essentially *in situ*. There are proven technologies widely and successfully adopted in the proposed project areas and their further application is basically limited by shortages of investment funds of the type that the project will provide. The project will not solve all the problems in the three PPs, but it will make a substantial contribution to alleviating them.

Development Alternatives. All of the participating PPs and Counties suffer from severe poverty which is leading to serious environmental problems. In this context, the "no development" option is not feasible within the government's poverty alleviation or environmental objectives. Within that context, development options in the participating PPs are severely constrained by environmental and technical factors. In Qinghai, the resource base of the move out Counties has been severely depleted due to intense population pressure and the associated unsustainable cultivation and over grazing that has been necessary for local people to survive. Neither the Government nor the World Bank has been able to identify agricultural technologies that can provide a solution given current population pressures and the only feasible alternative is to provide opportunities for at least some of the population to voluntarily move to other areas which offer the promise of a more sustainable future.

The benefits of this strategy can be extended further by rehabilitating the worst of the vacated land and treating (e.g. through terracing) the remainder for redistribution amongst those families remaining so that they too will have a better chance of improving their situation and the condition of the local environment (as will happen through an existing government program). The situation in the two other PPs is not quite as severe insofar as there are known strategies for improving the sustainability of rural development "*in situ*". In these cases, development options are constrained by the need to reduce risk. Preference under the project has been given to supporting known technologies which have already been shown to be effective and acceptable to farmers. The menu of possibilities is very limited. To the extent that other development options are being pursued through the project (e.g. sustainable rangeland management in Inner Mongolia), this is being done through demonstration/pilot programs which will provide a better opportunity to evaluate the effectiveness of these approaches and their acceptability.

Given the general development framework which arose from consideration of the above constraints, further work was done on consideration of detailed design options. From an environmental point of view, probably the most significant of this work related to water management and overall development options for the Xiangride-Balong irrigation development in Qinghai. A wide range of conjunctive water use options are available and mathematical modeling was used to evaluate five of these and select an approach which provided an adequate balance between engineering, environmental and other factors. Monitoring will be undertaken during project implementation to determine the need, if any, for revision of the proposed development strategy.

Proposed Intervention Strategy. An important aim of the proposed strategy is to progressively broaden the focus of the farming systems from exclusively food self-sufficiency, as it is at present, to one which continues to stress food security but also offers increased opportunities for generating cash incomes. As productivity and incomes increase, opportunities should be provided to progressively retire from cultivation steeper land and other areas subject to severe wind erosion which are not suitable for sustainable crop production. It is intended that these lands would be sown to forage legumes and grasses, or protective trees. The consequent improvement in soil water conservation and progressive reduction of soil erosion (wind, sheet,

gully) would, over time, also contribute towards raising sustainable crop and forage production. A priority objective of the development packages is to improve the nutrition and productivity of livestock which are essential, long-standing traditional elements of local farming systems in all three areas and cannot be ignored in any integrated development approach. Livestock development would encourage the cut-and-carry feeding of penned ruminant (cattle, sheep, goats) and improved non-ruminant (pigs, poultry, rabbits) integrated crop/livestock production systems, thereby progressively reducing or eliminating large and small ruminant grazing on natural pastures, which is one of the major sources of the land degradation problems being experienced throughout the PPs.

D. Proposed Project Supported Activities

Agro-ecological and social conditions in each of the three PPs are quite different and, hence, the details of the proposed investments intended to achieve the above strategic objectives differ substantially between Provinces although the physical interventions fall within five general classes as follows:

- i) **Land and Household Development (all PP)**. The investment activities include intensification of crop production through the use of proven improved and environmentally-friendly technologies to raise crop yields, introduction and/or expansion of cash crop production (vegetables, tree crops, fruits), conversion of livestock management from free-range to confined-feeding production systems for sheep, goats, cattle, pigs, rabbits and poultry, improvement in the quality of farm level technical services through skills upgrading of county, township and village technicians, and support for adaptive research into and on-farm demonstration of improved and environmentally sound farming systems;
- ii) **Irrigation and Land Improvement (all PP)**. In Qinghai, construction of a new regulating reservoir and renovation of an existing reservoir plus construction of irrigation and drainage systems to service approximately 19,000 hectares of land. In Gansu and Inner Mongolia, construction of dispersed, small scale irrigation works covering a total of 34,050 hectares plus terracing of 26,500 hectares of sloping land and installation of soil and water conservation works;
- iii) **Rural Infrastructure (all PP)**. Construction of 216 kilometers of Class III and IV rural roads (i.e. minor access roads) to improve access to 289 remote administrative villages; construction of drinking water supply facilities to serve 370,000 people in 760 administrative villages; and extension of electric power lines to 410 administrative villages;
- iv) **Rural Enterprise Development (all PP)**. Provision of credit to underwrite establishment of small scale, non-state owned, household-based rural enterprises for construction of food and fiber processing facilities based on appraisal criteria; and
- v) **Voluntary Settlement (Qinghai only)**. Voluntary settlement in a new agricultural development area for an estimated 57,800 absolute poor currently living in degraded mountainous areas of eastern Qinghai and 4,000 local herders and farmers living around the settlement area.

E. Common Indirect Environmental Impacts

There are several indirect potential environmental impacts that are common to the various project activities in all three PPs. These include:

- i) **Use of Plastic Mulch.** Increased use of plastic mulch is becoming a problem throughout China, notwithstanding its demonstrated agricultural benefits. In one of the PPs (Gansu) it is proposed to establish a small plastic recycling plant of a type being promoted throughout the country. Whether this proves to be financially viable (something which will need to be firmly established before financing is approved) remains to be seen. Neither Qinghai nor Inner Mongolia are likely to be able to generate the quantities of plastic that would render such a plant viable and hence, no such developments have been proposed in these areas. On the other hand, informal, inter-Provincial plastic recycling has started to develop in China and this may offer an alternative. In the longer term, the problem is only likely to be dealt with on a national basis through the promulgation and enforcement of national design standards for plastic film which include, *inter alia*, the requirement for film to be degradable following exposure to UV light. Such film is already available in China although it costs more than conventional film and its use is not mandatory. In the interim, this form of pollution has to be viewed as an unavoidable aesthetic impact of the proposed project;
- ii) **Small Scale Agro-Enterprise.** Some small scale agro-enterprises could generate liquid wastes containing organic material that are subject to regulation under national water pollution control laws. This is most substantially an issue with proposed developments in Gansu Province rather than in Qinghai and Inner Mongolia. In the cases that have tentatively been identified, the control technologies are well known, simple to design, construct and operate, and subject to regulatory procedures administered by Provincial and County Environmental Protection Bureaux (EPBs). Administrative steps will be included in sub-loan processing procedures in all three PPs to ensure that loans will not be issued without environmental clearances being received from relevant EPBs; and
- iii) **Increased Use of Agricultural Input.** Increased on-farm productivity will be achieved, at least in part by increased use of inputs, including fertilizers and pesticides. Regarding *fertilizer* usage, there are parts of China, particularly in lake catchments in the highly developed coastal zones of the country, where nutrient enrichment (eutrophication) problems are being experienced and research indicates that, while most of the problem is due to emissions of nitrates in human and industrial wastes, some (typically on the order of 20–25 percent of total nitrogen emissions) is due to non-point emissions from farms. Such problems are not being experienced in central and western China for the good reason that farmers in these regions tend, for financial reasons, to significantly under-utilize fertilizer. This is likely to continue to be the case in the project areas. In addition, the farming practices being promoted under the project are intended, among other things, to reduce soil loss, conserve water and increase organic matter retention. All other things being equal, all of these strategies contribute to reduction in nutrient losses from fields. Regarding the use of *pesticides*, World Bank funds will not be used for procurement of such chemicals although it is likely that farmers engaging in cash crop and orchard production will procure them using their own funds. The project will rely on continuation of existing pest management programs by Provincial and County Plant Protection Departments. These include farmer education, a highly

organized pest forecasting system that is designed to discourage calendar spraying, restrictions on the types of chemicals which can be sold and mandatory requirements for the display of occupational health and safety warnings and recommended application levels and procedures on containers.

F. Qinghai

Proposed Activities in Qinghai

Activities in Qinghai, unlike the developments in the other two PPs, is based totally on the development of irrigated agricultural production to accommodate voluntary resettlers. The project area has an arid to semi-arid climate and crop production is not possible in the absence of irrigation (either natural or artificial). Activities will involve development of an irrigation system to service an area of about 19,000 hectares which will be located in six separate development areas spread over a total area of approximately 250,000 hectares. Thus, the development area comprises about 8 percent of the “project area” (the geographical area whose boundaries circumscribe all the individual development areas).

Water Resources Development. Irrigation infrastructure would be developed through two separate systems servicing five separate irrigation districts located in close proximity to each other:

- i) **Xiangride-Balong Irrigation Sub-District.** The first system would be completely new and will comprise a diversion weir on the Xiangride River, a 28 kilometer conveyance canal leading to a 23 million cubic meter regulating dam¹. A 59 kilometer long canal would connect Keri Dam to the Balong Irrigation Sub-district (14,700 hectares) and part of the Qingshuihe Irrigation Sub-district (1,660 hectares). The canals will all traverse and be located within extremely sparsely vegetated desert land (vegetation cover generally less than 5 percent) and will be concrete lined to reduce seepage losses; and
- ii) **Hatu Irrigation Sub-District.** The second system will involve rehabilitation and increasing the delivery capacity of an existing irrigation system through improvements to an existing intake structure, raising the wall height of an existing regulating reservoir (Hatu Dam) by one meter, and treating the base of the dam to reduce leakage. This system would service a total of about 2,800 hectares in three irrigation sub-districts (Hatu – 760 hectares, Yikegaoli – 740 hectares and Xiaoxiatan – 1,130 hectares).

Activities will also include financing of installation of appropriate drainage systems and on-farm irrigation works in all the serviced areas.

Crop Production. Crop production investments in Qinghai would include the initial land development (clearing, leveling and cultivation) for crops (starting with green manure planting), forage and tree planting on 19,200 hectares to which water will be supplied through the irrigation component. Project funds will be provided to cover investments for the first crops to be sown by the settlers (seed, fertilizer, plastic mulch, pesticides, etc.), development of seed production and multiplication areas (679 hectares in total), development of two technical service centers, and

¹ The dam is, in fact, an off-river reservoir of a type often referred to as “turkey’s nest dam.” That is a reservoir which is surrounded on three or four sides by constructed walls. Keri Dam will have a front wall height/crest length of 40meters/390 meters and side wall heights/crest lengths of 21 meters/135 meters and 26 meters/480 meters. The reservoir will inundate approximately 127 hectares of unused desert land and have an average depth of about 15 meters.

installation of applied research and demonstration plots for farmer training. The main crops to be grown include grain (wheat and barley), potatoes, rape, beans and vegetables (onions, garlic, cabbages). Forage crops (vetch, alfalfa, clover and oats) would be grown as an integral part of crop rotation as is the widespread practice in arid and semi-arid development projects in China². About 15 percent of the land development area will be used for establishment of forested windbreaks, shelterbelts, fuel wood forests and production forests as is conventional practice in such developments.

Livestock Development. Forage production will be derived from the areas to be newly irrigated, with winter forage consisting of ensilaged greenfeed and byproducts, ammoniated straws and stalks which are widely used in China and supplemented, in some cases, by purchased or home-produced concentrates such as oilseed cake, wheat bran and barley. Livestock production will be based entirely on the stall-fed, cut-and-carry feeding system with no utilization of grassland areas. Production systems will include pig breeding and fattening, sheep and cashmere goat breeding and fattening and/or household chicken and egg production. The majority of households are expected to raise only a small number of animals, largely for household consumption but with one or two surplus animals sold for cash income, although a minority may choose to specialize in one type of animal production system. Small forage areas would be planted on each farm while specialized forage production farms (about 2,880 hectares in total) would be designated within the settlement area. Each household would be allocated land (about 0.256 hectares) including the forage production farms. Forage would include hardy varieties such as milk vetch, alfalfa and wild rye grass. A condition of household-based livestock financing would be a proven self-sufficiency in forage or grain. Livestock numbers would be based on feed balance calculations. Grazing on the natural grasslands surrounding the settlement area would be prohibited. Local Grassland Monitoring Stations supervised by Project Management Offices (PMOs), would spot check the accuracy of feed balances and compliance with confined feeding.

Low-cost, adobe and plastic cover livestock sheds, ammoniation pits, capital stock purchase, forage establishment costs would be financed, and for specialized households, one third of the cost of initial feed purchases. A number of households would specialize in forage processing with small low-cost straw and chaff cutters.

Rural Roads Development. Construction of 116 kilometers of all-weather, Class IV gravel roads on a 4x4 kilometer grid would be financed, which would follow branch canals in all irrigation areas plus 426 kilometers of farm roads. These roads will be no risk of increasing access to areas outside the project.

Rural Enterprises. This component will underwrite development of extremely small scale agro-processing enterprises including; a feed concentrate mill, a flour mill, a fodder chopping mill, a vegetable oil extraction mill and noodle manufacturing plant.

Rehabilitation of ‘Move-Out’ Areas. As part of existing land rehabilitation programs in the “move out” areas, approximately 85 percent of vacated land will be planted to trees and grasses and retired from cultivation. The remaining 15 percent is of lesser slope and will be terraced and shared amongst families remaining in the area to increase per capita farm size and improve the possibilities for developing more environmentally sustainable farming systems.

² Farmers in the arid regions frequently plant a crop such as clover as a green manure crop simultaneously with a grain crop or, if the season is long enough, as a second crop for forage production or as green manure.

Existing Environmental Conditions

The key environmental concern in Qinghai is the potential impact of the land use change to be promoted in the Xiangriade-Balong areas (hereafter referred to as the Qinghai-project area) of Dulan County where the resettlers are to be established. As noted above the environmental effects in the ‘move-out’ counties will be neutral to beneficial due to reduced pressure from agriculture and grazing on marginal lands combined with actions to rehabilitate these areas.

Location and Landforms. The Qinghai-project area is located in the southeastern corner of the Qaidam Basin, which extends diagonally southeast to northwest through the northern half of Qinghai Province. The mountains bordering the Basin to the northeast, southeast and southwest reach heights of up to 5,000 meters above sea level (a.s.l.) while the lowest elevations in the center of the basin are in the order of 2,500 meters a.s.l. The general slope of the Basin is from southeast to northwest.

The main landforms comprise the denudational mountains and hills which form the boundaries of the basin (and are also the only location of reliable precipitation), denudational and depositional gobi on the piedmont plains at the base of the mountains (the lower parts of these are the only areas where agriculture other than itinerant livestock grazing is possible) followed, in the lower reaches of the Basin, by sand dunes and salty marshes. Numerous salt lakes including some of the largest in China dot the lower parts of the Basin. The gobi piedmont areas are subject to ongoing depositional action and reworking as a result of flooding from the rivers that emerge from the mountains. Closer to the foot of the mountains, they are covered with gravel and vegetation is virtually non-existent. As distance from the mountains increases the slopes flatten, the surface materials become finer and the groundwater table is shallower (3-25 meters). These areas offer agricultural development potential provided that supplementary water can be provided.

Immediately to the north of the Qinghai-project area is located an extensive saline swampy area or “soak”, covering about 35 square kilometers which follows the course of the Qaidam River and exists due to the intersection of the underlying water table and the ground surface. The water is saline due to the evaporative concentration of salts dissolved in the groundwater. The ground surface in this area is braided, due to periodic flood flows in and overflows from the river and vegetation cover is variable from quite dense in the gullies to non-existent on the ridges. This type of swampy ecosystem continues intermittently along the course of the Qaidam River system for some 180 kilometers to the northwest until the river terminates in the Huaerxun Lake system, one of the largest systems of salt lakes in China.

Climate. The Qaidam Basin is totally cut off from maritime air masses and is thus the driest part of Qinghai and amongst the driest areas in all of China. Average annual rainfall in the northwestern parts of the Basin is in the order of 20–50 millimeters but this increases progressively towards the project area reaching 50–100 millimeters immediately west of Balong and 100–200 millimeters east of Balong. Rainfall in all areas is erratic and unreliable. Precipitation in the surrounding mountains can be as high as 700 millimeters, much of which falls as snow. Runoff and infiltration of this precipitation is essentially the sole source of water for all life within the Basin. Average temperatures are cool (around 4°C) with substantial seasonal variation (maximum temperatures can reach approximately 33° C and the minima can reach -26°C). There are about 220 frost-free days per year and windspeeds, particularly during March–May, can be high.

Surface Water Resources. The surface water systems comprise a network of ephemeral and semi-permanent “rivers” which debouch from the mountains forming the southern rim of the Basin, flow across the sloping piedmont areas and discharge into the trough of the Basin which,

as previously mentioned, flows north of the Qinghai-project area. The overall system is referred to as the Qaidam family of Rivers. Upstream of the Qinghai-project area, the main stem of the river is referred to as the Xiangride River which rises outside and to the south of the Qaidam Basin and then flows through a notch in the southern rim of the Basin about 50 kilometers southeast of the project area. The Xiangride River flows into a soak to the east of the Qinghai-project area. Drainage from this soak represents the start of the Qaidam (or Caidamu) River. The Qaidam River issues from this area and flows northwest past and to the north of the Balong Irrigation Sub-District. It is joined by numerous ephemeral tributaries also flowing out of the southern rim of the Basin, several of which (including the Xianomuhong River, the Hatu River and the Yikegao River) are already used as irrigation water sources. The Xiangride/Qaidam River system flows more or less permanently (at least in the vicinity of the Qinghai-project area) due to its upstream length (some 250 kilometers), and the fact that its headwaters flow through two large lakes with a combined capacity of about 8 billion cubic meters (Bcm).

These are three sources of water for the project area. Their identities and average yields (in million cubic meters (Mcm) per year) are:

Flow in Xiangride River –	387 Mcm per year
Flow in six small rivers flowing into the Balong area –	162 Mcm
Groundwater in the Balong area –	100 Mcm

Thus total availability is about 650 Mcm per year.

Flora and Fauna. Qinghai in general and the Qaidam Basin in particular, contain a comparatively low diversity and abundance of both flora and fauna due, in part, to the extremity of the environment and partly to the limited number of biogeographical units which occur in the region. The project area supports two main associations of *native flora*:

- i) Xerophytes and super-xerophytes of the piedmont and gobi areas, predominantly *Haloxylon ammodendron*, *Ephedra przewalskii*, *Ceratoides latens*, *Reuria soongorica*, *Calligonum mongolicum*, *Artemisia desertorum* and *Populus przewalskii*. All are widespread throughout similar areas in the region; and,
- ii) Halophytes (salt tolerant species) which occur in the saline swampy areas to the north of the project area. Main species include *Nitraria spp.*, *Tamarixchinensis*, *Phragmites communis*, *Achnatherum spp.*

There are no conservation reserves in or near the area nor was a need for such reserves identified in the Biodiversity Review of China (WWF, 1996). In addition to the native species, a wide variety of introduced tree species and agricultural crop species are found in existing oases scattered around the area.

Wildlife resources occurring in and adjacent to the Qinghai-project area are moderately diverse, particularly the bird species, although not abundant due to the exceptionally low productivity of the natural land systems. The main mammals identified in the area include *Procapra gutturosa*, *Lepus oiostolus* and *Vulpes corsac*. Birds are more diverse, with some eight species being identified in the area. Again, the habitat types represented in the area are widely distributed in central western and central northern Qinghai.

Environmental Management Issues

There are two categories of *environmental management issues* associated with the proposed development. First, the environment poses certain risks to the success of the proposed development. Second, the development itself poses certain risks to the local environment. The first category of risks arises from the extremely harsh nature of the environment in which the development is to be undertaken. The main issues are:

- i) **Wind Erosion.** Soils in most of the land to be developed are light textured and have been wind-blown into hummocks which will require leveling for irrigation development, raising the risk of increased wind erosion. This is a common problem and the standard safeguards are to level the land in alternating strips and to cease land development works during the windy months. These safeguards provide effective short term control. Longer term protection is provided through the extensive shelter belts of trees which are planted as soon as irrigation water becomes available (and before crop production commences) and are an invariable characteristic of oasis developments throughout China;
- ii) **Soil Salinity.** Soil investigations in the Balong irrigation area indicate the presence of saline/sodic soils in some areas which, if incorrectly managed, can threaten crop yields due to toxicity and/or impeded drainage. The safeguard required is to install necessary drainage, to ensure that land leveling is undertaken accurately, to over-irrigate during the first years of development to leach salts out of the surface layers and to closely manage subsequent irrigation to ensure that the salt front is kept well below the root zone and/or conjunctively use ground and surface water to control water table depth (as is proposed in parts of both the Balong and the Qingshuihe irrigation districts). Again, these measures are well known by irrigation and extension services in China and the project includes provision for further soil surveys as part of final detailed design of drainage systems and for training and demonstration of correct irrigation techniques for the new farmers. Nevertheless, this would have to be rated as a *potentially significant risk*, particularly in view of the fact that the majority of new settlers will not have had significant prior irrigation experience. Continuous monitoring of crop yields and soil and groundwater salinity levels is an essential safeguard for assessing the situation and identifying the need to take action through supplementary training of farmers and information dissemination. The risk of soil salinization and sodification is a related but well known risk that will also require constant monitoring; and,
- iii) **Water Supplies and Flood Risks.** The irrigation system will be totally dependent on the availability of water to meet crop demands. The total gross annual irrigation demand is estimated to be about 300 Mcm which is less than half the resources available in a 75 % rain year. Water balance and reservoir operation studies incorporating groundwater simulations were carried out to establish the adequacy of supplies from the Xiangride River and the Balong groundwater. Operational studies carried out for the optimum development option (Keri Dam plus 67 wells) using continuous flow records covering the period 1962-69, which was the driest period during the 40 years (1956-96) for which records are available, showed that the regulated flow in the Xiangride River plus conjunctive use of Balong groundwater satisfied demands in all years including a surplus for uses downstream of Keri Dam equivalent to 115 Mcm per year. Similar modeling showed that flows in the Hatu and Qingshuihe Rivers are

sufficient to meet projected demands in 75 percent of rain years which is consistent with current irrigation standards in China. In common with all irrigation areas in China, standard operating procedures are invoked to equitably ration water in drought years. Thus, there is an acceptable reliability of supply. As will be mentioned further below, the abstraction of water for the project area will come at the possible expense of water supplies to the saline swampy areas to the north of Balong and this may have indirect environmental consequences. Regarding flood risks, all rivers flowing out of the mountains are subject to periodic very high flows. These have been taken into account in project design with all development areas being provided with flood protection bunds.

In conclusion, the environment in which the proposed development is to be undertaken poses certain well-defined risks that accompany all similar developments in the arid and semi arid zones of China. The degree to which these risks are managed depends on the effectiveness of the key environmental monitoring programs that are included in the project design, and the effectiveness of the training and development programs that are implemented to educate and assist the project participants. Additional possibilities are provided through adoption of new technologies such as reduced tillage for improved wind erosion protection and moisture conservation which has been accepted as feasible in the area.

The second category of environmental issues relates to the possibility that the Qinghai activities could adversely affect environmental conditions in and around the site. The main risk in this regard arises from the fact that the project would involve a significant increase in the area of intensive agricultural development in the project area, which raises the potential for both direct and indirect environmental effects.

The major form of *direct environmental impact* having potential significance arises from conversion of approximately 19,000 hectares of lower piedmont land to irrigated agricultural land. In its present state, these lands have very limited value as pasture, with only about 1,300 hectares being suitable for low grade (that is, unimproved) pasturage, virtually all of which is located in areas of shallow groundwater along the northern boundaries of the project area. The majority of the project development area supports very sparse populations (ground cover is less than 5 percent) of xerophytic plants that are widely distributed across similar terrain around the Qaidam Basin. The direct ecological impact of the project, in terms of displacement of existing natural ecosystems, is thus considered to be insignificant. It should be noted that the proposed developments will provide certain ecological benefits insofar as floral biodiversity and the structural complexity of the local ecological system will be substantially increased, albeit artificially, and there will also be local micro-climatic benefits (moderation of seasonal temperature variations and increased humidity) which have been well-documented in China.

As previously mentioned, the proposed new regulating reservoir will occupy an area of 128 hectares of piedmont land which is at a slightly higher elevation than the irrigation areas and thus is more gravelly and sparsely vegetated. This reservoir is also located "off-river" and hence will not interrupt flow in the Xiangride/Qaidam river system. The environmental consequences of this development are limited.

There will be direct social impacts on both herder families (63 households or 352 persons in all) who use pasturage along the northern boundary of the project area as well as other herders (289 households or 2,411 persons) who drive their flocks through the area as they move them between summer and winter pastures north and south of the project area. Compensation arrangements have been proposed and, to the extent that these are freely agreeable and acceptable

to the affected persons, it is difficult to envisage any adverse environmental impact potentials arising.

The main *indirect potential environmental impacts* arise from the application of approximately 300 Mcm of water to the new irrigation areas, much of which presently flows into the saline swampy areas north of Balong. Modeling undertaken as part of project design indicated that, in the long term (5 to 10 years) the average groundwater level in the swampy areas could be reduced by up to 0.5 meters immediately north of the Balong irrigation district. It should be noted that groundwater levels in the area fluctuate substantially throughout the year depending on the flow in the Xiangride/Qaidam system and their tributaries (the fluctuation is reportedly in the range 0.1 to 0.5 meters). If there is an adverse effect, it is likely to occur on the margins of the area where vegetation is probably surviving close to the limits of its tolerance and has much less capacity to accommodate variations in the current pattern of water availability. The likelihood of this happening is conjectural at the present time due to the inherent inaccuracies of groundwater modeling.

It will be necessary to monitor groundwater levels and vegetation distribution to the north of the Qinghai-project area to assess the degree to which these effects materialize and determine the need for any corrective action. It should be noted that the impact is substantially determined by three factors: i) the balance between the use of surface and groundwater in the Balong irrigation sub-district; ii) the degree to which groundwater is exploited in the Qinshuihe Irrigation sub-district (to the west of Balong); and iii) the locations of the groundwater wells. The surface/groundwater usage balance selected for the preliminary design is intended to strike a balance between environmental, practical and financial factors. There are other feasible design and management options which can be adopted if necessary and would either leave groundwater levels in the swampy areas unchanged or actually increase them in some parts (for example, if no groundwater pumping was included in the project, water tables throughout the Balong area will progressively rise, extending the swampy area substantially but destroying the irrigation area).

G. Gansu

Proposed Gansu Activities

The Gansu activities will be implemented in 2,234 villages in 12 counties in southeastern Gansu Province. All land covered by the sub-project is already being used for agricultural production. The purpose of sub-project investments is to promote adoption of improved, more environmentally sustainable agricultural crops and technologies and to add value to agricultural outputs close to the point of production to increase income retention in the sub-project areas. Physical interventions include land development, small scale irrigation, improved crop production, livestock development, forestry development, rural enterprise development and provision of rural infrastructure.

Land Development. The Gansu activities will support land terracing over an area of about 21,000 hectares of moderately sloping and presently degraded land.

Small Scale Irrigation. The activities will support installation of micro-irrigation systems, purchase of sprinkler sets, lining of existing irrigation canals and improved rainwater collection cisterns. The areas concerned are small and widely dispersed throughout the Gansu counties.

Crop Production. The activities in Gansu will support improved planting of *food crops* over an area of about 31,000 hectares. Interventions include provision of plastic mulch for maize

in 11 counties and plastic mulch for wheat in four counties, provision of virus-free potato seed in four counties, promotion of wheat/corn inter-planting in two counties and promotion of high production broad bean planting in four counties. Activities will also support production of vegetable *cash crops* (9,000 hectares), fiber hemp production (1,040 hectares) and introduction of four species of Chinese medicinal plants and tubers (7,780 hectares). The production of Chinese medicinal herbs would focus on higher altitude areas of Gansu where poverty is endemic.

Livestock. Activities will support pig and cattle fattening, sheep production by individual households to supplement farm crop income, mixed livestock production systems using remaining natural grassland areas, commercial scale breeding pig and cattle fattening production operations, soft-shelled turtle production, and fish production. Most feed for ruminant animals and pig production and turtles and fish production would be obtained from crop byproducts and manufactured feed sources and have little additional impact on natural grassland ecosystems. Fodder legumes would be fed directly to livestock or processed into higher quality feeds. By products of maize and broad bean production to be supported under the project will provide animal feed and ammoniated grain straw is useful as livestock feed. A large amount of surplus crop byproducts and the technology to improve feed quality are available. Based on 1999 forage balance determinations the project would have, at full production, a 42 percent forage surplus over incremental livestock demand.

A total of 11 household livestock production models have been developed to suit different conditions in different counties. The majority incorporates multiple species (that is, sheep and cattle or sheep, cattle, pigs, etc.) and most rely totally on crop byproducts and/or prepared feed for inputs. However, grazing on natural grasslands is planned in three counties in Gansu, representing a total of 8,050 hectares or 19 percent of the total natural grassland area in these three counties. Most of these areas are in good to excellent condition due to a rotational grazing system that is already being followed. However, some other areas have been degraded by use of the land for cropping. About 2,300 hectares of this land would be rehabilitated under the project by planting grasses, alfalfas and clovers which will then be used as livestock forage. The sustainability of all production systems has already been established through preparation of county level feed balances. Additional livestock and grassland management plans must be prepared by each participating village as a condition of participation in Gansu activities.

Forestry. The activities will support planting of about 15,500 hectares of forests and perennial tree crops including apple and pear, prickly ash, walnut, Japanese larch, mulberry, olives and tea. These species will be planted on areas of steeper land that will be retired from cropping as part of the Gansu activities.

Rural Enterprise Development. The activities will support investments in a wide range of enterprise developments that have in common involvement of value-added processing of products generated from the project areas and addition of this value as close to the point of production as possible to maximize income retention in the project areas. There are two categories of investment: i) large scale development (investment greater than \$30,000); and, ii) small household enterprises. The Provincial Government has identified several candidates within the first category, including fruit storage, pig breeding farms, basket-making factories, medicinal plant processing facilities alfalfa processing and carpet weaving factories. With the exception of the pig breeding farms, none of these are of significant environmental consequence. Nevertheless, before any are accepted into the project they have to undergo defined technical and financial assessments including evaluation by Provincial and County level (EPBs) for compliance with any relevant emission standards and, as required, supervision of commissioning and operation of pollution control facilities.

Rural Infrastructure. The activities will support construction of 174 kilometers of all weather gravel roads in 10 counties linking existing villages with county road networks. Three small bridges will also be constructed. Improved water supplies will be provided to about 260,000 people in all participating counties. Supply systems will include springs, existing surface sources and rainwater runoff.

Existing Environmental Conditions

The 12 participating project counties in Gansu, are all located in the hilly parts of southeastern Gansu Province with elevation varying from about 550 meters to more than 4,000 meters. Environmental conditions are extremely variable due, primarily, to topographical variations. The climate ranges from sub-tropical humid in the southern parts of the project area to temperate humid in the north. Average annual temperatures range from about 6° C (Minxian County) to 15° C (Wenxian County) and average annual rainfall ranges from about 440 millimeters (Wenxian County) to 800 millimeters (Kangxian County) although the majority of counties fall in the lower end of the range. Growing seasons range from about 138 days in Qingshui County to 262 days in Wenxian with the majority experiencing growing seasons less than 160 days.

Five of the participating counties are located in the hills of the Loess Plateau and all but one of these (Minxian County) suffer from soil erosion which ranges from bad to very severe. Two of these counties (Xihe and Wudu) are more than 60 percent affected by severe erosion. There is virtually no natural vegetation left in the project area, most having been long converted to agricultural use and much of that having been since turned into wasteland through unsustainable usage. There are two high altitude Nature Reserves in the region (in Wenxian and Wudu Counties) but they are not located in the project areas.

Environmental Management Issues

The objective of the Gansu activities is primarily to reduce poverty through a variety of measures, some of which include the promotion of agricultural activities which are more environmentally sustainable than those currently being followed in the region. There is little doubt that the primary environmental risk associated with the project's development strategy arises from the proposed livestock development program. During the project design-phase, considerable work was done to prepare livestock development models including feed balances to ensure that the feed and fodder resources necessary to support the proposed livestock production systems will actually be available. Analyses done so far suggest that the resources arising from project investments alone are likely to significantly exceed feed demands. Nevertheless, these balances are based on County level data and provisions have been included in the project design for preparation, review and clearance of township level balances prior to disbursements being authorized for those townships as set out in the project documents. These safeguards were progressively developed through the project design phase and final environmental clearance depended on the inclusion of final arrangements as outlined and relevant conditionalities in the proposed legal agreement.

H. Inner Mongolia

Proposed Inner Mongolia Activities

The proposed activities in Inner Mongolia comprises investments in 136 townships within 15 counties/Banners covering a total project region that is about 138,000 square kilometers in area. Investments will be made in crop production (improved production of existing crops and

introduction of certain new crops), livestock production, tree planting/forestry development, small scale irrigation, land terracing/soil conservation, agro-enterprises and rural infrastructure.

Crop Production. The activities will finance improved production of a wide variety of existing crops, particularly maize and potatoes, which account for about 75 percent of the total area to be planted, but including also subsidiary crops such as buckwheat, peas and hybrid sunflowers. The total area over which such developments will be supported is 87,000 hectares spread across all participating counties/Banners. As in Gansu, all of these areas are already being used for agricultural production so that the main effect of the project is to intensify an existing land use rather than to introduce a major change in use. Also as in Gansu, the Inner Mongolia activities would supply households with the first year's requirements of quality inputs (seeds, plastic mulch, etc.).

Livestock Component. The project will support development of a wide variety of integrated household production systems (11 different models are possible), all but one of which are based on cut-and-carry plus natural pasture grazing approaches. The livestock to be supported under the different models include sheep, goats, cattle, rabbits, chickens and pigs and it is estimated that about 139,000 households will participate in the program.

The integrated household pasture and fodder production system to be supported under the project is referred to as *caokulun*, a sustainable livestock management system that has been developed to assist in reversal of the rangeland degradation occurring in Inner Mongolia in recent decades. A caokulun is one hectare of land protected by a wall and a tree-shrub shelterbelt in which irrigated fodder and grain crops are produced to benefit two households. Associated with the caokulun is an area of natural pasture assigned to each household (on a 30-year leasehold basis) on which household livestock are permitted to graze, and which will fall under the prevailing grassland management regulations. The livestock feed produced by the caokulun is used to supplement natural pasture forage obtained by grazing during summer and autumn and to provide a full feed ration to household livestock during the winter and spring, thus relieving grazing pressure at critical times to improve ecological condition of natural pasture ecosystems.

The project also includes a component that will demonstrate, on a pilot scale, another improved integrated farming system. The pilot will be undertaken on an area of about 1,370 hectares of natural grassland that is presently being over-grazed. It will demonstrate an integrated farming system comprising mixed crop and livestock farming, utilizing crop by products as the main source of ruminant forage for cattle and sheep, and recycling animal manure to the croplands. Finally, it is proposed that approximately 2,000 hectares of degraded grassland be rehabilitated through planting of improved pastures and reserved for forage harvesting (that is, not for grazing) while an additional 2,200 hectares will be fenced off for and managed under a regulated grazing regime. These activities are designed to complement the Inner Mongolian Government's existing reseeding and grassland rehabilitation programs.

Tree Planting. The activities will support planting of trees or protective bushes on an area of about 15,000 hectares of severely degraded land. Species to be planted include trees such as larch and wild apricot.

Small Scale Irrigation. The activities will support development of about 11,500 tube wells/dug wells to irrigate an area of about 22,000 hectares (that is, about 0.5 hectares/well). Canal lining would be provided on existing canals servicing an area of about 3,760 hectares. Finally, rainwater-based harvesting systems would be installed, covering about 3,300 micro-irrigation systems which are used for supplementary watering of rain fed crops.

Land Terracing/Soil Conservation. An area of 8,500 hectares of presently cultivated land with slopes less than 15° will be terraced while an additional 5,900 hectares of wasteland and degraded land along roadways and on ridges will be planted with trees for wind erosion control.

Agro-enterprises. The activities will provide financing for farmers to procure small feed chopping and threshing machines and small tractor sets. The scheme is voluntary. For the purposes of project planning it has been assumed that demand for about 200 sets of each might be realized.

Rural Infrastructure. Forty five kilometers of existing rural roads will be rehabilitated to Class III standard. One hundred and eighteen drinking water supply systems will be installed (dug wells and/or cisterns), and 860 kilometers of low voltage power lines (10 kV and 0.4 kV) will be installed.

Existing Environmental Conditions

The proposed project area is located in the central part of Inner Mongolia Autonomous Region, south of the Mongolian Plateau. It is totally within the Mongolian Steppe biological unit although over the 1,000 kilometers of project area, four sub-zones are defined based on topographical factors. The climate throughout the area is semi-arid, with average annual rainfall ranging from 325 millimeters to 390 millimeters, average annual temperatures ranging from 1.2° C to 5.6° C, and average windspeeds being moderate to high (ranging from 3.2 to 3.8 meters/second). Water resources (mainly groundwater) in the region are generally adequate although unexploited (it is estimated that only about 25 percent of the sustainably usable groundwater supply in the area is presently tapped) and soils are generally well-structured but nutrient deficient (predominantly brown chestnut soils). The dominant vegetation type is steppe grassland which accounts for about 70 percent of the project region and, in many places, has been overgrazed and is degraded. Crops account for about 12 percent of the area (less than 10 percent of this is irrigated) and forests for about 9 percent.

The area contains some of the best grasslands in China and includes a wide variety of species including *Stipa spp.*, *Agropyron spp.*, *Festuca spp.*, and *Cleistogenes spp.* which often can be highly productive, producing in excess of 2 tons/hectares of fresh grass when managed properly. Salt marshes occur in the lower lying parts, depressions without drainage and the dominant species in these areas are common ones such as *Carex spp.* and *Phragmites spp.* Terrestrial wildlife is generally of limited diversity and abundance and dominated by domesticated species (sheep, goats, horses, etc.). Native domesticates include the Mongolian Horse and Mongolian cattle. There are nine Nature Reserves in the region, two of which are State level, making them of national significance. Only one of these is located in the project region but it is not located in a participating Banner and will not be directly or indirectly affected by the project.

Environmental Management Issues

The primary environmental management issue in Inner Mongolia is the same as for the proposed Gansu Province developments; that is, promotion of increased livestock production for poverty alleviation runs the risk of exacerbating unsustainable use of rangelands. During the project design-phase, considerable work was done to prepare livestock development models including feed balances to ensure that the feed and fodder resources necessary to support the proposed livestock production systems will actually be available. Analyses done so far suggest that the resources arising from project investments alone are likely to significantly exceed feed

demands. Nevertheless, these balances are based on County level data and provisions have been included in the project design for preparation, review and clearance of township level balances prior to disbursements being authorized for those townships. The details of the proposed safeguards are outlined in the Environmental Mitigation and Monitoring Plan. These safeguards were progressively developed through the project design phase and final environmental clearance depended on the inclusion of final arrangements as outlined and relevant conditionalities in the proposed legal agreement.

I. Environmental Mitigation and Monitoring Plan and Additional Studies

Introduction

The environmental mitigation and monitoring strategy is based on lessons learned from many years of attempts to apply environmental management criteria to broad-scale rural development projects not only in China, but throughout the east Asian region. The approach taken also acknowledges that an integral project objective is the promotion and financing of environmentally sustainable and/or reduced environmental impact rural production methods and, as such, there is a commonality of intention between general project management and supervision activities (by all participants – World Bank and counterparts) intended to guarantee project success, and those intended to avoid and minimize adverse environmental effects.

In this context, the key criteria that have been followed in development of the project as a whole and its environmental management strategy have been as follows:

- i) To the maximum extent possible, environmental objectives should be pursued through the design of the project itself rather than relying unduly on *ex parte* supervisory processes;
- ii) Given the potential associated costs, environmental monitoring and supervisory activities should be focused on those activities and processes which have the potential to register adverse environmental impacts that are significant within the environmental and developmental contexts in which the project is to be carried out. Furthermore, monitoring of the physico/chemical environment should only be undertaken where meaningful baseline data exist or can be cost-effectively developed upon which to base interpretation of results;
- iii) The environmentally sustainable development technologies supported under the project should, to the extent possible, be selected from amongst those technologies that are already being applied within the project area and are well understood and accepted by project participants. To the extent that new technologies or modifications to existing technologies are to be promoted, it should be through research and/or demonstration and/or pilot activities;
- iv) The technological approaches and environmental performance standards required should be fully consistent with existing government programs and standards; and
- v) As much reliance as possible should be placed on the use of existing government regulatory, management and control agencies in preference to constructing “shadow” management and control systems which are unique to the project.

Mitigation Strategies and the Environmental Monitoring Program. An Environmental Mitigation Strategy is provided as Table 1, which sets out the main, potentially adverse environmental issues, in declining order of significance, that have been identified through a variety of sources including the provincial project EIAs, supplementary technical reports by relevant Chinese consultants and World Bank advisers, and field based review of these elements of the proposed project. It indicates in which PPs the issue arises to a significant degree, the nature of the mitigation measures incorporated into project design and the assessed need for any supplementary monitoring and control activities. This is complemented by a Project Monitoring Program which is provided in Table 2. Each village in the Project area would prepare and monitor an annual livestock and grassland management plan to ensure acceptable livestock feed balances and environmentally sustainable use of grassland. In addition, a Dam Safety Panel would conduct periodic reviews of the adequacy of the design and construction of the Project Dams during construction and at the start of operations.

Table 1. Environmental Mitigation Strategies

ISSUE	PPS IN WHICH THE ISSUE MAINLY PERTAINS	MITIGATION STRATEGIES	SUPPLEMENTARY MONITORING REQUIRED (see Note A)
1. Livestock 1.1 Feed Availability	All	1. Adoption of production systems already being used in or near the project area 2. Development of a variety of production systems to allow participants to choose based on their own judgement 3. Preparation of County level feed balances to establish that, in principle, the proposed systems are sustainable 4. Development and agreement of "Five Point Management Plan" (see Note B) 5. Reinforcement of the agreed plan through inclusion of legal condition of the Credit Agreement	Yes
1.2 Animal wastes	Gansu	1. EPB clearance for larger scale production units 2. Proven design adopted for small scale units	Yes
2. Irrigation/Water Resources 2.1 Water availability	Qinghai	1. Design based on available historic data	Yes
2.2 Downstream impacts (surface)	Qinghai	No specific mitigations included	Yes
2.3 Downstream impacts (groundwater)	Qinghai	1. Modeling of project development options 2. Selection of preferred option which provides a balance between various development/environment criteria	Yes
2.3 Downstream impacts (ecological)	Qinghai	Proposed Management Plan for the Balong Soak	Yes
2.4 Direct ecological effects	Qinghai	1. Location of proposed development area	No
2.5 Construction Impacts	All	1. Project focus on small scale irrigation works 2. Inclusion of standard construction phase environmental safeguards for small scale civil works	Yes
3. Rural Enterprises	All (but Gansu in particular)	1. Focus investments on small scale, household developments which generally have little or no environmental impact potential 2. Provision of administrative step in ABC loan processing procedures which prevents approval of loans for developments which require EPB approval but do not have it	Yes Yes
4. Land Reclamation	Qinghai	1. Soil surveys to identify saline/sodic lands 2. Reduction in scope of project to reduce areas of saline/sodic lands 3. Specification of leaching and water management procedures to maintain salt front below root zone based on existing proven procedures 4. Strip leveling of hummocked land to reduce susceptibility to wind erosion 5. Restriction of construction activities during the windy period (see Note C) 6. Inclusion of major shelterbelt planting program in the project for longer term control	Yes
5. Crop Production 5.1 Plastic mulch	All	No special mitigations other than in Gansu where a plastic recycling plant has been proposed as a possible candidate for financing through the credit scheme	No

ISSUE	PPS IN WHICH THE ISSUE MAINLY PERTAINS	MITIGATION STRATEGIES	SUPPLEMENTARY MONITORING REQUIRED (see Note A)
5.2 Agro-chemical usage	All	1. Bank will not finance procurement of pesticides/herbicides 2. Program includes funds for extension which contains standard packages on agro-chemical management 3. Program includes provision for adaptive research to optimize input usage and promote manuring technologies 4. Program includes extensive soil conservation components which have the indirect effect of helping reduce off-farm, non-point emissions of all sorts	Yes
6. Rural Infrastructure 6.1 Roads and bridges	All	1. Focus on very small scale developments (generally Class III and IV gravel roads) 2. Preference to upgrading of existing roads 3. Focus on farm access roads, inter-village roads and connector roads to higher levels within the road hierarchy so as to avoid risk of increasing access to remote areas	No
6.2 Water supply		1. Project to finance only very small scale household based systems 2. System designs include basic safeguards for public health (for example, provision of lips on water supply wells)	No
6.3 Rural electricity		Project to finance only local distributors	No
7. Forestry 7.1 Development		1. Selection of species/techniques which have already been proven in the project areas 2. Plantings include economic forests plus fuelwood areas based on quantitative demand estimates to ensure that participants have an economic stake in protecting tree plantings	No
7.2 Management		1. Participants have a financial stake in the management of economic forests 2. Public education (in the case of Qinghai – this is part of the normal extension program delivered to settlers in desert reclamation areas)	Yes
8. Other 8.1 Impact on Nature Reserves and other conservation areas	All	1. All project developments specifically excluded from such areas 2. Participating consultants requested to confirm that the design guideline was complied with	No

NOTES:

- A. The monitoring work for which a need is identified in this column is additional work or increases in already proposed programs that is required to provide a satisfactory level of assessment of actual environmental impacts.
- B. The Five Point Plan which was agreed to as part of project preparation is as follows:
 - Natural pasture land use will conform to existing grassland management and monitoring laws and regulations;
 - Ruminant livestock feeding will be based foremost on available crop byproducts and forages rather than on grazing natural pasture in order to minimize pressure on fragile grasslands;
 - Project participants who lease crop and/or grasslands will receive long-term (30+ years) land leases under which they will have the rights but also the responsibilities of land use;
 - Livestock densities will be based solely on realistically prepared and annually updated feed balances for green forage, crop byproducts, and feed grains; seasonal highs and lows in spring and fall; and types of livestock to be raised; and
 - The project village unit and its local government will be the basic unit to develop, implement and update grass and cropland management plans.
- C. These management provisions are followed as standard operating procedure in desert reclamation procedures.

Table 2. Proposed Environmental Monitoring Program

ISSUE	LOCATION	MONITORING ACTIVITY	RESPONSIBILITY	TIMING	COST CATEGORY (Note A)
Livestock Feed Availability	All PPs	1. Check village feed balances 2. Monitor area and status of grassland areas surrounding a selection of development areas in all PPs	PMOs Assigned organizations (Note B)	On demand Annual basis	CC PB
Animal wastes	All PPs	1. Review of random sample of ABC loan approvals to ensure that the necessary EPB clearances were secured	Bank	During supervision	BB
Irrigation/Water Resources Water availability	Qinghai	1. Continuation of existing flow monitoring 2. Continuation of recording of existing bulk water supply deliveries ex-Hatu and commencement of such recordings ex-Keri	Provincial Water Resources Bureaus.	Continuous	CC
Downstream impacts (surface)	Qinghai	Monitor applications of inputs plus periodic monitoring of surface water quality in a representative sample of locations upstream, middle and downstream of swampy area north of Balong	County EMS (Note C)	Twice/year	PB
Downstream impacts (groundwater)	Qinghai	Monitor pumping/application rates in tubewell supplied areas, groundwater levels in tubewells and groundwater levels in monitoring wells in the swampy area adjacent to Balong	Assigned organizations (Note D)	Annual	PB
Downstream impacts (ecological)	Qinghai	Review Status of Management Plan for Balong Soak. Annual surveys of land cover and wildlife numbers	Contracted institution	Annual starting Year 3	PB
Construction Impacts	All	Random field inspections of civil works	Bank	Bi-annual during initial years	BB
Rural Enterprises	All (but Gansu in particular)	Random checking of loan approvals to ensure that no loans were approved for proposals which lack EPB clearances	PMOs/Bank missions	Random	CC/BB
Land Reclamation	Qinghai	1. Further detailed soil surveys during detailed design 2. Sampling and analysis of soil and drainage water salinity/sodicity during leaching 3. Monitoring of drainage discharges (quantity and quality) from the development areas 4. Supervision of construction procedures to ensure compliance with specifications 5. Inspection of shelterbelt planting program	Design institute Design institute Design institute Agriculture Bureau Forestry Bureau	As required Monthly Monthly Ad hoc Ad hoc	PB PB PB CC CC
Crop Production Agro-chemical usage	All	Review of procurement contracts to ensure no pesticides/herbicides are financed Monitoring of progress of extension/training programs Monitoring of adaptive research and soil conservation programs Monitoring input levels in a random sample of plots and comparison with relevant national standard (GB-4285-84)	Bank Bank Bank Contracted institution	As required As required As required As required	BB BB BB PB

NOTES:

- A. PB = project budget
BB = Bank Budget (i.e. a responsibility to be accepted by the Bank and covered from its internal funds)
CC = cost covered under general project monitoring budget.
- B. In Inner Mongolia, this work will be done by the Grasslands Management Bureau (GMB), an institution of the Regional Government which already has this type of work within its purview. GMB will, however, require supplementary financing to cover direct costs associated with doing this work. The other two PPs are not as well equipped in respect of this type of monitoring and it is proposed that this work be done on contract by relevant universities or Institutes.
- C. EMS = Environmental Monitoring Station which is a unit of the Environmental Protection Bureau and usually the only institution at a county level capable of undertaking water chemistry analyses.
- D. The groundwater modeling work was done by Xinjiang Agricultural University, one of the leading groundwater modeling institutions in China and it is not unreasonable to assume that they may continue to be engaged on this work. However, they would have to apply for appointment on a competitive basis in accordance with relevant Bank procedures.

Costs of the Environmental Monitoring Program. As can be seen below in Table 2, supplementary budgets will be required to finance the several activities over and above the project monitoring and reporting activities which are covered in other budget categories. The cost provisions made to cover these supplementary activities are provided in Table 3.

Table 3. Estimated Cost for Proposed Environmental Monitoring Program

MONITORING ACTIVITY	COST PROVISION ('000 Yuan)
Livestock Monitor area and status of grassland areas surrounding a selection of development areas in all PPs	1,200
Irrigation/Water Resources Monitor applications of inputs plus periodic monitoring of surface water quality in a representative sample of locations upstream, middle and downstream of swampy area north of Balong	400
Monitor pumping/application rates in tubewell supplied areas, groundwater levels in tube wells and groundwater levels in monitoring wells in the swampy area adjacent to Balong	1,200
Annual surveys of land cover and wildlife numbers	300
1. Further detailed soil surveys during detailed design	300
2. Sampling and analysis of soil and drainage water salinity/sodicity during leaching	300
3. Monitoring of drainage discharges (quantity and quality) from the development areas	200
TOTAL	3,900

The overwhelming majority of these expenditures (Yuan 3,900,000) will take place in Qinghai Province.

Additional Activities

To increase the contribution to the environmental sustainability of the proposed programs certain additional studies, development and training activities are proposed, which would require additional funding as follows:

- i) **Management Plan for the Balong Soak.** The project already involves quite extensive monitoring of vegetation cover and groundwater of the Balong Soak to gauge potential impacts. This interpretation of monitoring results would be based on the assumption that maintenance of existing groundwater and vegetation is the optimum outcome, based on the "do no harm" philosophy. This assumption is not based on a detailed understanding of the dynamics of the ecosystem which, if better understood, may provide a basis for coordinated management of the irrigation area and the adjacent swampy areas to the benefit of both. The proposed work would begin with basic research into ecological relationships, flora and fauna surveys, identification of pressures on the area other than potentially hydrological issues (the main pressure is believed to be uncontrolled grazing by itinerant herders) which would lead to development of management possibilities and

options. A consultation process would then be commenced with a view to achieving some consensus on how utilization practices might be altered, leading to production of an agreed management plan. The plan could form the basis for bilateral support for implementation.

This type of study would be well within the capacity of one of the leading ecological research institutes of the Chinese Academy of Sciences and the estimated cost is about Yuan 1.5 million which would be spent over three to four years.

- ii) **Pest Management in Minority Areas.** There already exists a comprehensive program of pesticide regulation, education and monitoring carried out through local Plant Protection Bureaux and Plant Protection Stations. Previous experience suggests, however, that much more could be done to improve the effectiveness of these programs in general and amongst minority communities in particular. The proposed activity would underwrite a series of activities to strengthen existing programs in the project areas through development of training materials, training of trainers and labeling in local languages. Again, this work could substantially be undertaken by local experts working with indigenous trainers, possibly with some assistance from a foreign pesticide management expert as adviser. Estimated cost is in the order of Yuan 1 million.
- iii) **Training in Regional Land Use Planning.** Urban land use planning in China is quite well-developed albeit unimaginative. Regional land use planning for rural areas is almost totally non-existent and scarcely even exists as a discipline. The proposed program, to be focused in Gansu (due to the particular suitability of the issues they are facing to being addressed through regional planning approaches), would involve provision of training, carrying out of a regional planning case study, development and piloting of public consultation procedures to be carried out as part of the planning process. This would have to be done by foreign consultants. The estimated cost is in the order of Yuan 1.5 million

Supervision Needs. A substantial number of the field monitoring tasks required as part of the environmental monitoring program can be carried out by non-specialist staff provided that an environmental specialist participates in project launch workshops to agree with counterparts on formats for periodic progress reports to ensure a clear accounting of environmental issues. This specialist should probably return at the end of the second year when, based on previous experience, there should have been sufficient progress in the field to be able to actually inspect operations performance, particularly on construction-related issues. Specialist technical advice will also be required during initial missions to agree with consultants in Qinghai on the location of groundwater monitoring wells and monitoring/reporting protocols. Thereafter however, it should be possible to monitor progress in this regard through desk analysis of progress reports. An environmental specialist should participate in supervision missions at least once each year.

CHINA
WESTERN POVERTY
REDUCTION PROJECT
QINGHAI PROVINCE

MOVE OUT AREAS
 MOVE IN AREAS

PROVINCE ROADS
 NATIONAL ROADS
 PROVINCE CAPITAL
 NATIONAL CAPITAL
 COUNTY (XIAN) BOUNDARIES
 PREFECTURE BOUNDARIES
 PROVINCE BOUNDARIES

PROJECT COUNTIES:

DATONG
HUANGYUAN
HUALONG
XUNHUA
MINHE
MING'AN
DULAN

XIZANG

XINJIANG

To Ruqiang

MANGYADACHARDAN

GOLMUD

QUMALA

ZHIDUO

QIQUAN

DELINGHA

TIANJUN

WULAN

DUAN

Balong Keri

Xiaoxiaten

Yikegaoi Hatu

Kongrode

GANGCHA

Qinghai Hu

MOVE IN AREAS

MOVE OUT AREAS

HUZHIZH

XINING

LEDU PING AN

MINHE

TO LANZ

QINGHAI

JIANGNA

GUINAN

TONGREN

ZEKU

HUANGZHONG

HUANGYUAN

JIANGNA

YUNHUA

POKDE

MAQIN

GANDE

JIUZHI

DANI

BANMA

YUSHU

NANQIAN

Lancang Jiang

Tongtian

QUMALA

Chengdu

Chengdu

MADUO

CHENDU

GE'ERMU

ZADUO

YUAN

NEI MONGOL

For detail see IBRD 29995

0 50 100 150 200 250 300 KILOMETERS

XIZANG

To Lhasa

To Lhorong

SICHUAN

To Chengdu

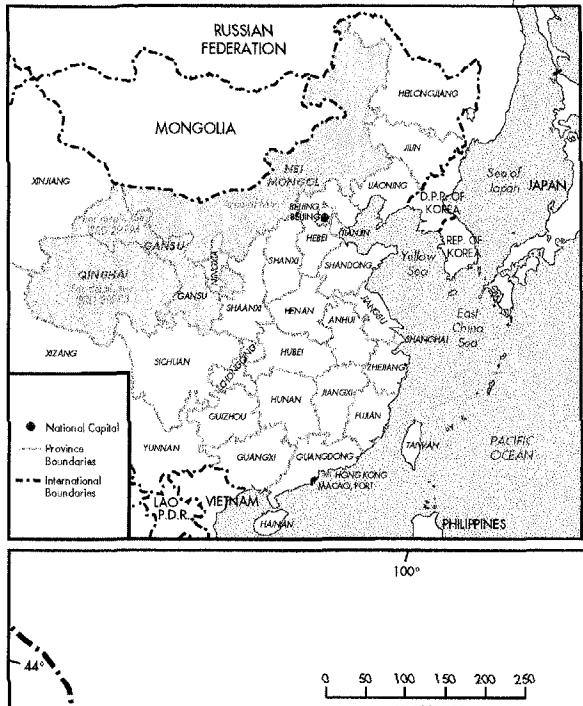
GANSU

For detail see IBRD 29994

ICFC FAN

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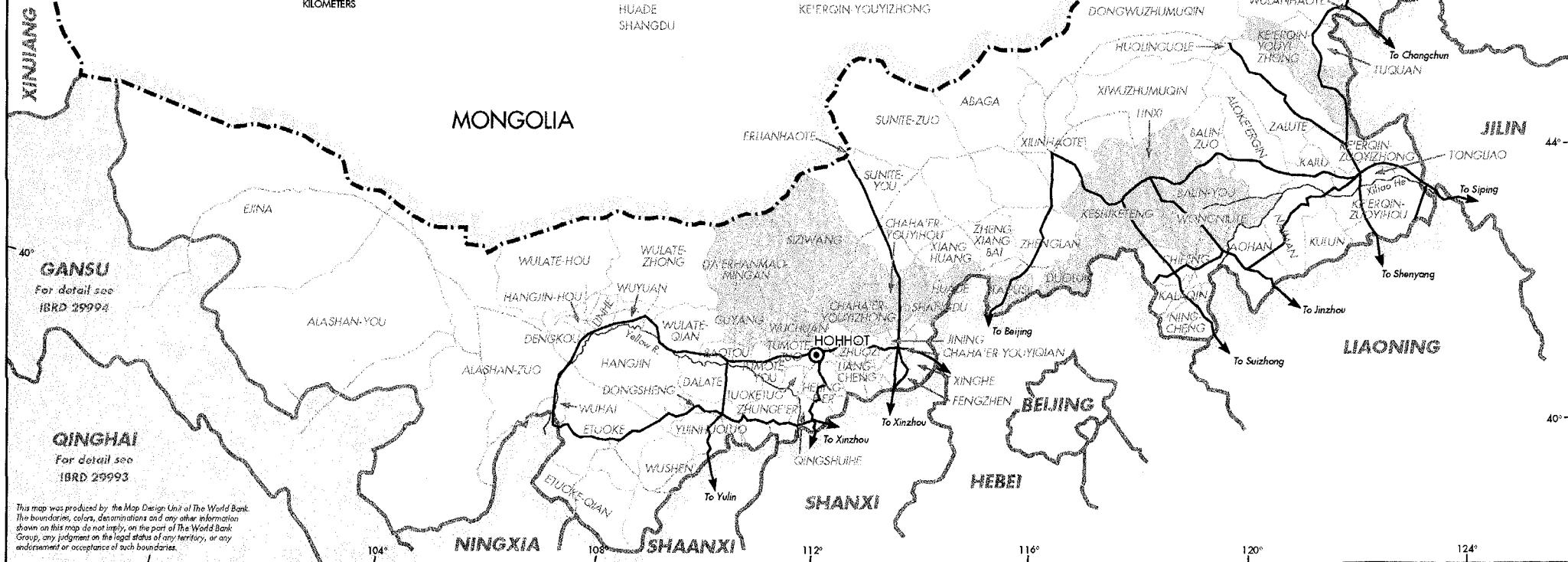
CHINA WESTERN POVERTY REDUCTION PROJECT NEI MONGOL AUTONOMOUS REGION

PROJECT COUNTIES/BANNERS

- PROJECT ROADS
- NATIONAL ROADS
- PROVINCE CAPITAL
- COUNTY (XIAN) BOUNDARIES
- PREFECTURE BOUNDARIES
- PROVINCE BOUNDARIES
- - - INTERNATIONAL BOUNDARIES

PROJECT COUNTIES/BANNERS:

DAERANMAOMINGAN	TAIPUSI
SIZIWANG	DUOLUN
CHAHAIER-YOUYIZHONG	KESHIKETENG
GUYANG	LINXI
WUCHUAN	BALIN-YOU
CHAHAIER-YOUYIYOU	WENGNUTE
HUADE	KEERGIN-YOUYIZHONG
SHANGDU	



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GANSU
For detail see
IBRD 29994

QINGHAI
For detail see
IBRD 29993

World Bank Loan for Poverty Reduction in West China

**Environmental Impact Assessment (EIA) for the
Agricultural Development and Poverty Reduction
Project in Xiangride-Balong, Qinghai**

Qinghai Institute of Environmental Science

(holding the Environmental Effect Assessment Certification of class A, issued by the
State Environmental protection Agency of China, No: 936)

Oct. 1998 Xining, Qinghai, P.R.China

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1. INTRODUCTION AND PROJECT BACKGROUND

The Qinghai component of the World Bank Loan for the Western China Reduction Poverty Project is named The Project of Agricultural Development and Poverty Reduction in Xiangride-Balong, and is hereafter called the ADPR Project

1.1 Purpose of the report

The World Bank loan and an equivalent fund from China will be spent in the ADPR Project. During the Implementation of ADPR, 57,800 impoverished people from the loess hilly land of East Qinghai Province will be moved in Xiangride-Balong, Qaidam Basin, 21,444ha land of suitable agriculture will be exploited in the move-in region. 61,800 people, including 57,800 from move-out region and 4,000 local people, will escape from poverty.

The ADPR Project is a large-scale migration and integrated agricultural development. Therefore, the category of the Environmental Impact Assessment (EIA) for the ADPR Project was determined as Category B, in accordance with the Environmental Protection Law of the People's Republic of China, the Environmental Monitoring Document (No.324) issued by State Planning Commission, Ministry of Finance and Peoples' Bank of China. It is also considered as a category B project in accordance with the World Bank's environmental guideline OD 4.01. This was confirmed by the Bank missions that have visited Qinghai in respect to this project

The potential environmental issues which might be associated with the implementation of the ADPR Project, as well as their frequency, intensity, scope of effect and mitigation measures, are identified and discussed in this report. The feasibility and the environmental impact of the project are analyzed and discussed comprehensively in the report. This provides a scientific basis for decision-making and management for the all of people concerned with the implementation of the project. It will also promote sustainable development of the social and economic activities. It will help the 61,800 of impoverished people escape from poverty, ensure a smooth start and successful operation of the project.

1.2 Brief Introduction to the Environmental Impact Report

1.2.1 Importance of the Project

Qinghai Province is located in Qinghai-Tibet Plateau. There are many minority nationalities, which make up 42% of the total population in the Province. It is an economically less developed Province and one of the poorest in China due to the disadvantages of the geographic, social and historical conditions. The 14 counties in the Province are in the national poverty list and 38 townships are in the provincial poverty list. The impoverished population in the province amounts 1.195 million, which represents 37.02% of the total farmers and herdsman in the Province. At present there are about 530,000 people facing shortages of food and clothing and living below the standard poverty line, about 100,000 people live below the basic poverty level. They mainly live in the arid mountain region of East Qinghai. The 1996 statistics show that the population density in this region is 70-85 persons/km², which is 7-8 times as much as the United Nations capacity criterion (5-10 persons/km²) for such arid mountain regions. The per capita dry land is 0.15 ha, the per capita grain availability is 200 kg, and the per capita income is less than 400 Rmb. This is the result of the high population density and the over use of the land. There are 21,444 ha of the suitable agricultural land with sufficient and high quality water resource in the Xiangride-Balong. Some successful models of agricultural development have been implemented since the 1950's in the areas adjacent to Xiangride-Balong. These include the Xiangride and Nuomuhong oases. So the implementation of the ADPR Project is definitely justified in view of the potential for achieving improved social economic development, improving living standards and improved environmental conditions. These then, are the goals of the ADPR Project.

1.2.2 Implementation Context for the ADPR Project

In 1996, Chinese Government declared to the world that poverty in China would be nearly eradicated at the end of 2000. To achieve this Goal, the Chinese government has worked out an "87 poverty reduction Plan" and carried out the poverty reduction projects in Southwest China and Qinba in cooperation with World Bank. The ADPR Project was suggested in this context. The Government of Qinghai province worked out an "87 poverty reduction plan of Qinghai" in 1997, in

order to realize the national poverty reduction plan. The project of Agricultural Development and Poverty Reduction in Xiangride-Balong was rated as one of the main projects in the "87 poverty reduction plan of Qinghai"

The People's Government of Qinghai forwarded a proposal (Qingzhen document No.74 -1996) about the project of Agricultural Development and Poverty Reduction in Qinghai to the State Planning Commission (SPC) in May 1996. The SPC, together with the Ministry of Finance and the Poverty Reduction Office (PRO) of the State Council specifically discussed the proposal and confirmed that the project of Agricultural Development and Poverty Reduction in Qinghai would enter the list of the third phase of World Bank loan projects in Feb. 3, 1997. Thus the design on the project was started on the basis of permission from SPC (Jibannongjing document No.380-1997) in June 2, 1997.

1.2.3 Structure of the Report

The report of the EIA is divided into 7 Chapters, with 3 main issues involved. The first describes the basis, purpose and norms of the EIA, the second describes the environmental status and social and economic conditions in both the move-in and move-out regions, and the third describes the existing environmental and social conditions in the project area. In the fourth chapter the environmental issues associated with the implementation of the project are identified and screened. Chapter five is in many ways the key chapter of this document, as it presents the environmental issues associated with each of the project implementation activities during the construction and operational phases of the project. It also identifies the mitigative measures that would be taken to avoid or minimize the environmental impacts and the monitoring procedures, indicators and responsibilities that would be applied during the course of the project. The costs for these environmental mitigation and monitoring activities are summarized in Chapter 6. The results of the public opinion survey relative to the implementation of the project are presented in Chapter 8.

1.3 Basis for the EIA

1.3.1 Legal

- Environmental Protection Law of the People's Republic Of China;
- Soil and Water Conservation Law of the People's Republic of China;
- Regulations of Wild Plants Protection of the People's Republic of China;
- Means of Environmental Protection Management in the Projects of Construction (86) No.003 by NEPA;
- Several Opinions of Environmental Management Problems in the Projects of Construction (88) No.117 by NEPA;
- Regulations of the Environmental Protection Design in the Projects of Construction (87) No.002 by NEPA;
- Decree No.324 by NEPA (1993), Circular on Strengthening the Management of Environmental Impact Assessment in the Projects by the Loan from the International Financial Organization;
- Decision of the Standing Committee of People's Congress of Qinghai Province on Strengthening the Eco-environmental Protection;
- Regulations of soil and water conservation in Qinghai Province;
- Detailed Rules and Regulations of Qinghai Province on Implementing "Grass Law of the People's Republic of China"; and
- Regulation of the Wild Animals Protection in Haixi Autonomous Prefecture of Mongolian-Tibetan Nationality, issued by the Standing Committee of People's Congress of Qinghai Province.

1.3.2 Technical Norms and Directives

- Technical guidelines for environment impact assessment by NEPA. (HJ/T2.1-2.3 -93);
- Guidelines for EIA of Chinese agriculture by exploiting and supervising department of NEPA and the Institute of the environmental research and monitor of the agricultural ministry;
- Guidelines of Work for World Bank -----Environmental Assessment (OD 4.01);
- Technical Guidelines for EIA- non- pollution eco-environmental impact by NEPA;
- Outline of EIA for the project of the Agriculture Development and Poverty Reduction in Xiangride-Balong by Qinghai Institute of Environmental Science;
- Memorandum of the technique mission of World Bank Loan for Poverty Reduction Project in West China, after investigation in Qinghai;

- Confirmation of the outline of EIA to the project of the Agricultural Development and Poverty Reduction in Xiangride-Balong by NEPA; and
- Demands of Environmental management for the project of the Agricultural Development and Poverty Reduction in Xiangride-Balong by World Bank.

1.3.3 Environment Quality Standards

- The standard of surface water quality, implementing the class 3 in "the environmental quality standard for surface water" GB3838-88;
- The standard of ground water quality, implementing the class 3 in "the quality standard for surface water" GB/T14848-93;
- The standard of the irrigation water quality, implementing the quality standard of rainfed crops in "the quality standard for irrigating water" GB5084-92; and
- The standards of drinking water for human and animals, implementing the "Standards for Hygienic Quality for Drinking Water".

1.3.4 Main Design Documents

(World Bank Loan for Western China Reduction Poverty Project -- The project of Agricultural Development Poverty Reduction in Xiangride-Balong is abbreviated to ADPR)

- Feasibility report of ADPR;
- Water balance report of ADPR;
- Feasibility report of Water Conservancy Project of ADPR;
- Feasibility report of Resettlement Project of ADPR;
- Feasibility report of Pasture and animal husbandry project of ADPR;
- Feasibility report of Cropping project of ADPR;
- Feasibility report of forestry project of ADPR;
- Feasibility report of education sub-project of ADPR;
- Feasibility report of hygiene sub-project of ADPR;
- Feasibility report of rural enterprise of ADPR;
- Plan of infrastructure construction of ADPR;
- Plan of road construction of ADPR;
- Plan of township construction of ADPR; and
- Plan of administrative setup construction of ADPR.

1.3.5 Principles of Environmental Assessment

The principles of the sustainable development, objective and scientific evaluation are followed in the EIA and design of the environmental protection for the ADPR. The same attention are paid for the both economic development and environmental protection so that the economic growth keeps same pace with the environmental improvement.

1.4 Organization and Methodology

1.4.1 Organization of Institutional Responsibilities

The institutional responsibilities for the report of EIA are shown in Table 1-1

1.4.2 Environmental Assessment and Work Responsibilities

See Table 1-2

1.4.3 Methodology of the EIA

Data search, on the spot investigation, comparison, analogue analysis, as well as remote sensing, and quantitative and qualitative review have been applied. Positive and negative Impacts of the project have been comprehensively evaluated. Special attention has been paid to the key points of the EIA.

Table 1-1 Institutional Responsibilities for the EIA

Responsible Units	Content
Qinghai Institute of Environment Science (QIES)	Evaluation outline of environment impact
General Station of Qinghai Environmental And Geological Monitoring(SEGM)	
QIES	Arrangement of environment evaluation work
QIES	Report book edit
SEGM	Evaluation of water environment impact
QIES	Evaluation of nature and society environment statement
QIES	Analysis of engineering to environment impact
QIES	Evaluation of ecological environment impact
QIES	Evaluation of social environment impact
SEGM	Evaluation of environment risk and countermeasure researcher
SEGM	Evaluation of public participation
QIES	Evaluation and analysis of environment economic efficient
QIES	Countermeasure of environment protection researcher
QIES	Summary

Table 1-2 Responsibilities of assessors

Name	Titles	Major	Task
Ma Shizheng	Engineer	Ecology	Taking charge the EIA
Li Yujun	Senior engineer	Hydrology	Engage in
Chen Xueshan	Engineer	Hydrology	Engage in
Lu Baocang	Engineer	Hydrology	Engage in
Liang Weiyu	Senior engineer	Geology	Engage in
Shi Ling	Assistant researcher	Economic assessment	Engage in
Wang Tao	Engineer	Environment engineer	Engage in
Liu Runjin	Engineer	Geography	Engage in
Wu Xiangpei	Assistant professor	Environment engineer	Engage in
Ding Xuegang	Senior engineer	Ecology	Engage in

2 DESCRIPTION OF THE PROJECT

2.1 Goals and Objectives

2.1.1 Project Goals

The agriculture resources such as soil, water, heat, and sunshine will be explored fully in the move-in region so as to develop agriculture and rural enterprise, to increase the income, to improve the living conditions, to promote social and economic development based on science and technology and open policy.

2.1.2 Project Objectives

Economic objectives: That the economic benefit should be achieve that are similar to those of other projects in Qinghai.

Social Objectives: That 61,775 people will be moved in within the first year, settled properly in second year, have adequate food and clothing in the third year, and that their living standard is above the poverty line in the fifth year.

Ecological Objectives: The natural ecosystem will be improved as economic activity increases. The largest agricultural oasis will be made in the Qaidam Basin.

2.1.3 Project Scope

The scope of migration: 57,775 households, in 448 villages, in 48 townships, in 6 counties (including 4 minority autonomous counties), in Haidong administrative prefecture.

The scope of resettlement for local people in move-in region: 4,000 people in 60 households.

The scope of farmland development: 21.444 ha of arable land in move-in region.

2.1.4 Indicators of Project Success

In the seventh year the following indicators will be achieved.

Incomes: Based on the price of 1997, the average earning of per settled household will be more than 700 yuan RMB per year. The average income of every farmer will have reached more than 1,140 yuan RMB per year, which is the objective of escaping poverty.

Resources: The average cultivated land per capita is 0.324ha, among of which the basic cultivated land, economic forest, forage land and forest are 0.22ha, 0.004ha, 0.044ha, 0.044 ha respectively.

Others: The percentage of children in school in the move-in area will be the same as that of move-out area. The primary education will be available to all.

The infant mortality, mortality of pregnant women and the mortality of children below the age of 5 will be within 4%, 4.5% and 0.14% respectively.

Incidence of infectious diseases will be controlled within 0.306%.

Iodine deficiency (goiter) will be eliminated.

In the sixth year every village in move-in region will be served by a road and have electricity.

The irrigation system and drainage facilities will be completed.

The problems of drinking water and energy resources for daily living will be completely resolved.

2.1.5 Important Features of Project Implementation

The significance of implementation of the project is to solve the problems of the 57,775 move-out farmers and 4,006 local settlers with respect to basic survival, food and clothing. The environment will be protected and improved both in the move-out and move-in areas. The resources of reserve cultivated land will be exploited in move-in area. This will raise the level of grain supply from the settlers and accelerate the development of society, economics and environmental protection in Qinghai province.

2.1.6 Environmental Protection Objectives

In order to ensure the production of agriculture, forest and stock farming and to raise the living standard of settlers, it is maintained that the main environmental quality of surface and ground water need to meet the standards of class 3 in GB3838-88 and GB/T4848-93.

2.2 Components of Project Implementation;

The project consists of three main components:

- resettlement 61,775 voluntary migrants;
- exploiting the resources of 21,444 ha of cultivated land; and
- developing water conservancy facilities and social infrastructure.

2.2.1 Resettlement of Volunteer Settlers

According to the results of environment analysis, the carrying capacity of land and water resources and the manpower needs suitable 57,775 migrants could be settled.

2.2.1.1 Screening of Settlers

According to the purpose of the project, the selection of settlers is limited to arid and semi-arid poverty area in east part of Qinghai Province. The criteria for selection are as follows:

1) Screening of move-out site.

- The land capacity for carrying population is more than 40 persons/km²;
- The area of natural disasters covers more than 30% in whole area;
- The ratio of vegetation cover is less than 10%;
- The gullied area is more than 15% in whole area;
- Acute shortage of drinking water, fuel, feed and manure;
- Income per capita is less than 580 yuan RMB (based on the price of 1996); and
- Provisions of per capita are less than 210 KG

2) Screening of move-out counties.

- Poverty counties determined by state government;
- Heavy soil erosion regions where soil erosion index is more than 2,000 tons/km²
- The poverty minority autonomous counties; and
- Non-irrigated land is more than 75% in whole area, no irrigation condition.

3) Screening of move-out town and village.

- Poverty household is more than 50% in that of whole town or village.

- 4) The screening move-out farmers.
- Application submitted by farmer;
 - Householder is healthy with agricultural experience;
 - Per capita income is less than 300 yuan RMB annually;
 - Per capita provisions is less than 140 kg of grain; and
 - Farmers with some skills such as teachers, paramedics, agricultural mechanics and skillful craftsman.

2.2.1.2 Scale of Resettlement

The population of 61,775 in seven counties will be resettled. The details are provided in Table 2-1.

Table 2-1 Scale and Type of Resettlement

Move-out county	Migration Population			Percentage of migrants in the impoverished population(%)	Percentage of minorities in the migrant population (%)
	Sum	Minority	Female		
Minhe	26,330	12,448	12,983	26.59	47.28
Xunhua	6,995	6,772	3,449	25.22	96.81
Hualong	10,090	8,537	4,976	15.48	84.61
Pinqan	6,130	2,914	3,023	22.54	47.54
Datong	2,000	1,813	986	7.41	90.65
Huangyuan	6,230	834	3,072	29.40	13.38
Dulan	4,000	33,318	1,840		100
Sum	61,775	37,308	30,329	15.36	60.41

2.2.1.3 Mobilization of the Population

The migrants are moved out and resettled by migration agency of local government. The processing of migration is divided into five stages and carried out in batches.

2.2.1.4 Resettlement Standards for Voluntary Settlers

Resettlement standards for voluntary settlement are as follows:

- Per capita farmland is 0.33 ha, which consists of cultivated land (0.22ha), forestland (0.05ha) and grassland (0.06ha);
- The house area is 0.04 ha per household;
- Electricity is available for every house;
- Drinking water is supplied by central standpipe in every village; and
- A solar energy stove per household.

2.2.1.5 Subsidies for Voluntary Settlers

- Migration - 240 yuan RMB per capita;
- Building cost - 500 yuan RMB per capita; and
- The total - 918.5 yuan RMB per capita.

2.2.2 Agricultural Development

The agricultural development consists of the development of cultivated land, stock raising, forestry, town and township enterprises.

2.2.2.1 Cropping Objectives

At the end of the ADPR Project, 21.444ha irrigated farmland will be exploited; the proportion of areas for crops, forestry and animal husbandry will be 70:15:15 in the project areas as a whole. The breakdown by sub-area is as follows: 70:15:15 in Xiaoxiatan, Balongtan and Qingshuuhe, 70:13:17 in Yikegaoli, and 85:15:0 in Keri and Hatu. The areas of cropping, forest and man-made grassland will be 13,600, 2,862.3, 2,719.4ha respectively. The agricultural support services system of agricultural technique will be developed completely. A comprehensive service center for agriculture will be set up in each village so that the technological training will be strengthened. In order to improve technical awareness there will be a technician in each township, a model of household in each village and a person understanding some agricultural science and techniques in the each household. The wasteland will be reclaimed in first year, cropped in second year; the goal of the project will be achieved in the 11th year.

Table 2-2 Reclamation and Planting Plan

Regions	Land	1 st year	2 nd year	3 rd year	4 th year	5 th year	6 th year	Sum of Reclamation	Sum of Green Manure Land	Sum of seed Land	Sum of cropping Land	Sum of Forestry Land	Sum of grassland
Balong	Green manure Seed Cropping Husbandry Forestry Reclamation			42076	66,000 2,104 39,972 9,252 8,611 90,117	42,333 3,300 62,700 14,000 14,325 64,802	2,117 40,216 8,977 9,294		150,409	7,521	127,844	32,229	32,229
Qingshuihe	Green manure Cropping Husbandry Forestry Reclamation	350 5015	3,498 19,902	12,548 3,498 750 767 2,988	12548			214,858	16,396	16,396	3,738	3,755	
Hatu	Green manure Cropping Husbandry Reclamation		9,662	9,662 1,705				24,917	9,662	9,662	1,705		
Keri	Green manure Seed Cropping Forestry Reclamation			4,776	239 4,537 844			11,370	4,776	239	4,537	844	
Xiaoxianan	Green manure Seed Cropping Husbandry Forestry Reclamation			4,587	9,191 229 4,358 975 1,522 12601	460 8,731 1,977 1,431		5,619	13,778	689	13,089	2,952	2,593
Yikegaoli	Green manure Seed Cropping Husbandry Forestry Reclamation		6,072	1,725 304 5,768 1,288 1,399 2,379	86 1,639			287,586	202,818	8,838	193,979	42,935	40,810
Sum													

2.2.2.2 Cropping Areas Structure

Crops which can be planted in the project area are as follows: wheat, barley, potato, pea, bean and rape. The soil fertility of the 214,440 ha is often poor. It includes including 3,874.1 ha of class 1 soils (18.1%); 50,002.7 ha of class 2 (23.2%); 5,784 ha of class 3 (27%) and 6,661.06 ha of class 4 (31%). The newly reclaimed wasteland of class 3 and class 4 must be planted to green manure in first year so that the output can reach 200kg per mu later. The saline land must be desalinized by water in the first year after ascertaining that this will not exacerbate the sodium problems.

2.2.2.3 Cropping Technologies

(1) The engineering criteria of wasteland reclamation: Gradient will be not less than 1/200; the size of each piece of land will be about 300x500m; the thickness of the arable strata no less than 30cm; each piece of land will contain a southern-northern canal at a space of 20m, 15 canals in it. The biological measures of wasteland reclamation include the planting of grain crops and economic. About 10% of the reclaimed will be used in planting green manure and forage grass every year. In addition, the reclaimed land will be used in planting vegetables, such as garlic, lettuce, and onions, which are suited to the local climate, in order to increase farmers' income.

Seed: Class 1 seeds will be provided by the agricultural technological groups of project headquarters as well as seed companies of the project counties. The new seeds will be cultivated and supplied by provincial and prefecture institutes. The pesticide, fertilization and plastic membrane will be supplied by rural marketing cooperatives.

(2) The technological criteria of planting crops:

Wheat: Generally planted in relatively heavier and more fertile soil. The main technologies are as follows: after reaping, the land will be irrigated before frozen so as to preserve the soil moisture and fertilizer. The farmland will be irrigated 6-8 times in the whole life of the crops. The seeds will be sown in 5 cm deep, the space of between rows is 10cm, so that there are 380,000-400,000 stems per mu, the average output will be 400kg per mu. Material input per mu: seeds, 20kg; manure, 2 m³; urea, 15kg; NH₂PO₄, 10kg; and pesticide, 0.25kg.

Barley: Is suited to heavier and more fertile soils. The seeds will be sown in 5 cm deep, the manure, 2 m³; urea, 5kg; NH₂PO₄, 15kg; and pesticide, 0.25kg. The spacing of rows is 10cm, so that there are 6,000-8,000 stems per mu, the average output will be 350kg per mu.

Potatoes: Virus free varieties will be selected and established in isolated areas. Plastic mulch will be used for larger fields. The ridge is 60cm, the space between ridges is 60cm, the space between lines is 30cm, the space between plants is 25cm, so that there are about 1,000 plants per mu, seeds, 150kg; manure, 3 m³; urea, 10kg; NH₂PO₄, 15kg; and pesticide, 0.25kg.

Rape: Will be planted on high-saline land, seeds will be sown in 0.5-1.0 kg, in 3cm deep, the space between lines is 20cm, so that there are 200,000-300,000 stems per mu, manure, 2 cubic; urea, 10kg; NH₂PO₄, 10kg; and pesticide, 0.25kg. The estimated output is 150kg.

2.2.2.4 Prevention of disease and pests for crops

- (1) The main pesticides: The investigation indicates that the project region is a place with a less frequent occurrence of disease and pests in Qinghai province. At present, the main pests are red spiders, aphids and grubs. The major pesticides are dipterex, rogor, furadan, phoxim, etc.
- (2) The main disease and pests and pesticides: the main disease and pests for project region crops are rootrot strip disease of wheat; the main pesticides are bavistin etc.
- (3) The main weeds in the field and pesticides: the wild oats in wheat, bean fields

2.2.2.5 Soil improvement

Out of the 21,444 ha reclaimed wasteland some parts are saline. The salt in the soil must be desalinized by water so that the salt content of the top 60 cm is less than 0.3-0.5%.

2.2.2.6 Irrigation schemes

Two irrigation schemes are planned the Xiangride-Balong area; one is the existing irrigation area in Xiangride, and another is the newly developed areas in Balong:

-
- (1) In the old irrigation region in Xiangride water is used in the following amounts: 420 m³ per mu for wheat; 380 m³ per mu for barley; 320 m³ per mu for beans; 320 m³ per mu for rape; 270 m³ per mu for potatoes; and 390 m³ per mu for forest. This gives a comprehensive use of 377.3 m³ per mu.
 - (2) The Balong areas (including Keri, Qingshuihe and Hatu) will use the following amounts by crop: wheat, 440 m³ per mu; barley, 390 m³ per mu; beans, 300 m³ per mu; potato 260 m³ per mu; forest, 340 m³ per mu; and grass 270 m³ per mu. The comprehensive water usage will be 364.5 m³ per mu.
 - (3) The comprehensive water efficiency of the canal system is 0.5 in the old Xiangride irrigation area. In Balong it is planned that it should be 0.6 for gravity and 0.67 for well irrigation. Thus, the gross water use in the old irrigation area is 754.6 m³ per mu. In Balong the gross water use in the gravity irrigation area will be 607.5 m³ per mu; and 544 m³ per mu in the well irrigation area. The proportions of water utilized by the different crops in the old irrigation region will be: wheat 44%, barley 8%, beans 7%, rape 22%, potato 4%. In the Balong irrigation area it will be: 43%, barley 15%, beans 15%, rape 16%, potato 9%, and vegetables 2%.

2.2.2.7 Organization and training

The organization and management for crops will be carried out by project headquarters and will be managed by the agricultural bureaus at county, township, and village level once the whole project is in normal operation. The agricultural technical service systems at province, prefecture and county level will be responsible for the corresponding technical service and training.

2.2.3 Pastures and Animal Husbandry

2.2.3.1 Pasture and Animal Husbandry Targets

The implementation of the animal husbandry component will yield (in the 7th year) 71,281,800 yuan (according to the market price of 1997) in terms of animal husbandry output value; the total income 18,599,340 yuan, 1,172.9 yuan animal output per capita, 306 yuan net income per capita. This will be achieved livestock 1 husbandry, pastures development, animal barn construction, stalk ammoniation and the comprehensive service system of pastoral animal husbandry. By the end of project there will be about 2,520 ha of planted pastures, 200 ha of farmland for seed, 243,100 m² of stock barns, 72,930 m³ of ammoniation cells; 455,275 domestic animals; 203,800 sheep units of livestock; 27,954.05 t of forage and feeds; and about 20,374.35t of refined feeds.

2.2.3.2. Technological program for Production and Construction

The implementation of the animal husbandry component will be similar to the implementation of agricultural component. The main activities will include the construction of the production elements, basic living facilities and comprehensive service system (focusing on common service points and areas). The construction of basic facilities for the settler households will include the development of the pastures, preparing farmland for seed, and constructing barns and methane-generating pits, etc.

- (1) Pasture development: A settler household is a unit, which will have 0.2411ha and supply 2.298t of fresh-dry hay. The new farmland for pastures will not be planted until the second year. It will be seeded with Astragalus adsurgens pall, common alfalfa, oats; in the proportion of 1:1:1.
- (2) The construction for seed farmland: will be reclaimed annually till obtained 200 ha in the whole irrigation region. The main species include aristae and oats; the proportion of planting is 1:1. Farmland for seed will be developed in the Yikagaoli region of Balong. It is divided into two parts, which will be planted and managed by the settler households.
- (3) The construction for stock shed: 12,155 barns be constructed for stock, covering 182,325 m² (10-15 m² per farmer).
- (4) Construction for methane-generating pit: there will be constructed 12,155 methane-generating pits, 72,930 m³, 6 m³ per household.

An animal husbandry veterinary station will be constructed. It will mainly include a hay and feeds processing workroom, a veterinary station, a domestic animal treatment shed, a breeding station, a storehouse, an office and a residence. Departments of agriculture, forestry and husbandry will prepare the plan.

2.2.3.3. The Pasture and Livestock Disaster Preservation.

There are research and disaster reports of very poor livestock conditions in the project area. Once the pastures have been constructed, its pest resistance of livestock will depend on selecting improve animals. For the animal disease and control measures see table 2-3.

Table 2-3 Animal disease and control

Animal	Epidemic disease	Treatment	notes
Pig	Swine fever, Pasteuellsis, Erysophylis	Three combine vaccine	Under control
Chicken	New castle	Vaccine	Under control
Cattle	Anthrax, Pasteurellosis	Vaccine	
sheep	Bradsot, struck, Enterotoxaemia Lame dysentery Anthrax, Botulism	Four combine vaccine Vaccine C-type	No epidemic, Under basically control

2.2.3.4. The organization and management.

The animal husbandry component of the project will be implemented gradually in the project area by province, county, township leaders and technological supervision teams.

The work will be done in three stages. First, the farmer will be instructed by the township comprehensive service system. Secondly, technological experts will instruct the leaders and technicians of the county and township. Lastly, the existing county technicians and new technicians will be instructed by county project office. The main contents of the scientific investigation and trials will include:

- (1). The experimental demonstration of pasture and stock management.
- (2). The experiments on the planting of high quality grass.
- (3). The experiment on the improvement of grassland.

2.2.4 Forestry

2.2.4.1 The Objectives of Forestry Construction

The short-term object is to control the tendency of desertification in the project area and establish the rudiments of an efficient artificial ecological system. This will be done to provide a framework for the sustainable development of a windbreak network for agricultural protection. By introducing the forest around the project area the coverage of the sand-break region will be increased from the present 3-5% to 15% or so. The long-term objective is to increase the vegetation cover around the project area from 46% to 59%. The coverage of forest, and forest grassland and summer pasture will be 15%, 60-70% and 95% respectively.

2.2.4.2 The layout and ways for the forestry construction

The general procedure for the establishment of forestry in the project area is: firstly, plant sand-break grass in the fringes of the oasis; secondly, introduce sand-break forest of bush and trees and then plant economic forest in areas with relatively better conditions.

The total goal of forestry at project completion will be complete 2,862.3ha, out of which the sand-break forest will be 819.7ha (28.6%); farmland windbreak 1,203.6ha (42.1%); economic forest 400.0ha (14%); fuel forest 346.0ha

(12.1%); windbreaks along roads and canals 73.0ha (2.6%); and tree nursery 20 ha (0.6%). In addition, of 1,191 ha. sand-break grass

2.2.4.3 Proceeding of Afforestation

The forestry engineering is to be completed in six years.

2.2.5 Rural enterprises

The establishment of rural enterprises mainly includes the processing of flour, rape seed and feeds. One objective of the rural enterprises is to solve the settlers' need for flour and the need of feeds and forage. Another is to increase the level of cash income and the opportunities for employment. The third is to make peoples' lives more convenient and to stabilize the social environment.

The scale of rural enterprises will depend on the demands of the settlers. According to preliminary estimates, 63 grain grinding machines of type of 6FY-1826 are to be purchased and installed, with a household unit processing on a small scale, so as to attain the general process capability of 20,979 t/year, the process of flour, 16,783 t/year; 9 extracted machines of type of 95 are to be built with a household unit processing the general process capability of 1,800 t/year, the edible oil, 540t/year; 20 grind machines for processing crude feeds, 3840t/year; 2 coordinate feeds machines, 3000t/year ; 20 machines of noodle made from beans and potatoes, 450t/year. The project will be started in the second year and completed in the sixth year.

2.2.6. The Establishment of Basic Facilities for Culture and Education.

2.2.6.1 Cultural Education.

2.2.6.1.1 Objectives of Cultural Education.

- (1) The rate of school attendance and completion of elementary school in project area will be about the same as in the move-out area in same period, the compulsory education will be generally available.
- (2) The rate of school attendance will increase gradually to 95% of the 7-12 olds in elementary school and 90% of 12-14 olds in middle school.
- (3) The good teacher teams will be achieved in which 90 percent of elementary school teachers and 80% of middle school teachers will be qualified by the end of the project.
- (4) A series of specialized professional training centers is to be built to provide training in, agricultural machinery, agricultural technology and agricultural processing. A farmer from every 80% household in project area will learn a new agricultural technology in addition to the cropping techniques.
- (5) The schools are to be built according to educational character of the minority nationality.

2.2.6.1.2 Construction and Implementation of the Project

Depending on the scale of settler population, the development trends and the settlement plan, middle and primary schools will be gradually built. In all, 5 primary schools and 10 middle schools with nine-year compulsory education system will be established and Dulan senior middle school will be expanded. The total construction area of 11 primary schools is 10,062 m² 10 middle schools with nine-year compulsory education system, 23,545 m² (including 15 classrooms of for nine-year education and vocational-technical education).

2.2.6.1.3 Project management

Project management of education is in the charge of the office of assisting the poor project in Qinghai.

2.2.7 Medical Treatment and Hygiene

2.2.7.1 Project objects

Through implementation of development project of assisting the poor in strange land, the focal point of work will be improving and increasing the supply capacity and utilization level of hygienic service of institutes of medical care, prevention, health in settles' region in order to guarantee that settlers will gain the basic medical service and will be improved health conditions. Infants death rate, pregnant women death rate, practical midwifery rate of new method, childbirth rate in hospital, incidence of iodine deficiency (goitre), incidence of infectious disease will be controlled in the average level in the same period in Qinghai.

2.2.7.2 Construction and implementation of the project

According to the project objectives a comprehensive service system will be established combining medical treatment, prevention and health. A central hospital and 21 rural clinics are to be set up, with conventional medical equipment.

2.2.7.3 Management and training

- (1) Management: Management and implementation of hygienic sub-project is in the charge of the office of hygienic sub-project.
- (2) Personnel training: The training will be implemented annually. 10 technical personnel in the central hospital, 5 in the town hospital, 42 in the rural clinics. In all, 57 persons/ year will be trained.

2.2.8 Supply engineering for surface water

2.2.8.1 Canal Construction in Xiangride and Major Dam Engineering in Keri

The principal diversion structure lies in on the left bank of Xiangride river, near the Xingride Bridge. The branch canal begins at the diversion structure and ends at Keri reservoir, and is 28.79 km long. The primary canal from Keri reservoir will convey water to the old irrigation region in Xiangride as well as to the Balong irrigation area, the Qingshui River irrigation area and the Hatu irrigation area. Over 311.6km of branch canals will be built in the four irrigation areas. Keri reservoir is to be built on the Keri River, whose storage capacity is 21,000,000 m³. The main dam is of sand-gravel construction; the principal component is 39m high of 204m along its axis; sub-dam on the left bank there is a section 189.6m long and 21m high; a sub-dam on the right bank is 480m long and 26m high. The base of this is covered top a depth of 23-43m with fine sand and cobbles As this is permeable it requires the installation of a membrane. This reservoir will submerge 6.7ha farmland and 120ha of grassland.

2.2.8.1.1 Main Canal System

The major water delivery works consist of :

- (1) Balong irrigation system: 90.5km of canals below Keri reservoir;
19 branch canals, 153km long;
irrigation command area of 12,440ha.
- (2) Qingshui irrigation system: 9.83km of canals;
2 branch canals, 19.2km long;
irrigation command area of 1,661ha.
- (3) Hatu irrigation system:
9.83km of canals;
branch canals, 8.5km long;
irrigation area, 758ha.
- (4) Keri irrigation system:
11.25km of canals and branch canals;
irrigation command area of 374ha.
- (5) Xiaoxia sands system:
Using water from Xiangride River, one 11.25km branch canal will be built; 1,313ha of irrigation command area.
- (6) The S. Yikegao system:
using water from Yikegao River 1 branch canal will be built, 5.5km long.

Drainage works:

Under the whole system class 5 drainage ditches will be built. The terrain of Balong and Qingshui River irrigation regions is high in the south and east, low in the north and west. In the northern fringes of the two irrigation regions drainage ditches will be installed to remove saline-water to Huobuxiong lake via Qaidamu river. This will be 32.9km long and consist of 19 pieces. There will be 153km of sub-ditches. The terrain of Hatu, Keri and Xiaoxia sands are higher and drainage conditions are better.

2.2.8.2 Hatu dam and its canal system

The project is to expand the storage capacity of Hatu reservoir; the former storage capacity was 1,320,000 m³. The clay dam will be elevated and strengthened to increase the capacity to 1,470,000 m³; the main dam is 9.5m high. The sub-dam is 5m high. The existing irrigation system will be upgraded. In addition 3 branch canals of 2.63km and 7 lateral canals of 3km are to be built. The reconstruction will involve 1 main canal of 9.83km, 15 branch canals of 13.3km, and 27 lateral canals of 12km.

Groundwater Supply

2.2.8.3 Irrigation with groundwater

Sixty-seven wells will be drilled in Balong and Qingshuihe where the water table is relatively higher to control the water table and prevent the soil salinization. The wells will be located in the mid-north of the project development area in an east-west orientation. The depth will be 80-100m, the distance between wells will be 1-2km in the east and west direction and 1km in the south and north direction. The annual output of groundwater is 23,000,000 m³. The irrigation command area will be 3,035 ha.

2.2.9 Drinking Water for Humans and Domestic Animals

With the high water table and abundant groundwater in areas of Kerixiazhuang, Hatu, Balongtan, Qingshuihe, 21 wells are to be drilled and 34 cisterns and 2 water towers will be built. This will provide drinking water for 55,040 people and 181,590 sheep units. In Kerishang Village and Yikegao Villages drinking water for humans and domestic animals will be piped in owing to the difficulties in well-drilling. The pipes are 25.38km in length and water is available for 6,735 people and 22,210 sheep units.

2.2.10 Power Transmission Lines and Transformers;

The high-voltage power line is 337.1 km, including 211.1 km. for 10 kV and 125 km for 35 kV, with two transformer stations.

2.2.11 The Rural Energy Conservation;

An energy-saving stove and a solar energy stove will be provided for each household in the project area.

2.2.12 Communications

In the project area, 425.7 km of simple roads will be constructed connecting 22 administrative villages.. These will include 15 main roads totaling up to 116.2km and 286 tractor roads totaling up to 408.3 km.

2.2.13 Project Administration

The implementation and management of the project will be supervised by the corresponding authorities at three-levels i.e. the Regional, Provincial and National Poverty Reduction Offices and the daily business will be taken care of by the Qinghai Poverty Reduction with Foreign Fund Office.

3. NATURAL ENVIRONMENT AND SOCIAL CONDITIONS OF THE PROJECT AREA

3.1 Project setting

The ADPR Project includes both move-out areas and move-in areas. The move-out region is an over populated region in Qinghai and is inhabited with 19 minority nationalities - Han, Hui, Tu, Tibetan, Sala, etc. It covers 6 state-confirmed poverty-stricken counties, including Minhe Tu Autonomous County, Pingan County, Xunhua Sala Autonomous County, Hualong Hui Autonomous County, Huangyuan County under the jurisdiction of Haidong Administrative Prefecture, and Datong Hui Autonomous County under the jurisdiction of Xining. The move-in area is located in the southeast part of Qaidam basin, including Xiangride and Balong area of Haixi Mongolian and Tibetan Autonomous Prefecture.

3.1.1 Natural Environment in the Project Move-out Area

The move-out area is situated on the transitional region between the Loess Plateau and the Qinghai-Xizang Plateau. It has varied with steep hill, deep valleys and barren land in topography, and suffers from severe soil erosion and frequent natural disasters, such as draught, flooding, hail, water-logging and freezing damage. So, the eco-environmental condition on which the agriculture and stock-raising depend, is weak.

3.1.1.1 The Physical Geography and Geomorphology

The move-out area is located in the east of the He-huang valley. The He-huang valley is part of geosyncline fold series of the Qilian Mountain Ranges in geological structure. On both sides of the river valley, there are some multilevel river terrace, covered by soil as thick as 10 to 100 meters. Soil in some places is so eroded that the rock bases are exposed. The terrain rises from the east to the west, ranging from 1,700m to 3,250m above sea level, the lowest in elevation being 1,650m at the low river mouth in Minhe County and the highest is 4,000m. The terrain from the river valley to the high mountains includes three physiographic zones: the river valley region, the hilly region and high mountain region.

Because of the great differences of altitude, the hill side fields make up 60-85% of all the farmland in this area, and more than 1/3 of the hillside fields have slopes of over 25 degrees.

3.1.1.2 The Climate

The move-out area has the typical plateau continental climate, the characteristics of which are: dry, bitter cold, long sunshine time, strong solar radiation and large temperature differences between day and night. The average annual temperature is 3-8.6 centigrade and the average annual precipitation 319.2-531.9 mm. The precipitation from July to September makes up over 70% of the annual rainfall, generally the relative humidity being 57%-64%, the evaporation is 1,739.9-2,224.9 mm per year, the wind speed 1.9-2.5 m /s and the maximum speed is 18m/s, happening during early spring and the late winter. The annual sunshine time could reach as many as 2,200-2,800hr. The total temperature is 1,450-3,500 above zero centigrade; the annual solar radiation is 580-600kj/cmsq. The crop growth period is 196-250 days, the frost-free periods is 90-185 days.

The three physiographic zones mentioned above correspond to major ecozones:

- The river-valley region, thanks to the low elevation, enjoys relatively higher temperature, longer crop-growth period, better irrigation conditions and higher crop yields; in spite of low precipitation and a dry climate;
- The hilly regions have more precipitation, but the evaporation is three times as much as the precipitation. Most of the fields in it are hillside ones, almost all of which lack irrigation, the average annual yield is 1,500 kg /ha; and
- The mountainous region, owing to the great height above sea level, has lower temperatures and relatively higher precipitation and humidity. It suffers from low temperatures so that such crops as spring wheat

ripen late. Only cold-resistant crops, such as highland barley, potato and rape will grow here. The natural disaster, such as hail and frost, affect the agricultural production.

3.1.1.3 Water Resources

The move-out area has an uneven distribution of water resources. The hilly region, with a dry climate, has poor rainfall. Surface water irrigation almost impossible as the hillside fields are located far away from the Huangshui River and separated from it by steep slopes. Little surface water available from other sources, as all the gullies and river courses rapidly go dry after the wet season. Ground water only occurs at great depth and is hard to exploit. The mountainous regions, although enjoying relatively more plentiful rainfall, are only suitable for cold-resistant crops.

3.1.1.4 Ecosystem Quality

The main ecological problems of each of the three ecozones are as follows:

- **The River Valley Region**

The elevation of the river valley regions is under 2,500m, and the region enjoys rich water resources and good sunshine and temperature conditions. It has a long history of irrigated agriculture and the people have developed a fairly high level of crop-husbandry skills and are relatively well off. Rapid construction of towns and the development of industries has attracted more people but reduced the amount of the farmland. As a result, the average arable area has been greatly reduced. Water is polluted and farmland along the riverbanks is being washed away, the continued agricultural development is restricted.

- **The Dry Hilly Region**

The agricultural ecology of the hilly region 2,000m-2,800m high above sea level is dominated by soil erosion and drought. The steep slopes and loose vegetation result in serious soil erosion and much barren land. Frequent natural disasters, such as droughts, floods and hail, contribute to low and reliable crop yields. As a result, people cannot provide for themselves and life is difficult. The hilly region has from 300mm--400mm annual precipitation, 80% of which falls between May and September. Storms and floods occur most frequently in July and August, causing severe soil erosion which in turn, results in uneven land surface, shallow soil layers and poor fertility. The organic matter content of the soil has dropped to 3,500kg /ha and the crop yield is about 2,800kg/ha

According to data from the Water Conservancy Bureau for Pingan County, there are about 575.4 km^2 of eroded soils in the county, amounting to 74.8% of the total. The annual soil loss amounts to 1,385,000 t. Less extreme soil erosion covers 48.5% of the total area in which the average soil loss is $773.9 \text{ t/km}^2/\text{y}$. More moderate soil erosion covers 32.73% where the average loss is $3,314 \text{ t/km}^2/\text{y}$. The most intensive soil erosion covers 18.77% of the area and the associated soil loss is $5,046 \text{ t/km}^2/\text{y}$. The loss of soil nutrients is far greater than the amount of fertilization that occurs locally.

Drought also seriously threatens the hilly region. Spring and summer droughts happen frequently. The losses caused by the drought are serious and the affected area is widespread. Drought happens in nine years out of ten and there is vicious circle of drought, increasing poverty and soil deterioration. Drought seriously affects agricultural production, and there is a serious problem of accessing drinking water. The problem of drinking water for domestic animals in six migrating counties has not been resolved yet. The local people live on the stored rainwater. In general the quality of drinking water is bad.

- **High Mountain Region**

Deep Mountain region is about 2,500 or 3,300 meters above sea level. Agriculture, forestry and animal husbandry are distributed alternately. The period of plant growing is short owing to the cold and wet climate, which has become the upper limit of farming. Furrows are deep and slopes are steep; farmlands are scattered; soils are poor. It has a history of burning wild grass for fertilizer. The organism of soil has been seriously destroyed. The efficiency of fertilizer is quite low. The farming conditions are poor, which has loaded the

burden of farmers. Highland barley and rape are mainly planted in the local area. In a normal way, the output of highland barley in unit area yield is 2,500-3,000 kg per acre and the output of rape seed is 1,000- 2,000 kg per acre. The annual precipitation is around 500 mm. The mountain flood frequently breaks out because there is much rain from June to September. Furthermore there are too much rainstorm and hail, which has caused the soil erosion, the destruction of farmland, and the violent drop of economic profit and so on. In this case, some of farmlands are deserted and at the same time hillside and mud-rock flow frequently happen in the area. The ecological environment is fragile. Such natural disasters as frost, hail and mountain flood are frequent. The farmlands in serious disastrous area are usually bare. For instance, serious flood took place in Huangyuan County in 1968, 1969, 1971, 1972, 1976 and 1989, which caused above 200,000 yuan RMB loss in each time. The catastrophic flood taken place on June 9, 1995 submerged and destroyed the soon-reaped crops in Cizaigou village, Natonggou village as well as both sides along the Huangshui branch. The flood tore down the houses along the banks and broke off traffic, communication and electricity supply. It has caused the loss of 2,107,000 yuan RMB.

3.1.2 Natural Environment of the Move-in Area

The Xiangride, Balong project region lies in the southeastern corner of Qaidam Basin, in Dulan County, Haixi Mongolian and Tibetan Autonomous Prefecture. The 109 national highway crosses through the basin. The project area lies in the southeast of the Basin and stretches from the foot of eastern mountain to Zhongjia in the west and from the foot of Buerhanbuda in the south to the Qaidam River in the north and covers 2,489 km². The potentially arable farmland covers about 21,444 ha, including 16,057 ha in Balongtan, 1,846 ha in Qingshuihe has, 842 ha in Hatu, 416 ha in Keri, 825 ha in Yikegaoli, and 1,458 ha in Xiaoxiadan. The project involves the town of Xiangride and the five villages of Xiangjia, Balong, Zongjia, and Gaoli, which have a population of 21,180.

3.1.2.1 Physical Geography and Geomorphorlogy

The project region is located in the southeastern corner of the Qaidam Basin, which is a closed inland basin, at altitudes of between 2,700 and 3,200 m above sea level. The project area slopes from south to north and from east to west (see Fig. 3-2). The surficial geology and topography reflects subsidence to the north of the Burhan Budai and Kulun Mountians, and the accumulation of quaternary deposits through the forces of water, wind and gravity. The principal physiographic zones of the region are described in the following paragraphs:

- | | |
|------------------|---|
| Mountain Zone | To extreme south of the project area there is a range of high mountains, the Burhan Budai Shan consisting primarily of basalt overlain with loess. These reach elevations of approximately 5,600m and are the principal recipients of precipitation in the region. They are also the principal source of the sediments that have been deposited in the Qaidam basin. |
| Mountain Valleys | Colluvial deposits are distributed along the both sides of the western valleys, most of which extends from south to north, with some northwest orientation. The width of the valleys varies. The sides are generally steep, loess covered, sparsely vegetated and subject erosion by water. Floodplains along the bottoms of the larger valleys, such as that of the Xianagride River, have substantial areas of finer textured material on which irrigated agriculture is practiced. |
| Pediment Zone | Along the northern fringe of the mountains there is a pediment reaching down to a lacustrine plain, consisting of colluvial (diluvial) deposits of water washed gravels and sands with pockets of finer textured materials, some of which have been reworked by wind. These are subject to ongoing depositional action and reworking by water as a result of flood episodes originating from the rivers that emerge from the mountains. The land slopes northwards at 8-18 %. It constitutes a gravel desert in which the surface is extensively covered with gravels and vegetation is sparse. The groundwater is deep. The parts of this zone with agricultural potential occur in its lower lying areas in which finer materials have been deposited, primarily by fluvial processes, and groundwater is shallower (3-25m) |

Transition Zone	Between the pediment zone and the lacustrine zone are fine to medium textured beach deposits, with a general east-west orientation. Some of which have been reworked into dunes by wind. These are generally the areas with the greatest agricultural potential.
Lake/Swamp Zone	This extensive swamp area covers the center of the Qaidam basin. It drains into Huaerxun Lakes, lying in the northeastern part of the basin, 182km from the project area, is the lowest part of the Basin. There are two small lakes lying 1.12 km apart; Southern Huaerxun Lake covers 74.3km ² and has a volume of approximately 150,000,000m ³ ; Northern Huaerxun Lake covers 108.4 km ² , and has a volume of about 320,000,000m ³ . These are high altitude saline lakes with little biological activity. Immediately around them there is no vegetation and the soil surface is covered with 5-20 cm salt. Southwards and eastwards to the northern border of the project area, is an extensive saline swamp, which covers a total area of 35.6 km ² . This is a recharge zone for the region and also receives substantial quantities of surface water from the Xiangride and other rivers flowing into the basin. Where the groundwater is deeper, the vegetation is dense, where it is shallower there is often a salt crust and sparse vegetation. It has generally flat to depressional topography with significant variations of microrelief. The moderately fine textured soils of this zone have potential for development, but problems of drainage and salt management need to be overcome before this can happen. These wetlands are also known to support a population of 500-600 swans and other waterfowl (see section 3.1.2.6 of this report).
Eolian Deposits	Wind has formed stationary or semi-stationary dunes, located mostly in the eastern Keri areas and the junction of western fine soil area and Gobi Desert. The dunes are 3-5 meters but some can reach over 10 meters high. The sandy soils of this zone have little potential for agricultural development.

3.1.2.2 Land and Soil Resources

(1) Characteristics of soil formation and region distribution

The characteristics of the soils of this region generally reflect the geomorphological and soil forming processes that have predominated in the various physiographic zones just described. For this reason the general textural composition of the soils was indicated in the foregoing discussion. Details of the soils of the area have been presented in a separate report prepared by the Project management Office. A brief description is provided below.

(2) The types and quality of arable soil

The arable soil can be divided into four types, namely, brown calcium soil, brown sandy soil, saline soil, and sandy soil.

I. Brown calcium soil: this has formed under the condition of cool, dry, semi-deserted climate. The vegetation belongs to the desert-pasture type. The parent materials are mainly fluvial. The process of the formation is the one of sorting and organic accumulation. The differentiation of soil layers is apparent. Based on the organic matter accumulation, soil salinization and erosion, this soil can be divided into four sub-types: brown calcium soil, light brown calcium soil, brown saline calcium soil and brown hilly calcium soil.

II. Brown sand soil: It is distributed over fan-shaped alluvial region ranging from western Mount Duoduo to southern edge of the Basin, including Gobi-desert gravel and fine soil. The characteristics are extremely dry climate, sparse and monotonous vegetation, and calcium carbonate accumulation on the surface. These soils have been seriously affected by weathering. To the north the fine soil is widely distributed over the surface, which shows the desert landscape. The matrix of the soil is composed of fluvial materials. From south to north, the grains gradually become finer. The process of formation has been weak, the differentiation of the profile into horizons is indistinguishable. Based on the types of salinization of soil, it can be divided into brown sand soil, brown gypsum sand soil, and salt crust brown gypsum sand soil.

III. Saline soil: It is largely distributed in the lake/swamp zone. Strong accumulation of salt has occurred due to the physiographic location of the zone, the flat topography, the shallow groundwater level and high evaporation. According to the amount of salt and the microtopography, the soil scan is classified into three sub-types: weak saline soil, salt crust soil and meadow saline soil.

IV. Weathered sand soil: It is distributed between saline soil and fine textured soils, in the Transition Zone and shaped into strips, where *Haloxylon ammodendron*, *Nitaria*, and *Tamarixchinensis* grow. Because of the strong wind action, surrounding the plants the eolian deposits are added to the original flat prolluvial matrix. Macroscopically it presents the landscape of dunes. The topography is complicated, and the texture is variable.

3.1.2.3 Climate

The area of Xiangride and Balong is located on the highland and has a continental climate characterized by rainfall, drought, sufficient sunlight, high ultra-violet radiation, and moderate temperature. It is favorable for the growth of plants and high yields.

(1) Temperature:

The average temperature in the region is 3.1-4.4°C. The maximum temperature is 33.2°C, and the lowest one is -26.6°C. The mean annual temperature drops 0.47°C for every 100 m increase of elevation and by 0.7°C for each 1° increase of latitude.

The days in which the daily average temperature steadily exceeds 0°C, are the days for the growth of grass and crops. There are 213 to 227 such days in the region. The days in which the daily average temperature steadily passes 5 °C are the periods of growth of trees. There are 165 to 183 such days in the region. The leafing period is from the first day with >5°C till the last day with < 3°C. The period in which the daily average temperature steadily passes 10 °C is that of active growth of crops, grass and trees. There are 79 to 129 days in the region. The accumulated temperature >0°C is 2,325-2,339°C; the accumulated temperature >5°C is 2,161-2,245°C; the accumulated temperature>10°C is 1,578-1,939°C. Crops can be planted in the area with an altitude lower than 3,200m, but in the area below 2,950m. It is suitable to grow early-or-middle-maturing crops.

(2) Soil temperature:

The distribution of soil temperature in the region is basically the same as that of climate, but during March to May, the soil temperature is higher than that of climate, and during June to September, it is lower than that of climate. After the frozen soil thaws during March and April the soil temperature rises rapidly and farmers begin to plant trees and sow crops. At this time the surface soil melts in the day and freezes at night. Spring wheat, barley and forage belonging to the grass family can be planted once the soil temperature in the first 5 cm consistently exceeds 0°C. In Xiangride this generally occurs on March 6. Once the soil temperature in the top 5 cm consistently exceeds 10 °C, it is the right time to plant potatoes, vegetables. This generally happens on April 11.

(3) Precipitation:

The annual precipitation in the region rises with the ascendance of altitude. Generally there is little rainfall in the northwest part, but there is more in the southeast. In the area west of Qingshuihe where the altitude is lower than 2,800 m., the annual precipitation is less than 50 mm. In the area east of Qingshuihe and west of Balong, the annual precipitation is 50-100mm.; and in the area east of Balong the annual precipitation is 100-200 mm.. The annual change of precipitation has formed a regular increasing and reducing periodic law in 4 or 5 years. In every 2 to 3 years, the rainfall begins to reduce, but it will increase again in another 2 to 3 years. 1967 is the year with most rainfall; in that year the precipitation in Xiangride reached 277.2 mm. 1961 is the year with least rainfall; in the year the precipitation in Xiangride is only 103.2 mm.. From July 4 to 12, 1983, it rained successively in Xiangride for nine days, the precipitation of which reached 38.5 mm. Generally the longest days with no rain is from April to September. From March 22,to June 12, 1961, there was no rain for 82 days in Xiangride.

(4) Frost Free Period:

The longest successive days with the average lowest temperature $> 0^{\circ}\text{C}$ are period of frost-free period. The shortest frost-free period is 104 days in Balong, and the longest is 127 days in Xiangride.

(5) Sunshine time:

The average sunshine time in the area of Xiangride-Balong is between 2,954-3,227 hours. The percentage of sunshine is between 66.4% and 72.6%. It is the area with the most sunshine time in China. In Xiangride the shortest sunshine time is 2,954 hours. In Qingshuuhe the longest sunshine time is 3,227 hours.

(6) Solar Radiation

The quantity of solar radiation in the Xiangride / Balong area is between 687.4-742.6 kilo-joule/cm². It is least in eastern Xiangride and most in western Zongjia. It is least in December and the most in May.

(7) The amount of physiological radiation:

The amount of physiological radiation is also called the amount of effective photosynthetic radiation. When the plant is in the course of photosynthesis, the radiation with the length of waves of 380-710 micrometer in the spectrum of red band or blue band, which is absorbed by plant is called effective photosynthetic radiation. The amount of physiological radiation is 336.8-363.9 kilo-joule/cm², the transforming pattern of which is equivalent to the solar radiation.

(8) Wind:

When the instantaneous velocity of wind is above 17m/sec it is called fresh gale (8 degrees). In the area of Xiangride, the annual average period of fresh gales is 20.4 days. At most, there are 50 days a year. Fresh gales are mostly concentrated between March and May. The maximum speed is 24.7 m./sec.. The annual average wind speed is 3.5 m./sec. In Balong the wind direction is W wind and WNW wind, and in Xiangride the wind direction is SE wind and SSE.

3.1.2.4 Water Resources

(1) Surface Water

The rivers in the project region are inland rivers belonging to the Qaidam River family. The river in the area, which can be utilized, is the Xiangride River.

The upper part of Xiangride River is separated into two branches, to the east and west. Each branch has its own adjusting lake. The eastern branch is the main stream, originated from Jiamuowen, Mount Cchangshi in the Animaqing Mountains in Guoluo Prefecture, westwards flowing into Donggeicuona, Lake which covers 253 km², and has a volume of 7,450,000,000 m³. The deepest part of the lake is 86 m. The western branch originates from the eastern part of Genke in Mount Burhuanbuda, and flows eastwards for 57 km into Lake Alanke. This 35 km², and has a volume of 490,000,000 m³. The two branches join and flow into Tuosu River, running northwards 40 km to the profile of Qianwaebo Hydrometric Station. Later the river is called Xiangride River, and flows continuously northwestwards 12 km to Xiangride Bridge. The total length is 250 km. The average annual discharge 12.63m³/sec. The proportion of the leakage of the profile of Xiangjia Hydrometric Station on Xiangride River is 28%-60%. The depth of water table is just 2m in Xiangjia. When it flows to the Xiangride Bridge, the depth becomes 13 m. When it comes to Xiangride Farm, the depth reaches 112m. The water of Xiangride River mainly comes from rainfall and melting ice and snow.

There are five other small rivers in the area, including the Hatu River, Qingshui River, Yikegao river, Keri River and Xiaonuomuhong River. Storms and floods happen frequently, so the discharge is variable, which is the main characteristic of the rivers in the region. The total volume of surface water in the area of Xiangride and Balong is 548,600,000m³, among which, Xiangride covers 386,900,000 m³, Balong 161,700,000 m³, Hatu River 47,000,000

m^3 , Xiangshugou 31,100,000 m^3 , Qingshui River 26,700,000 m^3 , Yikegao River 24,300,000 m^3 , Kerigou 16,800,000 m^3 , Xiaonuomuhong River 15,800,000 m^3 .

(2) Groundwater

According to the Report of Water Resources Supply Analysis in Developing Project Move-in Region in Xiangride and Balong the hypothetical groundwater supply capacity is 402,000,000 m^3 , of which the Xiangride area contributes 280,000,000 m^3 , and Balong 122,000,000 m^3 . The Project mainly makes full use of Xiangride River, Hatu River, Xiaonuomuhong River, the surface water of Qingshui River and groundwater resources in Balong. According to the research of water and soil resource balances, the water resources in the region can meet the need of both irrigation and drinking.

3.1.2.5 Vegetation

The vegetation in Xiangride and Balong is mainly xerophytes and super-xerophytes. There is a clear vertical vegetative profile from mountainous area to saline swamp:

(1) Alpine zone vegetation

It is distributed over the southern mountainous land of Gouli, Xiangjia and Balong. The main vegetation includes Potentilla fruticosa, Potentilla Glabra, etc.

(2) Desert Vegetation

It is distributed over pediment and alluvial areas. The main plants are Haloxylon ammodendron, Ephedra przewalskii, Ceratoides latens, Reauria soongorica, Calligonum mongolicum, Artemisia desertorum and Populus przewalskii, etc.

(3) Saline Vegetation

It is distributed over fine soil area and transitional area of saline swamp. The main plants are Nitraria, Tamarixchinensis, Phragmites communis, Achnatherum, etc.

(4) Introduced Vegetation

Xiangride is the biggest oasis in the project region. Trees are scattered here and there in Keri, Hatu, Yikegao. There are Introduced Populus Cathayana, Populus Alba var, Pyramidalis, Populus przewalskii, Populus simonii, Salix matsudana, Ulmus gleucescens, Elaeagnus angustifolia, Picea crassifolia, Hippophae rhamnoides, Lycium chinensis, Caragana intermedia, Malus pumila, Prunus armenica, Pyrus, etc.. Crops include spring wheat, rape, barley and bean and so on.

(5) The present condition of forest

Forest land:

According to the research, there are 9,734 ha of forest land in the project region, among which natural forest covers 7,833 ha and planted forest 1,900 ha. The area of forest is 2,819 ha, covering 29.0% of the whole; the area of scattered woods is 1,564 ha, covering 16.0%; the area of shrub is 5,323 ha covering 54.7%; the area of nursery is 27 ha, covering 0.3%.

In the forest land, the coverage of forest is more than 20%. The area of shelter forest is 2,730 ha, covering 96.8% (among which natural forest covers 1,505 ha, man-planted forest covers 1,225 ha); the area of economic forest (the garden lycium chinensis) is 89.7 ha, covering 3.2%. The proportion of forest cover is 0.46%

The Stock of living trees

In the project region the total stock of living trees is 611,888 m^3 . In it the forest stock is 567,632 m^3 , covering 92.8%, the stock of scattered woods is 44,256 m^3 , covering 7.2%, the stock of natural forest is 91,636 m^3 , covering 16.1%, and the stock of introduced trees is 475,996 m^3 , covering 83.9%.

3.1.2.6 Wildlife Resources:

Given the generally isolated nature of the move-in area and the adjacent mountains this is an area in which there are still significant wildlife populations. The principal species occurring in or near to the project area are listed in Table 3-1. For the species occurring outside the project area, please see Table 3-2.

Table 3-1 The Types, Species, and Habitat Characteristics of Wildlife in The Move-In Area

Types	Names	Numbers and Density and species in km ²	Status	suitable place for migration
Mammals	<i>Procapra gutturosa</i>	8-12 (0.056)	Common, lack of food (intending to move westwards)	Northwest swamp
	<i>Lepus oistemus Hodges</i>	35-45 (0.18)	Better	Northwest swamp
	<i>Vulpes corsac Linnaeus</i>	5-7 (0.03)	Common, lack of food (intending to move westwards)	Northwest swamp
Birds (Cygnus etc missing)	<i>Syrrhaptes paradoxus(pallas)</i>	20-35 (0.14)	Better	Surroundings around the project region
	<i>Alauda arvensis Linnaeus</i>	200-700 (0.3)	Better	Surroundings around the project region
	<i>Melanocorypha</i>	350-1000 (4.6)	Better	Surroundings around the project region
	<i>Aquila rapax Temminck</i>	5-10 (0.05)	Better	Surroundings around the project region
	<i>Melanocorypha maxim</i>	350-1000 (4.6)	Better	Surroundings around the project region
	<i>Motacilla alba</i>	350-1000 (4.6)	Better	Surroundings around the project region
	<i>Passer ammodendri</i>	350-1000 (4.6)	Better	Surroundings around the project region
	<i>Punurus biarmicus</i>	350-1000	Better	Surroundings around the project region
	<i>Phrynocephalus Ordinary</i>	200-300 (1.4)	Better	Surroundings around the project region
	Amphibians			

In the northern swamp zone of the project area, the construction of the project may influence on wildlife. As a result of project implementation the surface water will be transferred from the Xiangride River to the irrigation area. At the same time and groundwater will be exploited so that the groundwater table depth may be reduced.

A calibrated groundwater model has been used to estimate water level declines caused by pumping within and around the project irrigation area. The model indicates that, within the wetlands area adjacent to the northern

perimeter of the scheme, water levels can be expected to fall by approximately 0.5 metre within 10 years. No water table change is expected at a distance of 5 km.

Vegetation in the affected area could be degraded to lower yielding varieties or increase rooting depth to follow the water table. It should also be noted that, although there have been no regular water level measurements within this zone, the groundwater model indicates a natural annual water table variation of 0.11 to 0.58 metres under existing circumstances.

These data suggest that the area of wetlands to the north of the project may be slightly reduced, and may influence the survival of wild animals in it. Table 3-2 shows in detail the types, distribution of species and living conditions of wild animals which are influenced by the project.

Table 3-2 Types, Distribution of Species, and Habitats of Wildlife in the Project Area

Types	Names	Density of species (animals/km ²)	Living conditions	suitable place for migration
Bird	<i>Cygnus cygnus</i>	0.03	Common, lack of food (intending to move westwards)	Lake Keluke
	<i>Anser anser</i>	1.12	Common, lack of food (intending to move westwards)	Lake Keluke
	<i>Tadorna ferruginea</i>	0.72	Better	Lake Keluke
	<i>Anas platyejhynchos</i>	2.28	Better	Lake Keluke
	<i>Mergus albellus</i>	1.65	Better	Lake Keluke
	<i>Tringa totanus</i>	0.31	Common, lack of food (intending to move westwards)	Lake Keluke
	<i>Tringa hypoleucod</i>	0.16	Better	Lake Keluke
	<i>Larus ridibundus</i>	0.021	Better	Lake Keluke
	<i>Aythya fuligula</i>	1.84	Better	Lake Keluke

3.1.2.7 The Ecosystem Quality in the Move-in Area

The ecosystem in the Project move-in region is fragile. The structure is simple, ground cover is very sparse and the systems lack the ability of self-reestablishment if disturbed. The climate in the project is dry and the salt content of soil and groundwater is quite high so that the main vegetation species are xerophytes and halophytes. The vegetation is comparatively, sparse and species assemblages are simple and have low productivity. The ecosystem stability is poor and it is easily disturbed by activities that result in degeneration. Set against this it should be remembered that most of the naturally occurring species are well adapted to this very harsh climate. Thus it can be seen that once the ecological system or its structure is damaged or destroyed, the system or its structure may change and not easily recover.

3.2 Existing Social Condition

3.2.1 Social Conditions in the Move-out Area

3.2.1.1 Population

By the end of 1996, the population of the six counties in the move-out region had reached 1,328,200, amounting to 27.2% of the total population in Qinghai. This represents an increase of 43,800 since 1993, or an annual increase of 11.24%. In the move-out region, the county with the most rapid population-increasing rate is Hualong, with an annual increase of 17.02%. Minhe is the second, with an annual increase of 12.62% (see Table 3-3).

Table 3-3 The Population State of the Move-out Counties and Dulan county

Project Region		11993 (thousand)	1996 (thousand)	Increasing rate (%)	Proportion of Minority Nationalities (%)	Population Density (person/km ²)	
Move-in	Dulan	50.7	53.1	15.54		1.07	
Move-out	Minhe	344.3	357.5	12.62	53.9	200.85	
	Xunhua	101.9	104.9	9.72	92.4	49.97	
	Hualong	207.9	218.7	17.02	58	79.83	
	Pingan	105.8	107.1	7.19	22.3	140.56	
	Huangyuan	129.8	131	3.07	12	86.79	
	Datong	394.7	408	11.11	43.7	132.03	
	Total	1,284.4	1,328.2	11.24	47.05	114.3	

The move-out region is also a region in Qinghai in which the minority nationalities are comparatively concentrated. Some 47.05% of the total population in the region are minority nationalities, representing 31.8% of the total population of the minority nationalities in Qinghai Province. There are four minority nationality autonomous counties in Qinghai, namely, Minhe, Xunhua, Hualong and Datong. Among the population of the minority nationalities, 398,630, 124,840, 78,580 and 75,100 are the numbers of Hui, Tibetan, Tu, and Sala Nationalities respectively.

3.2.1.2 Socio-Economic Conditions

The socioe-economic conditions in the six counties of the project move-out area are characterized by the following situations:

- the backwardness of its culture and education;
- the high proportion of illiterate and semi-literate in the agricultural labor force exceeds 50%, which is 15% higher than the average proportion of the province;
- the backwardness of public health services (in relation to the size of the agricultural population, there is only 0.6 health personnel and 0.7 hospital bed for 1,000 people);
- the six counties have a total land area of 11,620 km², of which 176,730 ha are arable land, representing 15.2% of the total land area, and 556,000 ha are natural pastures, amounting to 47.8% of the total land area (of which 433,000 ha are utilizable pastures, occupying 37.3 of the total land area); and
- the six counties, have only 0.157 ha arable land per capita , while at the same time, the arable land for the rural population in Dulan County of the move-in region is 0.347 ha per capita, which is 2.2 times as much as that of the move-out region.

Although situations are not quite the same among the six counties, the general tendency is that the amount arable land per capita is decreasing at a rate of 1% annually, while the population is increasing at of 11.24% so that the limited arable land is under increasing pressure. Moreover, because of the steep slopes, it is difficult to irrigate all arable land and soils are becoming increasingly infertile. The grain output has been rather low (See Table 3-4), and the average quota of food grain for each individual farmer is around 200 kg per year, which is much lower than the national target of 400 kg per capita.

The Economic Composition of the Move-out Region

Agricultural production is the primary activity of the move-out region, which has a GNP of 2,194,520 yuan RMB among which the total agriculture output value is 1,380,660 yuan RMB, representing 62.9% of the total GNP; in Huangyuan agriculture provides 84.34% of the total GNP. Crop production is the main agricultural activity, and it is also a very important characteristic of agricultural economy. In 1996 the crop production ranked the first in its output value. Its contribution ranges from 59.4% to 74.1%. This is 6.21% higher than the crop production in the rest of the province (see table 3-5).

Table 3-4 The Arable Land per Capita and

County	Arable Land per Capita/ha				Grain Output(kg./ha)			
	1981	1986	1991	1996	1981	1986	1991	1996
Minhe	0.166	0.158	0.147	0.138	1,470	2,025	2,060	2,850
Xunhua	0.119	0.105	0.1	0.095	3,060	3,360	3,195	4,020
Hualong	0.212	0.202	0.226	0.179	1,808	1,905	1,887	2,820
Pingan	0.186	0.184	0.18	0.182	2,198	3,135	2,447	3,190
Huangyuan	0.216	0.203	0.197	0.196	1,530	2,820	2,080	3,249
Datong	0.201	0.191	0.176	0.164	2,018	2,550	2,384	3,570

Table 3-5 the Agricultural Gross Product (AGP) and its Composition in the Move-in-and-out Region

Region		AGP (Current Price, thouyuan RMB)	Proportion of GNP%	Composition of AGP %			
Qinghai Province		5,615,740	29.92	53.4	1.6	44.8	0.2
Project Region	Dulan County	142,126		61.7	0.6	37.7	
Move-out Region	Minhe	354,401	60.98	69.8	4.1	26.0	0.2
	Xunhua	91,899	69.05	74.1	3.5	22.4	
	Hualong	201,320	76.85	72	4.1	23.9	
	Pingan	109,911	51.98	59.4	3.6	36.8	0.2
	Huang- yuan RMB	173,054	84.34	67.7	18.1	30.5	0.04
	Datong	450,075	56.15	69.6	1.6	28.4	0.02

Note: According to the current price of 1996.

The Current Situation of Investment in Agriculture and Productivity in the move-out Region

The general pattern of land use in the six counties is shown in Table 3-6. The general investment in machinery and chemical fertilizer is 3.7 kw/ha and 156 kg/ha. These data suggest that machine power use is 111% and fertilizer use is 50% of the provincial averages, respectively of the average level of the whole province. Although the general use of agricultural machinery per unit area is higher than the provincial average the proportion of the area cultivated is much lower than the provincial average. The direct result of the low investment of machinery and chemical fertilizer is the inefficient land productivity and low labor productivity. In 1996, the grain output of per unit area of the six counties in the move-out region was merely 3,201 kg./ ha, only equaling 61.3% and 76.2% of the grain output per unit area of Xiangride and Balong, the two districts in the move-in region. The average grain output per worker was 743.2 kg., equaling to 83.9% of the average grain output per worker of the whole province. The agricultural gross output value per worker is 2,255.98 yuan RMB, merely 63.6% of the average agricultural gross output value per worker of the whole province (see Table 3-7).

The level of the economic development of the move-out region

In terms of the average population, most counties of the move-out region have lower economic indicators than the average for the whole province and the move-in region. In 1996, the agricultural gross output value per capita was 571 yuan RMB, the township enterprise output value per capita was 515 yuan RMB, and the food grain per capita was 320 kg. All of them were lower than those of the whole province and the project move-in region (see Table 3-8).

Table 3-6 Arable Area and its Composition in the Move-in-and-out Regions

County	Year-end Arable Area(kilo-ha)				Composition %		
	Sub-total	Irrigated land	Land in low mountains region	Land in high mountains region	Irrigated land	Land in low mountains region	Land in high mountains region
Total	176,728	37,933	87,313	51,482	21.5	49.4	29.1
Minhe	45,079	9,155	28,062	7,862	20.3	62.3	17.4
Xunhua	9,255	4,695	4,068	492	50.7	44	5.3
Hua-long	35,234	5,026	19,160	11,048	14.3	54.4	31.3
Pingan	14,335	3,741	7,601	2,993	26.1	53	20.9
Huang-yuan RMB	19,813	5,587	5,227	8,999	28.2	26.4	45.4
Datong	53,012	9,729	23,195	20,088	18.4	43.8	37.9

Table 3-7 Agricultural Income and Labor Productivity Per Unit Area in the Move-in-and-out Regions

Region		General Power of Agricultural Machinery wa./ha	Amount of Chemical Fertilizer Applied kg./ha	Grain Output Per Unit kg./ha	Output Per Labor kg./person	AGP Per Labor (yuan RMB/person)
Qinghai Prov.		3,371	310.08	3,137	886	3,546.9
Move -in	Dulan	1,304.86	351.12	3,072.08	2,361.05	7,106.3
	Xiang-ride			5,220		
	Balong			4,203.4		
Move -out	Minhe	2,688.32	100.33	2,850	687.44	2,051.6
	Xunhua	7,423.18	277.41	4,020	740.95	1472.95
	Hualong	3,417.83	249.42	2,820	806.88	3,144.2
	Pingan	3,387	121.09	3,190.65	424.4	716.82
	Datong	4,271.83	145.53	3,570	1,010.81	2,041.1
	Huang-yuan RMB	3,807.9	131.6	3,249	421.08	1,640.9

Table 3-8 The Economic Development Level Per Capita in the Move-in and Move-out Regions

Region		AGP Per Capita yuan RMB	Township Enterprise Gross Product Per Capita yuan RMB	Net Income Per Capita Yuan RMB	Food Grain Per Capita kg
Qinghai Prov.		1,192.21	1,960.98	1,173.8	254
Move -in	Dulan	2,677.28		1,195.43	889.52
	Xiangri-de	2,040.46		889.46	946.24
	Balong	1,994.74		1,341.57	469.98
Move -out	Minhe	991.31	894.54	757	329.27
	Xunhua	875.71	192.80	530	237
	Hualong	920.42	358.57	761	320.51
	Pingan	1,016.77	655.99	682	315.82
	Huang-yuan RMB	1,321.36	713.08	720	339.25
	Datong	1,103.17	504.36	987.03	379.72

The Situation of Energy Development in the Move-Out Region

The Qinghai Environmental Science Research Institute made an investigation of the situation of energy development of the prospective settlers in the move-out region in August 1998. The result of the investigation shows that the main energy resources of the move-out region consist of wheat stalk (90%), animal dung (5%), and fuel wood (5%), the last of which is mainly obtained by felling the natural vegetation.

In addition, since the wheat stalk is primarily used to supply living energy, the arable land in the move-out region is badly in shortage of fertilizer. According to the investigations and interviews, about 75% of the farmers apply less than 0.5 m³/mu of manure to the land, and what is worse is that most of the organic fertilizer is made by digging up the turf and burning them into plant ash. This has seriously destroyed the ecological environment of the grassland, and aggravated the soil erosion of the move-out region.

3.2.2 Social and Economic Conditions in the Move-in Area

The move-in region refers to an area under the jurisdiction of Dulan County, i.e., the five towns and townships of Xiangride, Xiangjia, Balong, Zongjia, and Gouli. The social and economic indicators for this area are summarized in Table 3-9.

Table 3-9 Basic Conditions of Immigrant Settlement(1996)

Indicators	Unit	Xiangride	Xiangjia	Balong	Zongjia	Gouli	County Camel Farm	Total
Total Population	Person	9,621	4,835	3,696	1794	1,236		21,182
Rural Population	Person	8,534	4,609	3,561	1621	1,185		19,510
Farming Population	Person	8,534	2,443	1,950	469			13,396
Rural Labor Force	Person	3,941	3,042	1,784	715	529		10,011
Arable Land	Ha.	1,800	920	522.67	129.33		63.33	3,435.33
Effective Irrigated Land	Ha.	2,400	980	740.67	160		63.33	4,344
Of the above: Farmland Area	Ha.	1,800	920	522.67	129.33		63.33	3,435.33
Forest Area	Ha.	600	60	18	30.67			708.67
Pasture Land Area	Ha.			200				200
Crop Sowing Area	Ha.	1,729	868.73	504.88	128.86		60	3,291.5
Grain Sowing Area	Ha.	1,329	732.07	368.45	105.76		60	2,595.3
Machine-ploughed Area of the Year	Ha.	1,706.7	801	480	12.9		60	3,176.7
Machine-sown Area of the Year	Ha.	1,557.2	181	365	77		60	2,240.2
Machine-harvesting Area of the Year	Ha.	200	200					400
Ratio of Grain to the Total Sowing	%	76.86	84.27	72.3	82.07		100	78.85
Grain Output		9,502.84	3,751.1	1,969.01	323.91		157.2	15,704.1
Grain Output Per Unit Area (kg./ha)		7,155	5,130	5,344	3,062.7		262	6,051
The Total Rural Economic Income	Thou. yuan RMB	18,974.3	12,769.7	6,452.2	5,233.1	1438.1		44,867.4
AGP	Thou. yuan RMB	16,769	12,305.2	6118	4,833.1	1398.7		41,424
Ratio of Agriculture to the Total Rural Economic Income	%	88.38	96.36	94.82	92.35	97.26		92.32
Ratio of Planting Industry to AGP	%	94.54	60.58	29.15	9.49			61.68
Ratio of Animal Husbandry to AGP	%	4.74	39.39	70.85	90.49	100		38.02
Ratio of Forestry to AGP	%	0.72	0.03	0	0.02			0.30
Total Rural Economic Income Per Capita	yuan RMB	1,972.18	2,641.1	1,745.72	2,917	1,163.51		2,118.18
AGP Per Capita	yuan RMB	1,742.96	2,545.02	1,655.3	2,694.0	1,131.63		1,955.62
Net Income Per Farmer	yuan RMB	1,390.33	1,817.27	948.31	1,836	745.4		1,199
Food Grain Per Farmer	Kg.	1,113	1,535	1,010	691			1,172
Grain Output Per Labor	Kg.	2,411	1,233	1,104	453			1,569

Sources: The statistic data of the society and national economy of Dulan County in 1996.

The project region and its surrounding areas are rich in metal and non-metal mineral resources, which are worthy of exploitation. The Qinghai-Tibet highway also runs through the south side of the project region, providing a very convenient transportation. The main metal resources are copper, iron, gold, lead and zinc. Of the nonmetal resources there are coal, natural gas, oil. The mineral resources in the surrounding areas are mainly distributed in the low and medium high mountainous areas in the south of the region. According to the preliminary exploitation and the incomplete statistics, there are more than 10 coal deposits with at least 13-18 million tons of coal. Since 1985 in Dulan County, some farms and livestock operations as well as some private enterprises have organized manpower to exploit the coal deposits. The highest annual output was 35,000 tons. However, owing to the financial and technical problems as well as the inconvenient transportation and high cost of shipment, it was hard for those small

organizations to compete in the market, so most of them operating. At present, only the county-run Tatuo Coal Mine, 123 km southwest of Balong, is still operating. This coal mine has a reserve of 12 million tons. The annual production is 10,000 tons, but it is estimated that 25,000 tons could be produced. Another mine, the Xiangmatuo Coal Mine, is located 80 km to the south of Balong and is operated intermittently. It has reserves of 800,000-1,000,000 tons.

According to a survey of the rural households in the region of Xiangride and Balong, the consumption of basic food commodities is as shown in Table 3-10. The proportion of calories provided by vegetable foods represents 92.1% of the total calories absorbed. The diet pattern of the rural population in this region is thus largely vegetarian. Cereals are the dominant food while animal products are only subsidiary food.

Table 3-10 Basic Food Consumption Patterns – Move-in Area

Food Components	Units	Consumption
Food grains	kg/year	240.8
Meat	kg/year	12
Eggs	kg/year	0.54
Aquatic products	kg/year	2.24
Vegetables	kg/year	34.99
Edible Oil	kg/year	8.49
Sugar	kg/year	0.65
Total Calories/cap/day	Joule	1.05×10^7
Absorbed Protein	g/day	67.5 (13.92 g. high quality)
Fat	g/day	45.4

Experience has shown that once farmland has been arable for more than three years it can yield more than 4,500 kg/ha, so long as there is an adequate water supply. In this case, there will be a large increase of the supply of meat, eggs and other non-staple foods.

4. ANALYSIS OF ENVIRONMENTAL ISSUES ASSOCIATED WITH THE PROJECT IMPLEMENTATION

4.1 Identification and Screening

This analysis of the environmental issues is based on an understanding of the project implementation plans as well as a thorough review of the environmental characteristics of the project zones, including both the move-out and move-in areas. The principal project objectives are:

- The selection of the voluntary emigrants from the move-out region and the assistance to them to move to the project move-in area;
- The introduction of comparatively advanced techniques for the development of a relatively efficient irrigated agricultural area in what has until now been a harsh desert or semi-desert;
- To relieve the pressure of on the land in the move-out region, so as to improve the current social and environmental situation in the move-out area; and
- To develop the move-in region rationally, and take advantage of its water, soil, light, and heat, resources so as to achieve the aims of project and to enable it to operate in a sustainable manner.

Two key documents have been used as the basis for the environmental assessment work"

- "The Guiding Principles of Evaluating Techniques to the Influence on the Environment--Non-pollution Ecological Influence(□HJ/T19-1997)" issued by the National Bureau of Environment Protection; and
- "The Working Guide of the World Bank -- Environmental Evaluation (OD04.01)".

Following the suggestions provided in these a screening of environmental issues has been undertaken which is presented in Table 4-1.

4.1.1 The Special Features of the Influence on the Environment

The principal features of the project implementation that will have an influence on the environment are:

- The redistribution of both the groundwater and surface water resources;
- The alteration and exploitation of the land resources (by levelling, draining and irrigating); and
- The introduction of greatly increased numbers of human beings, animals and plants by improving the conditions for their survival in this area.

4.1.2 The Discernment and Screening of the Factors Influencing the Environment

The need for screening, the degrees of impact and the evaluation categories are listed in "Environmental Evaluation (OD04.01), the Working Guide of the World Bank", taking these into consideration, the following criteria are applied in the screening that is presented in Table 4-1.

Degree of Impact	Great	Medium	Little
Favorable	+++	+++	+++
Unfavorable	- - -	- - -	- - -
Assessment Categories	A	B	C

Table 4-1 Screening of Environmental Impacts in the Move-out Region

		Construction Stage			Operation Stage	
		Screening of Immigrants	Pre-moving Preparation	Removal of Houses etc.	Moving Activities	Post-moving
Natural Resources	Surface Water	-	-	-	-	+
	Ground Water	-	-	-	-	+
	Environment Air	-	-	-	-	+
	Solid Wastes	-	-	-	-	+
	Noise	-	-	-	-	+
	Soil and Wind Erosion	-	-	-	-	+++
	Wild Vegetation	-	-	-	-	+++
	Wild Animals	-	-	-	-	++
	Crops	-	-	-	-	-
	Man-made Pasture Land	-	-	-	-	++
Biological Resources	Biological Diversity	-	-	-	-	++
	Landscape Aesthetics	-	-	-	-	+++
	Land Utilization	-	++	-	-	++
	Social Development	-	-	-	-	++
	Culture and Education	-	-	-	-	++
Social Environment	Living Standard	-	-	-	+	++
	Public Health	-	-	-	-	+
	Public Security	-	-	-	-	+
	Cultural Relics and Historic Sites	-	-	-	-	-
	Quality of Living	-	-	-	+	+

Table 4-2 Screening of Environmental Impacts in the Move-in Region

		Construction Stage							Operation Stage						
		Infrastructure	Farm-land Development	Forest Development	Pasture land Development	Township Enterprises	Irrigation	Immigrant Settlement	Infrastructure	Farm-land Development	Forest Development	Pasture land Development	Township Enterprises	Irrigation	Immigrant Settlement
Natural Resources	Surface Water	-					-	-	-	-	-	-		-	-
	Ground Water						--	-						-	-
	Environment Air	-	--	--	--	-	-	-		++	++	-		-	-
	Solid Wastes	-	-	-	-		-	-						-	-
	Noise	-	-	-	-	-		-	+					-	-
	Soil and Wind Erosion	--	-	--	--			++	+	+++	+++		-	++	
	Wild Vegetation	--	--	--	--		-	++	++	++	++		++	-	
	Wild Animals	-	--	--	--		-	-	-	++	++		++	-	
	Crops	-						++	++	++	++		++	++	
	Man-made Pasture Land	-	--	--	--		-	++	-	-	-		++	++	
Biological Environment	Biological Diversity	-	-	-	-			+	+	+	+		++	+	
	Landscape Aesthetics	--	-	-	-		-	++	+	+++	+++	++	++	++	
	Land Utilization	--	-	--	--		-	++	++	++	++	-	++	++	
	Social Development						+	++	++	++	++		++	++	
	Culture and Education							++							++
Social Environment	Living Standard							++	++	++	++		++	++	
	Public Health	-						+	++	++	++		++	++	
	Public Security	-						-	-				-		
	Cultural Relics and Historic Sites														
	Quality of Living							++	++	++	++	++	++	++	

4.2 Environmental risk

The purpose of this section of the report is to briefly review the major operational and natural risks that may impact the environment of the project area and the possible measures that should be adopted to mitigate against their occurrence or minimize their effects.

The project region is located at a deserted or semi-deserted area which is ecologically sensitive. The agricultural system can only be established on a strip of appropriate soils provided that sufficient water resources of adequate quality are made available. If the water supply cannot be guaranteed, or the irrigation system stops working due to unpredicted events or inefficient management, the crops and windbreak belts will be severely impacted and may even perished. Given the slow establishment and very long reproduction cycle of the primary sand fixation vegetation, abandoned land would be desertified rapidly and may suffer irreversible deterioration. This could lead to the failure of other adjacent areas through the movement of wind blown sand. Once the project is established, it is, therefore, important to ensure that it continues to operate as a complete unit and that its major components, particularly canals and reservoirs continue to operate fully. Other more specific risks are summarized in Table 4-3.

4.3 Analysis of Project implementation on the Environment

4.3.1 Analysis and Assessment of Impact on Ecological Environment

In the move-out region, the emigration will relieve the pressures on the environment, especially the demands for living plant materials. This will greatly reduce environmental degradation. In this case, it will also increase the availability of resources and space. Although the population density in the move-out region will only be reduced from 114.3 persons per km² to 113.6 persons per km², and the area of arable land will only increase from 0.157 ha to 0.158 ha per capita, it will be possible to return farmlands that slopes of more than 25 to forest and grazing land. With the implementation of "The Third Period Project of 3-North Windbreak Forest in Qinghai", "The Project of Ecological Transformation Construction in Qinghai", and "The Project of Soil Conservation in Qinghai Loess Plateau", the deterioration of the environment in the move-out area will be contained, and the ecological environment can be restored to some extent. It is predicted that by 2010, the vegetation area will cover 50%-65% of the land in place of the current 10%-35%. Water loss and soil erosion will be reduced from the current 78% to 20-30%.

In the move-in area, the key objective is to harness the low-efficiency ecological system in the desert and semi-desert area to establish a stable and highly efficient agricultural system. The general ecological environment in the project-implemented area should develop benignly. The forest for sand control in the surrounding area should extend from 15% now to between 32% and 35%. The general vegetation coverage in the project area itself will extend from 46% to over 60%. In the project area, the coverage of forest will be extend over 15%, forage plants will be extend 60%, and the summer forage plants and crops will be extend over 95% respectively. Experience at Xiangrige Township has shown that by that time, 10-30 new biological species may come to inhabit the area and that the biological output will be increased by 10-12 times that of the original vegetation. On the whole, the comprehensive ecological environment will be developed benignly. The species structure of the artificial ecological system is simple, efficient, and easy to control. At the same time, however, it would be easily effected by outside factors, such as plant diseases and insect pests. Much attention should be paid to the identification, prevention and elimination of plant diseases and pests as to protect fields, grassland and forest from being damaged. It is estimated that the output of the artificial grassland may be 11.4 times more than that of the original grassland.

Table 4-3. Assessment Risks to Project Operations

Risk Element	Effects	Probability of Occurrence	Avoidance or Mitigating Measures	Institute Responsible
Flood	Loss of life, destruction of property, farmland, and grassland	Significant	Install flood control facilities and through the project area in relation to all major water courses	Construction Unit
Climatic Disasters (Hail, frost, snow)	Affect the output of agriculture, pasture land and forestry	Minor	Not specifically required	
Extended Drought	Reduce agricultural production	Extraordinarily severe drought occurring once in 20 years. Greater probability for smaller droughts	1) rational utilization of reservoir water resources; 1) making a better job of meteorological forecast; 2) breeding and dissemination of drought enduring crops.	Meteorological Bureau of Dulan; Provincial Institute of Agricultural Science
Destruction of reservoir or canal system	Insufficient irrigation water, crop failure, site abandonment	Very slight for dam collapse; greater for temporary failure of canal system	Regular examination of the stability of reservoir and canal system. Establishment of emergency plans.	Dulan Bureau of Conservancy
Uncontrollable impact of plant diseases and insect pests	Reduce agricultural production	Slight to moderate	1) improve prediction and identification of plant diseases and pests; 2) reinforcement of seed quarantine; 3) breeding of disease- and pest-resistant crops and grass	Dulan Bureau of Agriculture and Animal Husbandry; Provincial Institute of Agricultural Science□ Provincial Institute of Animal Husbandry Science.
Plant disease and illegal felling of trees	Destruction of windbreak belt,	Moderate to high	Reinforcement of the prevention and elimination of plant diseases; regular monitoring of the conditions of plant growth; strict management of windbreak belt; strict banning of illegal felling.	Dulan Forestry Station
Overgrazing	Degeneration of pasture land.	Moderate to high	controlling strictly the number of livestock, realizing scientific grazing, and increasing the scale of livestock raising in sheds.	Dulan Bureau of Agriculture and Animal Husbandry
Salinization and/or sodification of soil	Affect agricultural productivity and salinize the soil	Moderate to high	1) rational utilization of water; 2) control of groundwater level by way of well irrigation and drainage. 4) Monitor soil chemistry regularly 5) Train farmers in water use	Dulan Bureau of Conservancy

The project can extract groundwater and draw Xiangride River for irrigation, which will cause a 3.5 kilometer shrinkage of Qaidam River source towards the northwestern direction, and also cause a 0.11-0.58 meter drop of groundwater under a plot of 17.5 square kilometer land, 4.5 kilometers away from Qaidam River source. The salt marsh land now covered with Carex plants in the area will be replaced with the salt grassland vegetation, with reed, *Stipa purpurea* as the principal plant species. Under the natural condition, an evolution cycle will need 8-15 years. Parts of the area will probably face with sand desertification unless some necessary artificial measures are exerted.

4.3.2 Assessment of the project's influence on the climate in the area

The climate in the project area can be improved through such methods as the planting of windbreaks and sand-controlling forest, farmland-protected forest, field and meadow vegetation, and reallocating of water resource. By

carrying out these measures, in the project area, the average wind speed can reduce 25-40%, with a 50-62% increase of relative humidity and a 2-4°C decrease of the annual temperature difference.

4.3.3 Assessment of the Project's Influence on the Social Environment

The implementation of the project can greatly hasten the economic development and improve the corresponding social environment in the area. But, on the other hand, some social disorder incidents may probably occur if some issues, such as proprietary right of resources, and relationship of multi-nationalities, cannot be treated properly.

4.3.4 Assessment of the Project's Influence on the Incidence of the Endemic Diseases and Epidemics

Main endemic diseases and infectious diseases in the move out area are brucellosis and hydatid disease and iodine deficiency, (the incidence of iodine deficiency 4.74%, the incidence of hepatitis, tuberculosis, diseases related to stomach and intestines 3.6%). The types of the endemic diseases and infectious diseases in the move-in area are almost as same as those in the move-out area; but the incidence of brucellosis and hydatid diseases is higher in the move out area, and the incidence of other diseases is lower in the move out area (iodine-deficiency 1.6%, infectious diseases 2.8%). The immigration may cause an increase of brucellosis and hydatid disease among the move in farmers, and may also bring some infectious diseases to the original inhabitants; but will eliminate iodine-deficiency and decrease the diseases that related to stomach and intestines.

5 ENVIRONMENTAL MANAGEMENT PLAN

5.1 Summary of Environmental Issues, Mitigating Measures and Monitoring

The project's influence on the environment covers the move-out and the move-in area, but will be most drastic in the move-in area. Impacts will occur during the construction period and operation periods.

In the following part of this report, all the issues affecting the environment are identified and analysed. Corresponding mitigation measures are proposed, and the environmental monitoring plan and the corresponding responsibility are identified. This orderly identification, assessment and presentation of mitigation measures ensures that no important issues are overlooked and that negative environmental impacts are reduced to a minimum. Chart 5.1 illustrates the detailed analysis. Identification of mitigation measures, monitoring scheme, and the responsibilities.

5.2 Management System for Environmental Mitigation and Monitoring

5.2.1 Environmental Responsibilities

Mainly the environmental protection, resource management and administrative enforcement of law in the project counties conduct the environmental management under this project. The management regulations are as follows:

The position of an environmental protection monitoring personnel (part-time acceptable) is established in every project township and village. This person is responsible for the implementation and inspection of the environmental protection in the region under its jurisdiction.

All the reports of the environment and resource monitoring are collected and then submitted to the bureaus of environmental protection at Prefecture and Province levels, and to the project office on a month-quarter-year basis.

The Environmental Protection Bureau of Haixi Prefecture is responsible for the regular and periodic supervision and inspection of environmental monitoring and management, action plans and progress of implementation in the project regions.

According to the schedule of environmental monitoring, arrange the tasks of the environmental monitoring and urge the corresponding monitoring units and the environmental protection institutions in the project county and prefecture to compile the environmental monitoring and assessment reports.

The provincial environmental monitoring station conducts a regular inspection of the law enforcement and the measures of the environmental protection in the project region, compiles inspection reports of the environmental protection monitoring, submits them to the provincial bureau of environmental protection and to State Bureau of Environmental Protection.

The Provincial Project Office and the Provincial Bureau of Environmental Protection are responsible for the supervision and inspection of the overall implementation plan for the environmental protection in the project region. The provincial project office is responsible for the collection of reports for the overall environmental protection monitoring in the project region and for the submission of them to State Bureau of Environmental Protection, the Poverty Reduction Office under the State Council and the World Bank.

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Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation (1)

Contents		Survey of the item	Environment context	The possible environmental issues	Move-out areas			Operation stage			Investment in environment protection
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
Immigrants	Immigration population:	Households: 11,555 and immigrants: 57,775	Types of landforms: mountainous and hilly, with a slope of 15-35°. 2.Types of soil: loess and sierozem. 3.Thickness of soil: 45-375mm, and wind speed: 1.5m/s and windy days: 3-5 months. 4.Vegetation: desert grassland, with a covering rate of 8-10%. 5.Quality of environmental air: reaching grade 2 level. 6.Quality of Acoustic environment: excellent. 7.Immigration area is grassland and farmland; No specially reserved land in the area	Pulling down houses will cause dust rising, deserted land and desertification. Felling residence trees will cause soil erosion.	<ol style="list-style-type: none"> To draft the harnessing plans of ecological environment in the immigration area and leave the sloping field with a slope larger than 15° non-arable for afforestation and graze so that ecological construction can be put into effect. To purchase immigrants' forested land and forbid felling forest to prevent the immigrants from felling trees. To avoid pulling down the houses in the windy seasons. To forbid the immigrants to destroy and fell the vegetation around. 	Township governments in the immigration area	<ol style="list-style-type: none"> To draft the harnessing plans of ecological environment in the immigration area and leave the sloping field with a slope larger than 15° Non-arable for afforestation and graze so that ecological construction can be put into effect. To purchase immigrants' forested land and forbid felling forest to prevent the immigrants from felling trees. To avoid pulling down the houses in the windy seasons. To forbid the immigrants to destroy and fell the vegetation around. 	<ol style="list-style-type: none"> whether to leave the sloping field with a slope larger than 15° non-arable for forestation and graze so that ecological construction can be put into effect. Whether to purchase and compensate for immigrants' forested land. To enforce the laws of water and land conservancy and prairie. To forbid the immigrants to destroy and fell the vegetation around. 	Township governments in the immigration area	<ol style="list-style-type: none"> Monitoring project. Monitoring spots: monitoring spots will be established according to the technical regulations of distribution of monitoring spots of environmental monitoring. Monitoring time: once a year. Undertaker: Environmental monitoring stations of counties in the immigration area. supervising units: every county's environmental protection bureaus in the immigration area. 	Monitoring fees: 18,000 per year

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(2)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
Immigrants	immigrants	Households: 11,555 and immigrants: 57,775	Immigrants have no experience of the whole family's immigration and have inadaptability for the natural and social conditions in the project area	1. The psychological pressure 2. adaptability for the natural and social conditions 3. Infamiliarity to cultivation 4. Anxiety over the poor income, the disputes with local herdsmen and insecurity of their children's education 1. infectious diseases and their incidence: iodine deficiency (4.75%); generally accepted infectious diseases (3.6%); Brucellosis and echinococcosis . 2 The control: The first two are well controlled((4%) and the second ones are in slight rise.	1. To arrange the immigrants to visit the project area, waiting immigrants for the construction of the infrastructure. 2. To do the propaganda work 3. To establish the perfect service system of farming basis and educational systems and infrastructure.	Bureaus of education in the immigration area	Project offices in the immigration counties	1. to help immigrants to know the basic conditions 2. To ensure the construction of educational institutions 3. To ensure the agricultural infrastructure and service system smooth.	Dulan Education Bureau and project office	Monitoring contents: 1.Whether to arrange the immigrants to visit the natural and social conditions. 2.Whether they know the project area 3. Whether the educational institutions are built according to the plans 4. Whether the farm infrastructure is perfect 5.monitoring unit: Dulan Project Office 6.supervising unit: General Office	Monitoring fees: 8500 yuan / year
		Subsidy of immigrants	1. the average income per person is <300yuan/year 2The severely poor with less than 220kg/year 3. No residence	Project offices in the immigration counties	Subsidy for the immigrants: Immigration fee:240 yuan/p; housing: 500yuan/p; immigration fee: 110yuan/p; others: 68.5yuan. The total : 918.5 yuan.	Project offices in the immigration counties	General Office of Qinghai Province	1.fees of immigration and housing construction are handed out to the immigrants. 2.Fuel fees in the form of goods are given to them	Project offices in the immigration counties	Supervision content 1. whether moving subsidy and fuel fees in the form of objects are handed out to immigrants 2. monitoring units: project offices 3. Supervising units: General Office of Qinghai Province	Monitoring fees: 58000 yuan (one year before immigration)

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(1)

Contents		Survey of the item	Environment context	The possible environ-mental issues	Construction stage			Operation stage			Investment in environment protection	
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility		
Construction of infrastructure	Construction of reservoir	Construction of the main body of Keri reservoir	Construction of Keri Reservoir: its capacity is 21m m ³ ; main dam: 49m high and 391m long; left auxiliary dams are 21m high; m ³ of earth and stone is 2895430 cubic m.	1.Types of landforms: plain. types of soil: brown soil, gray and brown desert soil. thickness of soil : 45-75cm, wind speed is 3.5m/s and windy days is 3-5 months. Vegetation: desert prairie and wasteland (covering rate of vegetation is 8-10%). Quality of air can reach grade 2 level and of acoustic environment is excellent. Wild animals include Mongolian gazelle, plateau hares, foxes and birds.	Submerged grassland and farmland is 120ha and 6.06ha; insufficient energy for daily life will cause felling sand vegetation; the pollution including the dust and noise by construction; the solid waste material and release of waste water can affect the surface water and ground water; the risks for the dam's bursting.	To compensate for the loss of grassland of herdsmen; to get rid of the rubbish properly; no construction in windy seasons; construction rubbish can be gathered and buried underground after completion; to be thrifty in using water; to build low-cost bridges every 3-5 km for herdsmen.	Construction units	Regular monitoring of the security of reservoir and water quality. Dulan project office is for examination of the dam's security and monitoring of water quality	Reservoir security and regular monitoring of water quality and timely handing the accidents	Project Office of Dulan County	Items of monitoring : ss, degree of mineralization, sulphate, chloride, arsenic, nitrate, hydargyrum. Monitoring spots: two monitoring spots. Monitoring time: twice/y. Units: Haixi Prefectural Bureau Environmental Monitoring . supervising units : Harxi Prefectural Station of Environmental Monitoring	The stability of dam is monitored by dulan Bureaus of Water Conservancy, monitoring fees:2000yuan/y. Monitoring fee of water quality :5600yuan/y
		Construction of the key water control project	Diversion canal is 28km and needs 68325m ³ of earth and stone	1.Vegetation: desert steppe and desert with a covering rate of 8-10%; quality of the environmental air reaches grade 2 standard; quality of the acoustic environment : excellent	waste material left by construction: flying dust and noise by construction; solid waste material by construction. Waste water and workers' rubbish will affect the surface water and ground water	No construction in windy season; to spray water before construction; building rubbish is gathered together in the fixed places and be buried after completion; to be thrifty in using water and avoid heavy release of waste water.	Construction units	Monitoring of the security of canals and regular monitoring of water quality. Dulan Project Office is for monitoring of security of canals and water quality	Security of canals and monitoring of water quality and timely handling the accidents	Project Office of Dulan County	Items of monitoring : ss, degree of mineralization, sulphate, chloride, arsenic, nitrate, hydargyrum. Monitoring spots: two monitoring spots. Monitoring time: twice/y. Units: Haixi Prefectural Bureau Environmental Monitoring . supervizing units : Harxi Prefectural Station of Environmental Monitoring	Monitoring fee: 16500 yuan/y

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Move out areas

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage		Operation stage			Investment in environment protection	
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person		
	Key conveyance canal	Key conveyance canal: 48.76km long and needs 68325 m ³ of earth and stone	Vegetation: desert steppe and desert with a covering rate of 8-10%; quality of the environmental air reaches grade 2 standard; quality of the acoustic environment : excellent	Waste material left by building ; dust and noise by construction; waster water and workers' rubbish will affect the surface and ground water. Canal failure will cause decrease in output	no construction in windy seasons; construction rubbish can be gathered and buried underground after completion; to be thrifty in using water; to build low-cost bridges every 3-5 km for herdsmen.	Construction units	Monitoring of the security of canals and regular monitoring of water quality. Dulan Project Office is for monitoring of security of canals and water quality	Security of canals and monitoring of water quality and timely handling the accidents	Project Office of Dulan County	Items of monitoring : ss, degree of mineralization, sulphate, chloride, arsenic, nitrate, hydrarygyrum. Monitoring spots: two monitoring spots. Monitoring time: twice/y. Units: Haixi Prefectural Bureau Environmental Monitoring . supervizing units : Harxi Prefectural Station of Environmental Monitoring	Monitoring fees: 15000yuan/y

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Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(2)

Contents	Survey of the item	Environment context	The possible environ-mental issues	Construction stage			Operation stage			Investment in environ-ment protection	
				Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility		
Construction of infrastructure Enlarged capacity of Huitu Reservoir	Construction of dam	Capacity is 1470000 cubic m. the dam is heightened 1 more meter. The m3 of soil and stone is 150000 m3	Vegetation: desert steppe and desert with a covering rate of 10-12%; quality of the environmental air reaches grade 2 standard; quality of the acoustic environment : excellent	Waste material left by building ; dust and noise by construction; waster water and workers' rubbish will affect the surface and ground water. Canal failure will cause decrease in output	No construction in windy season; to spray water before construction; building rubbish is gathered together in the fixed places and be buried after completion; to be thrifty in using water and avoid heavy release of waste water.	Construction units	Regular monitoring of the security of reservoir and water quality. Dulan project office is for examination of the dam's security and monitoring of water quality	Reservoir security and regular monitoring of water quality and timely handing the accidents	Project Office of Dulan County	1. safety examination of dam, water conservancy. 2. check of system of rational use Haixi Prefectural monitoring Station Supervising unit: Haixi Prefectural Bureau of Environmental Protection	Monitoring fees: 13500yuan /year
	Construction of key diversion canals	Branch canals of water diversion is 3.5km and The m3 of soil and stone is 861 m3	Vegetation: desert steppe and desert with a covering rate of 10-12%; quality of the environmental air reaches grade 2 standard; quality of the acoustic environment : excellent	Waste material left by building ; dust and noise by construction; waster water and workers' rubbish will affect the surface and ground water. Canal failure will cause decrease in output	No construction in windy season; to spray water before construction; building rubbish is gathered together in the fixed places and be buried after completion; to be thrifty in using water and avoid heavy release of waste water.	Construction units	Regular monitoring of the security of reservoir and water quality. Dulan project office is for examination of the dam's security and monitoring of water quality	Security of canals and monitoring of water quality and timely handing the accidents	Project Office of Dulan County	1. safety examination of canals, water conservancy, system of rational use of water. 2. Monitoring of water quality. 3. Monitoring units: monitoring division of Dulan project office; Supervising unit: Dulan Bureau of water conservancy	Monitoring fees: 12500yuan /year
	Construction of trunk canals	Three branch canals to be built, with total length of 8.5km and 25315 m3 of soil and stone	Vegetation: desert steppe and desert with a covering rate of 10-15%; quality of the environmental air reaches grade 2 standard; quality of the acoustic environment : excellent	Waste material left by building ; dust and noise by construction; waster water and workers' rubbish will affect the surface and ground water. Canal failure will cause decrease in output	No construction in windy season; to spray water before construction; building rubbish is gathered together in the fixed places and be buried after completion; to be thrifty in using water and avoid heavy release of waste water.	Construction units	Monitoring of the security of canals and regular monitoring of water quality. Dulan Project Office is for monitoring of security of canals and water quality	Security of canals and monitoring of water quality and timely handing the accidents	Project Office of Dulan County	1. safety examination of canals, water conservancy, system of rational use of water. 2. Monitoring of water quality. 3. Monitoring units: monitoring division of Dulan project office; Supervising unit: Dulan Bureau of water conservancy	Monitoring fees: 14500yuan /year
	Construction of lateral canals	19 lateral canals with 8.3km and 17843 cubic m of soil and stone	Vegetation: desert steppe and desert with a covering rate of 10-12%; quality of the environmental air reaches grade 2 standard; quality of the acoustic environment : excellent	Waste material left by building ; dust and noise by construction; waster water and workers' rubbish will affect the surface and ground water. Canal failure will cause decrease in output	No construction in windy season; to spray water before construction; building rubbish is gathered together in the fixed places and be buried after completion; to be thrifty in using water and avoid heavy release of waste water.	Construction units	Monitoring of the security of canals and regular monitoring of water quality. Dulan Project Office is for monitoring of security of canals and water quality	Security of canals and monitoring of water quality and timely handing the accidents	Project Office of Dulan County	1. safety examination of canals, water conservancy, system of rational use of water. 2. Monitoring of water quality. 3. Monitoring units: monitoring division of Dulan project office; Supervising unit: Dulan Bureau of water conservancy	Monitoring fees: 12500yuan /year

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Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
	Minor nuomuhong gravity irrigation area, Keri , Yikeguang, Xiaoxiatan irrigation area and Balong well irrigation	Trunk canals: 181km, lateral canals: 309, with the total length of 516km, branches: 1725, with 868km and 2238500 cubic m of soil and stone								

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Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(3)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage		
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility
Construction of infrastructure	Bed of roads	The bed of town-level high ways: 6.5 m W(gravel-paved)116.2km L the bed of village-level highways: 6m W(gravel-paved) 425.7km 569489 cubic m of stone and soil	1. land forms and features: alluvial plain 2. Types of soil: gray and brown desert soil; 3. thickness of soil: 30-120cm; 4. modulus of soil erosion: 3320t/km2.y 5. wind speed: 3.5m/s (average), 17m/s (max), direction of wind: northwestern north western towards west 6. Vegetation: desert and desert steppe(8-18%) 7. No sensitive protected areas and view 8. Wild animals: Mongolian gazelle, lepusoistolus	Soil erosion	1. no construction in windy seasons 2. No excavation in the slope with over 10 degree. 3. Measures in water and soil protection are established 4. Excavation and ill should be equal 5. To reduce the temporarily occupied areas 6. To plant trees along the roadsides 7. To grow grass in the excavation spots before rainy seasons 8. To spray water before construction	Units of construction	1. whether to abide by the law on water and soil protection and law on parie 2. To supervise the enforcement of the two laws	Haixi Prefectural Bureau of Environmental Protection (not)	Units of management of highways	1.monitored contents: effect of water and soil protection caused by project 2. Monitoring spots: 3 spots 3. Frequency: 2 / year 4.Undertaker: Dulan Station of Parie 5.Supervisor : haixi Prefectural Bureau Of Environmental Protection
		Surface of town-level roads: 3.5m W (gravel-paved), 116.2km L surface of village -level roads: 3.0m W , 425.7km L. 1054033 cubic m of stone and soil					Contents: surface water: ss Spots: two spots near highways frequency: 1/year units: Haixi	Regular and irregular examination of bridges and canals and maintenance of highway safety	Dulan Bureau of Communications	Haixi Oprefectural Station of Environmental monitoring station
	Bridges and canals	Highway bridges: 9 Ditches : 37 Simple bridges: 20 Culverts and pipes: 8 Flood-discharge bridges:26	Surface water Bridges are planned to cross the seasonal rivers	Effect on the surface water	1. no excavation near the rivers 2. No release of waste water into rivers 3. Measures of water and soil protection in bridges and canals project should be established 4. To maintain safety	Units of construction	Prefectural Bureau of Environmental Protection			

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Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(4)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection	
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility		
Construction of infrastructure	Project of power supply	Scale: 10kv power line: 211.1 km; 35kv power line: 120km. transformer stations: 2	Land forms and features: alluvial plain Vegetation: desert vegetation(15-40%). utilized land: prairie	Soil erosion	1. no construction in the windy seasons 2. Restore of vegetation	Units of construction	Haixi Prefectural Bureau of Environmental Protection	Restore of vegetation in excavation area	Haixi Prefectural Bureau Of Environmental Protection	Fees of vegetation restoration fees: 4000 yuan/year monitoring fees: 2000y/ye		
				Soil and vegetation ruin	1. no enlargement of construction spots 2. Carriages and workers can't ruin vegetation	Units of construction	Haixi Prefectural Bureau of Environmental Protection	Restore of vegetation in ruined area				
				Flying dust and noise	1. no construction in windy seasons 2. No nocturnal construction in neighbourhood.	Units of construction	Haixi Prefectural Bureau of Environmental Protection					
				Public safety	1. to establish the system of safety construction 2. Protective bars and danger signs around the transformers are erected.	Units of construction	Haixi Prefectural Bureau of Environmental Protection					

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(5)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
Construction of infrastructure Drinking water supply project	Concentrated water-supply spots	Cisterns : 21	Land forms: alluvial plain. Average wind speed: 3.5m/s., Windy season: March-May. Vegetation steppe is the main species. Wild animals: lepus oiosolus and birds	Soil and vegetation ruin	No enlargement of the construction and no damage to the biological resource	Units of construction	Haixi Prefectural Bureau of Environmental protection	No enlargement of construction and damage to biological resources	Haixi Prectural Bureau of Environmental Protection	No enlargement of the construction and no damage to the biological resource	Monitoring fees: 2100 yuan/year
	Driven water supply spots	Driven wells: 36		Flying dust and noise	No building in windy seasons. No nocturnal construction		Haixi Prefectural Bureau of Environmental protection	No construction in windy seasons and no nocturnal wo constructioon.	Dulan Water conservancy	Building meets the demand of environmental protection	Monitoring fees: 2000 yuan/year
	Water supply project	Cisterns : 21 Driven wells:36		Quality of water	Mouth of wells and cisterns are 0.5-1.0m higher above the ground		To keep away the surface water from the driven wells and cisterns	Units of construction	Contents: ph, general hardness, mercury, chloride, colon bacillus flora, hexabasic chromium.	Monitoring fees:12000 yuan/year	
				Public safety	Covers of driven wells and danger signs and protective bars around the transformers		Regular and irregular examination of the safety	Haixi Prectural Bureau of Environmental Protection	Project office of Dulan county		
Agricultural development Development of land	Arable land area: 19172ha, including farmland: 1293 lha	Annual cultivation: 1 st year: 334ha 2 nd year: 2669ha third year: 5001 ha 4 th year: 6848 ha 5 th year: 4320ha	Landforms: alluvial plain. Types of soil: brown soil and sierozem, salt soil temperature: 3.1-4.4 °c degree. Average wind speed: 3.5m/s. Vegetation: desert, steppe and meadow(8-35%). Wild animals: Mongolian gazelle and lepus ojostolus	Original vegetation's ruin will reduce the covering rate of the area . Flying dust	First afforestation and then cultivation . land of lower cover rate is first developed and. No construction windy seasons	Township governments of development zone	Project Office of Dulan County	To plant protection forest and grass in the first year cultivation	Dulan forestry Station	Desertification of land and growth of forest	Monitoring fees: 1300 yuan/year
				Wild animals	Cultivation of the land will make wild animals immigrate out of the project area.	No hunting the resources of will animals. To strengthen the propaganda and avoid the ruin of wild animals.	Newly established township governments	DulanBureau of Agriculture and animal husbandry	To define the north of the project area as the no hunting area and no one is allowed to go hunting.	Dulan Station of Agriculture and Animal husbandry	Wild animals and change and the density of the species. One time/year

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Contents	Survey of the item	Environment context	The possible environ-mental issues	Construction stage			Operation stage			
				Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
		Pastoral passage	1330ha of winter and spring prairie owned by 352 herdsmen from 63 households is occupied, and many herdsmen and farmers will be affected.	4000 herdsmen and farmers from 600 households can enjoy the same treatment as the immigrants. Pastoral passages will be built in very 3-5km	Project office of dulan county	Government of Dulan county	1.The newly established institutions will help and the herdsmen to cultivate the grass. 2. To guarantee the grazing passage smooth	Dulan Station of Agriculture and Animal husbandry	1.The use of land 2.Productivity and herdsmen's income 3.grazing passage's smoothness. 4.diputes with immigrants	Investment in environment Mitigation fees: 800yuan/year

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(6)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection	
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility		
Agricultural development	Development of land	Construction of artificial grasslands	Annual cultivation: 1 st year: 0 ha 2 nd year: 51ha third year: 342 ha 4 th year: 1050 ha 5 th year: 2099, 6 th year: 2719 ha. Fodder land: 2719.4ha	1. Land forms: alluvial plain 2. Types of soil: sand . Thickness; 30-120cm 4.Modulus of soil erosion: 3630t/km ² .y 5. Wind speed: 3.8 m/s average. 6. Vegetation: desert and desert steppe (8-12%). 7.No specially reserved land 8. Wild animals: Mongolian gazelle and lepus oiostolus	Vegetation and soil	1. no construction in windy seasons 2, to plant trees after felling 3. To forbid over grazing	Households	Dulan station of prairie	No overgrazing	Dulan prairie station	1. productivity of grassland 2. Erosion of soil 3. rational use of grassland 4. Monitoring unit: Dulan prairie station . 5. Supervision: Project office of Dulan county	Monitoring fees:2000yuan/year
		Construction of artificial forest	Artificial farm land protection forest:1203 ha, fuel forest:346 ha, forest of anti-wind and sand fixation: 820ha economic forest:400ha , road protection forest: 73 ha, gardens: 20 ha, total: 2862 ha	1. Land forms: alluvial plain 2. Types of soil: sand 3. Thickness; 30-120cm 4.Modulus of soil erosion: 3630t/km sq. Y 5. Wind speed: 3.8 m/s average. 6.Vegetation: desert and desert steppe (8-12%). 7.No specially reserved land 8. Wild animals: Mongolian gazelle and lepus oiostolus	Vegetation and soil	1.no construction in windy seasons 2.To protect the forest of anti wind and fixation of sand 3. To fell the fuel forest too early .	Households and township governments	Dulan forestry station	1. appointed person is in charge of the protection forest 2. Regular monitoring of farm protection forest	Dulan forestry Station	1. productivity of forest 2. Erosion of soil 3. Rationia use of fuel forest	Monitoring fees:1500yuan /year

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Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			
				Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
Dipping vats	Dipping vats: 2		Soil and water	1.to keep a dipping vat away from the water sources 2. To make water proof treatment 3. Warning placards and protective bars are erected	Newly established township governments	Dulan bureau of agriculture and animal husbandry	1. no construction of dipping vats near the source of water 2. Collect the residue of the vats and dispose of them by air drying 3. Warning placards and danger signs are erected. 4. Regular monitor	Dulan Station of Agriculture and Animal husbandry	The residue of dipping in the soil and the ground 2. The strict use of the dipping according to the requirements	Investment in environment Monitoring fees: 10500yuan/year

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation (7)

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection	
				Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility		
Settlement of immigrants	Settlement	57775 Immigrants of 11555 households from Haidong Prefecture are resettled	1. Land forms: alluvial plain 2. Types of soil: sand 3. Thickness: 30-120cm 4. Modulus of soil erosion: 3630t/km sq. Y 5. Wind speed: 3.8 m/s average. 6. Vegetation: desert and desert steppe (8-12%). 7. No specially reserved land 8. Wild animals: Mongolian gazelle and lepus oistolus	Flying dust and desertification	1. no construction in windy seasons 2. to plant trees after felling 3. To forbid over graze. 4. Construction of houses according to the regulations 5. The rational distribution of the dustbin of daily rubbish 6. No release of waste water into rivers	Households	Chief of village and households	1 to plant vegetation around residence 2. To dispose of the rubbish regularly 3. To make physical checkup 4. To keep water clean. 5. no common use of water by citizens and animals	Chief of village and households	1. productivity of grassland 2. Erosion of soil 3. rational use of grassland 4. Monitoring unit: Dulan prairie station . 5. monitoring contents : ph, cod , bod 6. nitrate, nonionic, volatile phenol, conductivity hexabasic chromium	Monitoring fees of public health: 25000yuan/year. Monitoring fees of environmental quality: 43000yuan /year
				Social environment	1. public safety 2. Local social economic development 3. Technological and service 4. Improvement of infrastructure 5. Control of population 6. Grazing passages	Households and township governments	Project office of counties	To treat the minor nationalities according to the national policies and protect the benefit of people of minor nationality	Newly established township governments	1.Monitoring contents: public safety 2.Agricultural infrastructure's operation 3. Invasion of local herdsmen's benefits	
		Distribution of villages: 21 administrative villages and 126 villages in two township governments	immigrants include: 37000 are of minority origin from hui, tibetan, tu and sala nationalities, accounting for 60.1 %	Disputes between nationalities	1. concentrated distribution of villages 2. Immigrants of the one nationality is resettled in one village	Newly established township governments	Project office of Haixi Prefecture	To deal with the disputes and contradictions between nationalities and to do the propaganda work of national policies	Newly established township governments	1. The enforcement of national policies . 2. Democratic right of the organizations Timely settlement of disputes	Monitoring institutions: newly established township governments and Dulan Bureau of civil affairs. Supervision: Dulan project office

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(8)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection	
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility		
Settlement of immigrants	Resettlement of local herdsmen and peasants	Resettlement of local herdsmen and peasants and compensation	To resettle 4000 farman of 600house holds from dulan county	1. Land forms: alluvial plain 2. Types of soil: sand 3. Thickness: 45-210cm 4. Modulus of soil erosion: 3320t/km sq. Y 5. Wind speed: 3.5-3.8 m/s average. 6. Vegetation: desert and desert steppe (8-52%). 7. No specially reserved land 8. Wild animals: Mongolian gazelle and lepus oiotolus	1. styles of production will cause their inadaptability 2. No mastery of technology will lower the herdsmen and peasant 3. Full compensation can not be made up.	1. to compensate the herdsmen and peasants for their economic loss according to immigration's regulations 2. To set up the service institutions to help and instruct the herdsmen and peasants in production 3. To train the local herdsmen and peasants to master the production technology	Dulan project offices	Dulan prairie station and newly established agricultural technology service.	1.to compensate the herdsmen and peasants for their economic loss according to immigration's regulations 2. To set up the service institutions to help and instruct the herdsmen and peasants in production 3. To train the local herdsmen and peasants to master the production technology	Dulan project offices	1. productivity of grassland 2. Life Quality of peasants and herdsmen 3. Productivity of farmlan 4. The technological ability and level 5. The enjoyment of the preferential policy and the same treatment 6. Monitoring units: Dulan prairie station and project office 7. Supervision: General Office of Qinghai Province	Monitoring fees:5600yuan/year
Town and village enterprises	Processing industry	Flour and fodder processing	Grinding flour, extracting oil and fodder processing, and processing of starch noodles	1. Wind speed in the project area: 3.5-3.8 m/s (average) and 17m/s (max)Wind direction: northwest and northwest towards west 2..no production of township and village enterprises	1.dust in processing flour and fodder will cause slight pollution to the air. 2. Slight pollution will affect the health of workers.	1.the processing machines should meet the demand of environmental protection 2. To Regularly fix and maintain the machines to reduce the release of dust 3. To hand out the dust masks and covering to protect them	Owners of enterprises	Undertakers of monitoring of environmental protection	1. the processing machines should meet the demand of environmental protection 2. To Regularly fix and maintain the machines to reduce the release of dust 3. To hand out the dust masks and covering to protect them	Undertakers of monitoring of environmental protection	The enforcement of laws of Labor and environmental protection Monitoring units: Dulan Project Office	

Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation (9)

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection		
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility			
Agricultural development and production	Agricultural irrigation			<p>Diversion Xiangride of Xiangride Irrigation area : 115,000,000 cubic m/year Drawing ground water : 23,000,000 cubic m/year</p> <p>Balong and Keri irrigation area: 110,000,000 cubic m/year Supply to Qingshi river : 17,000,000 cubic m/year Drawing of ground water : 23,000,000 cubic m/year . wells: 67driven</p> <p>the major wild animals: Tadorna ferruginea, (density : 0.18/kmsq) ,Cygnus cygnus (0.34)</p>	<p>Ground water level: ground water level in the 0.5-1km north of project area is 0m and the source of Qaidam river is 32km from the north line of project and The ground water level in the source of Qaidam river is 0m.</p> <p>the major wild animals: Tadorna ferruginea, (density : 0.18/kmsq) ,Cygnus cygnus (0.34)</p>	<p>1.the decline of ground water level in the lower reaches of Xianride River is 0.11- 0.58m , affecting 17.5km of swap areas and transition from swap areas to the desert steppe.</p> <p>2. Transformers will affect the public safety</p>	<p>1.rational use of water resources</p> <p>2.Popularize the water saving technology to households</p> <p>3. To collect water fees and avoid irrational use of water</p> <p>4. To draft the rational irrigation measures</p> <p>5.Monitor the ground water level</p> <p>6.Warning placards and protective bars are erected</p> <p>7.Artificial planting grass</p>	Dulan Water Conservancy Bureau	Dulan Water Conservancy Bureau	<p>1.rational use of water resources</p> <p>2.Popularize the water saving technology to households</p> <p>3. To collect water fees and avoid irrational use of water</p> <p>4. To draft the rational irrigation measures</p> <p>5.Monitor the ground water level</p> <p>6.Warning placards and protective bars are erected</p> <p>7.Artificial planting grass</p>	Dulan Water Conservancy Bureau	<p>1.water conservancy's operation</p> <p>2.Water saving technology's popularization</p> <p>3. Regular monitoring of ground water level</p> <p>4. Regular examination of water conservancy</p> <p>5. Timely repair of damaged water conservancy</p> <p>6. Warning placards and protective bars' situation</p> <p>7. Normal growth of the artificial grass</p> <p>8 Monitoring : dulan water conservancy bureau</p> <p>9. Supervision: dulan Project office</p>	Monitoring fees: 7500yuan/year
					<p>Wildlife will be affected</p> <p>1.to establkish non-hunting zone</p> <p>2.Define the Keluke lake as the reserved area of production of waterfowl and put in food to attract the birds</p>	Dulan Bureau of Agriculture and Animal Husbandry	Haixi Prectural Bureau of Animal Husbandry	<p>1.to divide non-hunting zone</p> <p>2.Define the Keluke lake as the reserved area of production of wild animals and put in food to attract the birds to monitor the number and existing conditions.</p> <p>3.To observe the routes and destinations.</p>	Dulan Bureau of Agriculture and Animal Husbandry	<p>1.enforcement of law on wild animals</p> <p>2. Division of protected area of water birds</p> <p>3. Change of number and species of wild animals.</p> <p>Monitoring : dulan water conservancy bureau . Supervision: dulan Project office</p>			

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Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(10)

Contents		Survey of the item	Environment context	The possible Environmental issues	Construction stage			Operation stage			Investment in environment protection
					Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
Agricultural development and production	Agricultural production	Amelioration and improvement of soil productivity Wheat : seeds: 20kg/mu manure: 2 fang (Chinese unit) carbamide: 15kg ammonium primary phosphate: 10kg Highland barley: land with thick soil and high fertility and condensed planting. depth of seeding : 5cm. Rowing space is 10cm. live seedlings: 400000/mu, with an output of 350kg/mu. Seeds: 15kg/mu. manure: 2 fang (Chinese unit), carbamide: 5kg ammonium primary phosphate. 10kg. Potatoes: growing technology of detoxicated potatoes in growing potatoes is applied. The width of rowing is 60cm and rowing space is 60cm and seeding space is 25cm. Manure: 3 fang (Chinese unit) carbamide: 10kg ammonium primary phosphate: 15kg. Beans: the early and deep sowing. The depth of sowing is 8-10cm and rowing space is 15cm, with live seedlings of 6-80,000/mu. Seeds: 15 kg, manure: 2 fang (Chinese unit) carbamide: 10kg, ammonium primary phosphate: 15kg. Rape is grown in the soil with high percentage of salt. seeds: 0.5-1.0kg/mu, depth of seeding is 3cm and rowing space is 20cm and live seedlings of 200,000-300,000/mu. manure: 2 fang (Chinese unit) carbamide: 10kg ammonium primary phosphate: 10kg, the estimated output is 150kg/mu.		There is no pollution by the fertilizers and pesticide in the project area.	The over use of fertilizers can cause , (1) hardening of soil and change the physical features of soil, (2)over nutrition	Dulan Bureau of Agriculture and Animal Husbandry	Soil nutrients: Ph, manure, denitrogen by alkaline, total phosphorus, rapid available phosphorus, mercury, chromium, arsenic, and zinc. Monitoring : dulan water conservancy bureau . Supervision: dulan Project office	Monitoring fees of soil nutrients 28000yuan/year. Monitoring fees of environmental quality of soil: 35000yuan/year			

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Table 5-1 Possible environmental problems, harnessing measures and Process and duty of the plan's implementation(11)

Contents			Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
						Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and responsibility	
Agricultural development and production	Agricultural production	Pest control	Pest control: 1. the chemicals for the prevention and elimination of pests includes rogor, diptex, furan and so on. The pesticides is applied in 0.3kg/mu 2. The chemical for the cure of diseases of crops:	1.pests of crops are red spiders, aphid and grub. 2.diseases of crops; root rot and yellow rust . 3.Weeds in the wheat and beans: wild oats. 4. No application of pesticides	1. pollution of soil environment 2. Harm to people and domestic animals	1.rational application of agricultural chemicals 2.The application of farm chemicals with low poison residue and biological pesticides 3.The enforcement of application regulation to avoid toxicosis 4. Th warning sighs to show application of them 5. Application of farm chemical far away from water resource 6. Spraying tools can be kept in a safe place 7. Containers of farm chemical can not be thrown everywhere.	Village committees	Township governments	1.strict control of application of farm chemical 2.Technical training of safety application 3.Warning placards should be erected after spraying. 4.Forbidden mixture and application of farm chemical 5.Empty containers should be retrieved in certain places.	Newly-founded village committees	1. Application of chemical according to the safety measures stipulated by the state 2.residue of farm chemical 3.Poisoning of people and animals 4.Timely treatment of the toxication 5.Retrieving the empty containers 6.Residue in the crops and grass . 7.Monitoring unit: Haixi Prefectural Station of Environmental monitoring 8. Supervisor: Haixi Prefectural Bureau of Environmental Protection.	Monitoring fees of residue of farm chemical: 25000yuan/year. Monitoring fees of residue in crops and grass: 28000yuan/year

5.2.2 Maintenance and Enhancement of the Monitoring Institutions

The executive institution of the project environmental monitoring and management is Project Office of Foreign Investment in Qinghai Poverty Reduction Development. It is subordinate to Qinghai Poverty Reduction Office in terms of administration, accepts the supervision of the World Bank specialists and Qinghai Provincial Bureau of Environmental Protection, and the consultation of the corresponding specialists in terms of professional work. Its major responsibilities are:

- (1) Carry out national and local laws of environmental protection, environmental standards and policies as well as the environmental protection requirements of the project by the World Bank, accept the supervision of the environmental protection management in the project region by the State, the Province and the World Bank.
- (2) Arrangement of the personnel training in the field of environmental protection (For details, see Table 5-2), increase necessary apparatuses, equipment and materials for the environmental protection (for details, see Table 6-1)
- (3) Control and execution of *Environmental Management and Monitoring Plans for the Poverty Reduction Project of Xiangrige-Balong Agricultural Development*.
- (4) Control of the implementing schedule, quality and fund of the environmental protection management and monitoring plans at every stage of project implementation.
- (5) Arrangement of pollution control and ecological restoration and for the supervision and management of the formulation, research and implementation of the production schemes of cleaning techniques.
- (6) Settlement of the fund raising in environmental protection management, monitoring and scientific researches and experiments and for the inspection of the implementation schedule.
- (7) Dissemination and application of production technology in clean techniques and advanced technology in agricultural production and environmental protection.
- (8) Signature of the target responsibility contract of environmental protection with the construction units and corresponding administrative departments, and conduct the supervision and inspection of the settlement of the target responsibility contract of environmental protection.
- (9) Compilation of the reports of environmental monitoring and assessment at province level, and, according to the schedule of Monitoring Protection Management and Monitoring Plans, submit them in time to the World Bank and the environmental protection administrative departments at state and province levels.
- (10) Coordination with the environmental protection department to deal with the accidents of environmental risks.

5.3 Personnel Training Plan for the Environmental Management, Monitoring and Assessment

For details, see Table 5-2.

Table 5-2 The Management and Monitoring of Environment and the Personnel Training Program

Nos.	Items	The 1 st Year (July-Aug.)	The 2 nd Year (June-July)	The 3 rd Year (July-Aug.)	The 4 th Year (July-Sept.)	The 5 th Year (July-Aug.)
1	Aims	Get acquainted with the environmental features in the project region, command of the impact of civil construction on the environment, fully aware of the environmental protection countermeasures to be adopted in the project construction, and make preparation for the realization of the environmental protection strategic schemes and targets in Environmental Impact Reports and The Action Plans for Environmental Protection Management and Monitoring.	Training of the advanced technical personnel in environmental management, environmental assessment and monitoring, and information processing.	Training of the technical personnel at the local and basic levels in environmental management, environmental assessment, control and monitoring of pollution, and information processing.	Get acquaintance with the advanced experiences and techniques and the operational management methods of regional development of environmental protection and management in developed countries.	Learn the engineering design of environmental control in the construction of agricultural field development project, methods of environmental protection, restoration methods and experiences in the control of environmental pollution and ecological destruction.
2	Contents	The designing route and approach of Environmental Impact Reports, the major impact on the environment by the project construction, its generating route, degree and scope, environmental protection countermeasures schemes and the implementation steps, methods and approaches of The Action Plans for Environmental Protection Management and Monitoring.	Technology in environmental management, environmental assessment and monitoring, and information processing.	Compilation of technical reports for environmental management, environmental prediction, forecast, environmental assessment, monitoring and information processing techniques, environmental monitoring and assessment.	Environmental protection management, environmental prediction, forecast, environmental protection experiences and methods, and operational modes of management.	Engineering design of environmental protection, protection and control of soil environment, protection of water resources, salinization of soil, desertification of soil, control of the underground water, protection and improvement of ecological environment, etc.
3	Objects	Environmental management personnel, engineering designing technicians, local administrators and environmental protection monitors at the basic level.	Environmental management personnel and technicians in environmental engineering design, environmental monitoring, environmental information processing, etc.	Environmental management personnel and technical personnel.	Technical personnel in environmental management and environmental protection engineering.	Administrative and technical personnel in engineering design and management of environment, and the implementation of environmental blending project, etc.
4	Training Methods	Learning courses	Short-term intensive learning	Training courses	Inspection tours	Training courses
5	Duration (Days)	30	60	40	60	60
6	Places	Xining	USA, Australia, Canada	Lanzhou, Beijing	USA, Japan	Xinjiang, Shangdong, Hebei

Table 5-2 The Management and Monitoring of Environment and the Personnel Training Program

Nos.	Items	The 1 st Year (July-Aug.)	The 2 nd Year (June-July)	The 3 rd Year (July-Aug.)	The 4 th Year (July-Sept.)	The 5 th Year (July-Aug.)
7	Classes (Times) Person/Times	2 50	1 3	2 20	1 2	2 20
8	Execution Units	Qinghai Provincial Institute of Environmental Science	Qinghai Provincial Bureau of Environmental Protection, Provincial Project Office	Provincial Project Office	Provincial Bureau of Environmental Protection	Provincial Project Office
9	Departments in Charge	Provincial Project Office, Provincial Bureau of Environmental Protection	Provincial Poverty Reduction Office	Provincial Poverty Reduction Office	Provincial Poverty Reduction Office	Provincial Poverty Reduction Office

6. Cost for Environmental Activities

6.1 Summary of Environmental Costs

The budgetary estimate of the costs for environmental protection under this project is based on the accounting results of charge standards in the document No. 435 of Qinghai Price and Charge. The document is issued jointly by Qinghai Provincial Bureau of Commodity Prices, Qinghai Provincial Bureau of Environmental Protection and Qinghai Provincial Department of Finance. For the results of the budgetary estimate, see Table 6-1.

Table 6-1 The Budget for the Environmental Protection (Yuan yuan RMB)

Year	Items	Monitoring Investment	Equipment				Training			Others		
			Sub-Items	Sub-Sum	Sub-Items	Sub-Sum	Sub-Items	Sub-Sum	Sub-Items	Sub-Sum	Sub-Items	Sub-Sum
1 st	Environmental Quality monitoring	Environmental Quality monitoring	118,000	708,000	Environmental Quality monitoring	148,400	148,400	Environmental Quality monitoring	19,000	83,500	Environmental Quality monitoring	21,000
2 nd			118,000						64,500			21,000
3 rd			118,000									21,000
4 th			118,000									21,000
5 th			118,000									21,000
6 th			118,000									21,000
1 st	Social Environment Monitoring	Social Environment Monitoring	52,000	312,000	Social Environment Monitoring	258,000	458,000	Social Environment Monitoring	363,000	613,000	Social Environment Monitoring	31,000
2 nd			52,000			200,000			210,000			31,000
3 rd			52,000						42,000			31,000
4 th			52,000									31,000
5 th			52,000									31,000
6 th			52,000									31,000
1 st	Agricultural Environment Monitoring	Agricultural Environment Monitoring	45,000	270,000	Agricultural Environment Monitoring	200,000	270,000	Agricultural Environment Monitoring	32,400	105,400	Agricultural Environment Monitoring	
2 nd			45,000			70,000			28,000			
3 rd			45,000						45,000			
4 th			45,000									
5 th			45,000									
6 th			45,000									
1 st	Forestry monitoring	Forestry monitoring	15,000	90,000	Forestry monitoring	6,000	6,000	Forestry monitoring	21,000	21,000	Forestry monitoring	
2 nd			15,000									
3 rd			15,000									
4 th			15,000									
5 th			15,000									
6 th			15,000									
1 st	Pastoral Environment	Pastoral Environment	13,000	78,000	Pastoral Environment	6,000	6,000	Pastoral Environment	28,000	41,000	Pastoral Environment	
2 nd			13,000						13,000			
3 rd			13,000									
4 th			13,000									
5 th			13,000									
6 th			13,000									
1 st	Wetland Biological Monitoring	Wetland Biological Monitoring	28,000	168,000	Wetland Biological Monitoring	15,000	15,000	Wetland Biological Monitoring	15,000	15,000	Wetland Biological Monitoring	
2 nd			28,000									
3 rd			28,000									
4 th			28,000									
5 th			28,000									
6 th			28,000									
Sub-sum		1,626,000	9,019,000				878,900				380,500	
Sum							3,787,300					

Note: The monitoring cost includes sampling, analysis fees etc. The environmental quality monitoring will be carried out by environmental protecting agency, other items will be carried out by related agencies as indicated in the management plan (Table 5-1).

7. EVALUATION OF PUBLIC PARTICIPATION

7.1 Public Participation Investigation Methods

7.1.1 Dissemination of Information

Since August, 1997, Project Office of Foreign Investment in Qinghai Poverty Reduction Development and offices of poverty reduction in the counties of move-out region have conducted publicity of migration to the townships and villages in Minhe, Datong, Ping'an, Huangyuan, Hualong and Xunhua. On-the-spot inspections to the move-in region were organized for the local township and village officers and migrant representatives (including representatives from National People's Congress, Chinese People's Political Consultative Conference, religious circles, minority ethnic groups and women). The purpose was to acquaint themselves with the natural environmental conditions and social and economical status in the move-in region. Various kinds of mass media were used to publicize the information of migration, such as, radio and television broadcasts, videos, blackboards, reports, etc. The volunteer immigrants who had already settled in the move-in region were also invited to serve as examples, talking about the adaptive process and their personal experiences, so as to let the migrants aware of the policies, legal regulations and possible difficulties and risks in the process of migration. By way of widespread publicity and general mobilization, migration has become a household word.

7.1.2 Social Investigation

In order to let the public in the move-out region have a better understanding of this project in terms of its type, scale, place and the major environmental problems related to the project, Qinghai Provincial Institute of Environmental Science and Qinghai Provincial Institute of Plateau Geography jointly conducted a survey of public participation in the move-in and move-out regions from September to October, 1997. The methods employed are mainly questionnaires and interviews.

(1) 1,800 copies of questionnaires were distributed in the emigrant counties: Minghe, Hualong, Xunhua, Huangyuan, Ping'an and Datong. 1,458 copies were received. The items under investigation include: whether to agree to the migrant development or not, and other 42 items;

(2) In the move-in region, we interviewed and provided questionnaires to the present immigrants and the local farmers and herdsmen in Balong township, Chasuhe, Qingshuihe, Yikegaoli. 120 copies of questionnaires were distributed, out of which 104 copies were returned. The major items include: whether to agree to the migrant development or not, the impact of migrant development on the environment and other 24 items;

(3) Interviews were made with the 159 households of farmers and herdsmen inside and outside the project region. The items include whether to agree to the migrant development or not, the impact of migrant development on the environment and other 27 items.

7.2 The Results of Public Participation Investigation

Through social investigations and interviews, we have had a general ideas and responses of the recent immigrants in Qaidam region and the farmers and herdsmen in the regions related to the migration on the project construction, together with their wills and needs.

7.2.1 Reaction of Recent Volunteer Settlers

Since 1986, all together 6,152 households, 28,584 persons have migrated to Dulan and Wulan areas from Haidong prefecture by means of labor invitation and immigration, settlement in relatives' and friends' houses, and village transferring in Qaidam region. After the settlement, the immigrants mainly undertook agricultural production, contracting all together 8,866 ha of land. The immigrants generally felt comfortable and satisfied with the new environment.

(1) There is a more arable land with a high production potential. After moving to Qaidam, the arable area per capita of the immigrants is 0.492 ha, over twice the area of that in the former inhabitant region (arable land per capita 0.157 ha). The quality of land changed from the original dry land to the present watering fertile land with a much greater yield. The original output in Haidong prefecture is 1,882.5 kg/ha, whereas the output in the move-in region can reach 6,051/ha, more than tripled that of the original.

(2) Obvious Improvement of Working Conditions

The immigrants moved to Qaidam have basically achieved "moving out in one year, settling down in two years, having adequate food and clothing in three years and shaking off poverty in four-five years". According to the statistics in 1996, there were 13,600 immigrants in Qaidam who have basically settled the problem of having enough

food and clothing (per capita grain ration in a year is 280 kg, per capita income 580 yuan RMB), covering 47% of the total population of the immigrants. There are 11,600 who have steadily rid of poverty (per capita grain ration in a year is 1,000 kg, per capita income 1,000 yuan RMB), covering 40% of the total population of the immigrants. There were 3,200 well-to-do farmers whose income amounts to over 2,000 yuan RMB, covering 11% of the total population of the immigrants. It is investigated that in 1996 some immigrants in the area have achieved the per capita production of grains of 1,080 kg, the total output was 30.78 thousand tons, with 10 thousand tons sold to the country.

With the improvement of living standard and condition, many move-in farmer households have been able to build new houses of wood and brick structure, purchase walking tractors, motor cycles and household appliances. The living standard has greatly improved compared with that in the move-out regions.

Through the investigation of the immigrants in Balong, Dulan, and Keke, Wulan, we find that the returning rate is zero. This is because that the natural environment in the move-out region is extremely poor whereas that in the move-in region is comparatively better. Besides, the move-in region belongs to irrigation agriculture with better counterpart facilities and better basic construction of transportation.

Attitudes towards Migration

Through the analysis of the questionnaires of the farmers waiting to move out in Huangyuan, Datong, Ping'an, Xunhua, Hualong and Minhe, the number of people willing to move out is 1,394, covering 95.6% of the total number of people investigated. The main reasons are: wanting to improve their living conditions (478 people), scarcity of arable land in the hometown (476 people), hoping to have a change of environment (117 people) and for the sake of the next generation (147 people).

Expectations of the New Environment

Through the analysis of the questionnaires of 1,458 households planning to move out, the first difficulty of the immigrants is lack of food (covering 14.48%), the requirement of the new environment is the settlement of food and house, enough food; the second difficulty is the construction of houses (occupying 15.16%), hoping to have new houses so as to achieve better settlement. Besides, some immigrants have also expressed their expectation and requirement about the attendance of school for their children and the transportation in the move-in regions.

Concerns for the Migration

People in the move-out region show concerns about the funds for the moving and settlement, whether there are governmental subsidies and whether the funds are adequate.

State of Mind of the People Unwilling to Migrate

Out of the total 1,458 copies of questionnaires distributed in the move-out region there are 64 people unwilling to migrate, covering 4.4% of the total number of population under investigation. Most of them are satisfied with the current way of life and feel it difficult to leave their hometowns, some of them fear that they will not be adaptable to the new environment.

7.2.2 Public Responses in the Move-in Area

Through the analysis of the investigation results from 104 copies of questionnaires and interviews of 159 households, we find that the farmers and herdsmen in the move-in region adopt the attitudes towards the project construction as follows:

- (1) The majority of farmers and herdsmen express their willingness to follow the arrangement of the government, willing to accept immigrants (148 households, covering 93%). The minority of herdsmen feels worried about it because the immigrants will occupy their grassland resources, which will affect their present living standards (6 households, covering 3%).
- (2) 98.7% of the people in the questionnaires think that the project development will exert an obvious favorable influence on the ecological environment, social environment and economic level in the project region.
- (3) They worry about the availability of compensation since the construction of reservoirs will be likely to submerge their pastureland and cultivating land after the project development.
- (4) They worry about the decrease of time in doing part-time business after the agricultural development.
- (5) They generally worry about (100%) the cutting of the vegetation will destroy the ecological environment and the wild animal and plant resources.

21% of the population worry about the influx of immigrants and the increase of population will cause more social unrest.

ANNEXES

Annex 1

Feed Balance

In terms of the balance between grass and livestock, we made a predictive analysis of the areas, modes and approaches of the construction of man-made pastureland based on the Feasibility Research Report on Grass and Livestock under Xiangrige-Balong Agricultural Poverty Reduction Project. The results indicate that the output of grass from all kinds of man-made grassland and that of stalk produced by farmland (50%) amount to 71,704.85 tons / year, that the number of the herbivorous domestic animals is 230,800 which will consume 70,701 tons / year, that the amount of grass produced by the man-made grassland which is to be built in the project region will be much higher than that of the grass needed by the animals, which has a surplus of 1,003.91 tons per year; Meanwhile, the amount of refined food for pigs, chickens and other domestic animals is 17,190.72 tons / year. However, the amount of refined food produced by the fields in the project region is 20,374.3 tons / year, with a surplus of 3,183.63 tons each year. As a result, the balance between grass and livestock in the project regions will have been achieved by the time the project is fulfilled (approximately in six years' time).

Annex 2**Balance Analysis between Resources and Energy**

- (1) In terms of the balance between energy supply and energy demand, Dulan County is one of the regions, which has scarce resources of energy for daily living (ie. cooking and heating). Farmers and herdsmen mainly burn stalks, straw and dung to cook food and heat houses,. In the whole county, the amount of available heat energy is 72,280 tons, amounting to 36,530 tons of standard coal, including 24,840 tons of stalks, which equals 12,410 tons of standard coal. The amount of energy from dung is 38,200 tons, amounting to 18,560 tons of standard coal. The amount of firewood is 973,000 tons, equaling to 556,000 tons of standard coal. Of the conventional energy coal amounts to 514,000 tons; energy from small hydropower stations equals 236,000 tons of standard coal.
- (2) The supply of heat energy in Balong region is not only important to the environmental conservation in the settlement and but also to the immigrants' normal life and work. Therefore, whether the immigration project will be successful or not depends to a high degree on resolving the supply question. In order to solve the energy problem, we have made a survey in five villages of Balong region, which are inhabited by the farmers emigrating from Haidong Administrative prefecture in 1987. At the same time, we have put forward some suggestions on how to make better use of the energy and analyzed the balance between supply and demand. The results of survey showed that immigrants mainly burn stalks for cooking, the amount of stalks used for cooking is 70% of the total amount of stalk produced annually. The 30% of the stalks are used for raising domestic animals. About 90% of the wheat chaff is used to heat their kang, and all the animal manure is sent to their fields. From this information, it is easy to see that the structure of energy use is very simple, somewhat primitive. Table 1 shows the consumption pattern:

Table 1 Shows rather low use of firewood 9 %,which is because it is mainly used for starting fires. This also probably reflects the general scarcity of wood. In order to protect forests and natural environments, Balong township government supplies each household with 500 kilograms of firewood annually. According to the results of survey, few immigrants use energy-saving stoves, and the heat energy transformation rate of their present systems is only 13 %. It is estimated that the heat transformation rate of stalk-burning stoves is only about 10%, while that of firewood stoves and coal stoves is about 20%. Each household consumes 3,250,640 joules. As far as the energy consumption structure is concerned, there are two problems in the Balong region. Firstly, the abundant solar energy has not been utilized at all. Secondly, the stoves are neither energy saving nor highly energy efficient. With regard to the resent energy consumption structure, stalk should be used as the main resource of energy for living and with coal and solar stoves as subordinate resources, at the same time, it is necessary to popularize energy-saving stoves and make proper use of agricultural residue materials so that the energy consumption structure will be more appropriate. In order to achieve this goal, we will adapt two plans, one is named Low Plan and the other is High Plan. (See tables 2 and 3)

According to Low Target Plan, every household will get 0.22 ha of farmland and each ha of farmland, and each ha field can produce 3,000 kilograms of stalk, of which 54.65% is used for cooking, which covers 45.07% of the total daily consumption. Each household consumes 500 kilograms of the firewood and 1,129.16 kilograms of coal respectively. If each household has a solar cooking stove which heat transforming rate is 15%, and the rate of firewood stoves and coal stoves is 25%, each household consumes 35,000,270 joules of energy daily.

According to High Target Plan, every farmer will get 0.22 ha of farmland, each ha of farmland can produce 6,000 kilograms of stalk, of which 31.13% is consumed for cooking the average amount of coal consumed by each household is 1,000 kilograms. If each household is equipped with one solar cooker, the general heat transforming rate of the stoves is 21.33, in which the heat transforming rate of the stalk stoves is 20%, and that of firewood stoves and coal stoves is 30%. The daily consuming amount of energy is 40,323,830 joules

Table 1 Consumption Amount for Each Household in 1996 (Unit: kilogram standard coal) 1996

Energy Source	Stalk	Firewood	Coal	Total	Average amount per person
Amount used	2,193	286	645	3,124	625
Percentage	70	9	21	100	

Table 2 Proper Consumption Structure of Energy in the Settlement (Low Target) Unit: Kg/Standard Coal

Name	Stalk	Firewood	Coal	Solar Cooker	Total	Per Capita Amount
Amount for each household	1,092.00	285.70	645.20	400.00	2,422.90	484.58
Composition(%)	45.07	11.79	26.63	16.51	100	
Total Consumption Amount (ton standard coal)	17,035.20	2,228.46	10,065.12	6,240	37,797.24	

Table 3 Proper Consumption Structure of Energy in the Settlement (High Target) Unit: Kg/Standard Coal

Name	Stalk	Firewood	Coal	Solar Cooker	Total	Per Capita Amount
Amount for each household	1,244.00	142.85	571.40	400.00	2,358.25	471.65
Composition(%)	52.75	6.06	24.23	16.96	100	
Total Consumption Amount (ton standard coal))	19,406.4	2,228.46	8,913.84	6,240	36,788.70	

In a long run, High Target Plan is suitable not only for the energy consumption structure in the settlement but also for planting structure. Therefore, it will be beneficial to the people in the settlement. However, this energy consumption structure is mainly based on a considerable amount of grain, and only by means of using stalk-saving stoves will it be carried out. So it is difficult to adapt this energy consumption structure in the immediate future. As a result, we will have to make great efforts to achieve this goal within a few years.

During the first year, the immigrants must grow green manure plant to enrich the soil. From then on, they begin to grow wheat and other crops. The balance between energy supply and demand is based on Low Target Plan(See table 4).

Table 4 Estimated Amount of Energy Consumption for Each Household (Low Target) Unit: kg

Name	Move-in 1 st year			Move-in 2nd year			Move-in 3 rd year		
	Amount	Consumption or Supply Amount Available	Amount of Standard Coal for Each Household	Amount	Consumption or Supply Amount Available	Amount of Standard Coal for Each Household	Amount	Consumption or Supply Amount Available	Amount of Standard Coal for Each Household
Stalk				3,996	2,184	1,092	4,995	2,730	1,365
Firewood	500	500	285.70	500	500	285.70	500	500	285.70
Coal	1,129.16	1,129.16	645.20	1,129.16	1,129.16	645.20	1,129.16	1,129.16	645.20
Solar energy	1set	800	400	1set	800	400	1set	800	400
Total			1,330.90			2,422.90			2,695.90
Demand Amount			2,422.90			2,422.90			2,422.90
+ -			-1,092.00			0			+273.00

Table 5 Annex on calculation of average energy consumption of villages in the settlement region (unit: kg)

name	The forth year			The fifth year			The sixth year		
	Amount	Amount available	Coal per household	Amount	Amount available	Coal per household	amount	Amount available	Coal per household
stalk	5,994	3,276	1638	6,993	3,822	1,911	6,240	79,922	2,184
Firewood	500	500	285.70	500	500	285.70	528.84	528.84	302.18
coal	1,129.16	1,129.16	645.20	1,129.16	1,129.16	645.20	1,129.16	1,129.16	645.20
Solar energy	1 piece	800	400	1 piece	800	400	1 piece	800	400
total			2,968.90			3,241.90			3,531.38
Amount of demanding			2,422.90			2,422.90			2,422.90
+ -			+546.00			+819.00			+1,108.48

As shown in Table 4 above, 1,092.2 kg coal will be needed if the whole family members of each household move into the settlement area at the first year of immigration. Therefore, we suggest that each family should send two manpower's to that settlement in the first year to do the preparations such as build irrigation works, plant trees and build farm houses for the immigration of whole family on second year. These two manpower from each family only need 969.16-kg coal at the first year.

The energy consumption for the living of move-out population should mainly depend on the coal at the first year of immigration and should change to crop stalks at the second year. There should be only 1,000 kg coal needed at the third year because of the development of animal husbandry farm, crop and plant cultivation, the output of grain production will be increased and income of the immigrants will be raised, and they can afford to buy it. The energy consumption level of each household at the first year in the settlement is identical with the plan showed above.

The settlement area can supply 1,441,920 kg firewood and stalks at the sixth year of immigration, that is 72.10 kg for each household and supply will be apparently increased in the following years (see Table 6).

Table 6 The available amount of firewood in the settlement of project region

Years	6	7	8	9	10	11	12	13	14	15	16	17	18	19
The amount	1.44	240	221	285	133	357	340	505	478	733	553	505	500	1,229

of coal and firewood											
----------------------	--	--	--	--	--	--	--	--	--	--	--

1108.84kg coal will be saved from each household in the settlement at the sixth year. When the supply of energy can not meet the needs of the family in that area, move-out population should change their life style and the consumption structures according to their own living conditions, such as to build solar heating houses, solar heating green houses and solar water heating facilities. Only by the means of partly being paid by government to support energy supply for the immigrants in the settlement at the first year and meet the needs of the supply by themselves in the following years can we completely solve the energy problem in countryside and can we stop the destruction of ecological environment and obtain the sound cycle of agricultural production and energy supply.

2. The supply of coal resource

There is a small coal mine in Matuo county, which is 80 km from the south of the project county in Balong. The prospected coal resource in the mine is between 800,000 to 1,000,000 tons. The coal mine is now run by an individual and annual output of the production is 800 tons from the year of 1993 and coal is mainly produced in summers and falls. The output of the production is not stable due to the lack of fund and technology. According to the immigration plan above, the immigrants in this area will rely on coal as fuel at the first year of immigration. Therefore, we suggest that the government in Dulan county should work out a plan or combine mining method to develop Matuo Coal Mine in the area of Balong as soon as possible so to meet the needs of immigrants there in the future.

In general, the coal supply stations should be set up in the towns and villages to meet the needs of the immigrants in these areas and supply coal with government subsidized price so to avoid cutting trees and digging grass which destroy the ecological environment. In order to protect the ecological environment, the government should control and distribute crop stalks left from agricultural production and put them into fuel for immigrants.

In accordance with implementation of the settlement plan, the annual fuel consumption plan showed in Table 6. The general principles of the plan will be; every immigrated household should build a energy-saving stove, a solar stove. The experimental works on methane generating pit should be done in these areas. 12,155 solar stove, 12,155 energy-saving stove will be built in according to the plan and 3,403,400 yuan RMB will be needed in this project.

Table 6. Annual plan of energy implementation in the settling region

year	Immigrant (family)	Solar energy stove			Firewoo d-saving stove			Total (1000 yuan RMB)
		Amount (piece)	Unit price	Total (1000 yuan RMB)	Amount (piece)	Unit price	Total (1000 yuan RMB)	
1								
2	212	212	200	42.40	212	80	16.96	59.36
3	1,799	1,799	200	359.80	1,799	80	143.92	503.22
4	3,222	3,222	200	644.40	3,222	80	257.76	902.16
5	4,357	4,357	200	871.40	4,357	80	348.56	1,219.96
6	2,565	2,565	200	513.00	2,565	80	205.20	718.20
total	12,155	12,155		2431.00	12,155		972.40	3,403.40

Annex 3**(1) Water and Soil Balance Analysis**

According to the overall planning of ADPR project, the total developing land areas in the project region is 28.7586×10^4 mu. See Table 1 for the distribution of irrigated areas in different irrigated regions. According to the proportion of land-using structure, agriculture occupies 70%, forestry and animal-husbandry makes up 15% each; the proportion of agricultural plantation is as such: wheat 60%, barley 8.57%, legumes 11.43%, rape 15.71%, potato 4.29%.

Table 1. The distribution of Irrigated Areas (Unit: 10,000 mu)

Name of irrigated Regions	Irrigated Areas	Gravity Irrigation	Well Irrigation	Water Irrigation System
Qingshuuhe	2.4917	2.0047	0.4870	Qingshuuhe(gravity irrigation)
Hatu	1.1370	1.1370	--	The Hatu River and Xiaonuomuhong River
Keri	0.5619	0.5619	--	Irrigating by using the water from the Xiangride River 0.5619
Balong	21.8852	17.82	4.0652	Irrigating by using the water from the Xiangride River 17.82
Xiaoxiatan	1.9684	1.9684		
Yikegaozi	0.71438	0.71438		
Total	28.7586	24.2064	4.5522	Total irrigated areas by using the water from the Xiangride River 18.3819

According to the SDJ217-84 of Design Regulations of Irrigation and Escape Canals, the irrigation designing adopts P=75%, the net irrigation quota for spring wheat is $420m^3/mu$ in Xiangride river valley areas, $440m^3/mu$ in Balong region; for barley, $380m^3/mu$ and $390m^3/mu$ respectively; for legumes, $320m^3/mu$ and $330m^3/mu$ respectively; the same quota for rape is as that of legumes; for potato, $270m^3/mu$ and $260m^3/mu$.

The net irrigation quota in project construction areas is $364.5m^3/mu$, and the valid usage coefficient of canals is $\mu=0.6$ considering that all types of canals (such as main canals, branch canals and lateral canal) should be treated with anti-seep process; $\mu=0.67$ is adopted in well-irrigation areas. The general net irrigation quota in old irrigated areas is $377.31m^3/mu$, the valid usage coefficient of canals is $\mu=0.50$. The irrigated areas in Balong region are 18.3819×10^4 mu (by drawing water from the Xiangride river), 3.8561×10^4 mu (by using local natural water resources), 4.5522×10^4 mu (by wells). In the old irrigated areas, that is, the Xiangride river valley areas, there are irrigated agriculture and forestry areas 13.2516×10^4 mu. Another 1.9684×10^4 mu are left for making lands from transforming the river. The total irrigated areas are 15.22×10^4 mu.

Table 6. Chart of the Amount of Surface Water Resources in Xiangride-Balong Region

Name of Rivers	Water Areas(Km ²)	Rate of Flow(m ³ /s)	Runoff (10 ⁸ m ³)
Qingshui	346	0.847	0.267
Xiaonuomuhong	221	0.500	0.158
Hatu	613	1.49	0.470
Yikeguang	305	0.77	0.243
Yangshugou	416	0.986	0.311
Kerigou	251	0.532	0.168
Xiangride	12,339	12.27	3.869
Total			5.4860

We can see from Table 6 that the total amount of surface water resources in Xiangride-Balong region is $5.486 \times 10^8 m^3$, out of which, $3.869 \times 10^8 m^3$ water is in Xiangride area, $1.617 \times 10^8 m^3$ in Balong region. Moreover, the supply of ground water in Xiangride-Balong regions is $4.02 \times 10^8 m^3$, among which, $2.8 \times 10^8 m^3$ water is in Xiangride area, $1.22 \times 10^8 m^3$ water in Balong region. The usable ground water resources in Balong is $0.98 \times 10^8 m^3$, however, the ground water resources in Xiangride area is not taken into consideration in the project development construction. In order to fully use surface water resources, exploit ground water resources reasonably and guarantee agriculture

irrigation, water consumption during critical irrigation period is adjusted in different periods in the month. In early 1960s, Xiangride Farm set up a floodgate in the outlet of the Tuosuo Lake to control the runoff water to make up a balance in dry season. The project will make a change to the Tuosuo lake floodgate, and make the lake a natural adjustable reservoir. We will assume three different volumes for the lake: $1.1 \times 10^8 \text{m}^3$, which guarantees 97.00% irrigated areas with $0.97 \times 10^8 \text{m}^3$ water drawn off the lake; $1.3 \times 10^8 \text{m}^3$, which guarantees 100% irrigated areas with $1.04 \times 10^8 \text{m}^3$ water drawn off the lake; $0.8 \times 10^8 \text{m}^3$ which guarantees 94.7% irrigated areas with $0.907 \times 10^8 \text{m}^3$ water drawn off the lake. See items 8,9,10,11,12,13,14,15,16, in the reports of water balance between supply and demand for detailed calculation results which shows that water resources will be fully used when the Tuosuo Lake contains $1.3 \times 10^8 \text{m}^3$ water.

In general, the project mainly aims at using surface water resources of the Xiangride River, the Hatu River, the Xiaonuomuhong River, the Qingshui River and ground water resources in Balong region. The critical issue of the project is whether the water resources in this region can meet the needs of irrigation and sustainable development.

From the above statements we can see that, the total exploitable land areas in the project regions is $28.7586 \times 10^4 \text{mu}$; the gross irrigation water consumption is $2.977 \times 10^8 \text{m}^3$ (ground water occupies $0.24 \times 10^8 \text{m}^3$); the total amount of surface water in this region is $5.486 \times 10^8 \text{m}^3$, the exploitable ground water in Balong region is $0.98 \times 10^8 \text{m}^3$, totaling is $6.466 \times 10^8 \text{m}^3$, which can meet the needs of irrigation in this region. In addition, there is enough space to exploit water resources to meet the needs of sustainable development in this region. However, the project development administration departments should strengthen the management of the Xiangride River water resources and the floodgate of the Tuosuo Lake in a scientific way. They should improve the adjustment between the Keri reservoir and the Tuosuo Lake, and transform the present canals in the old irrigation areas so as to reduce water waste. They should also try to use surface water resources to the greatest extent, exploit ground water reasonably, so that the water resources in this region will meet the needs of the project region.

Table 2. Chart of Gravity Irrigation Water Quota in Balong Region

Month Period Items	3		4			5			6			7			8			9		10		11	□ □
	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First tendays	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days		
Net water consumption	6.89	15.16	16.17	14.73	--	2.61	26.07	28.27	25.44	25.87	26.0	25.98	24.05	24.58	21.72	23.93	23.99				17.05	15.50	364.01
$10^4 \text{m}^3 / 10^4 \text{mu}$	22.05		30.9			56.95			77.31			74.16			69.64					17.05		15.50	364.01
Gross water consumption	11.48	25.27	27.78	24.55	--	4.35	43.45	47.12	42.40	43.12	43.33	43.30	40.08	40.97	36.20	39.95	39.98				28.42	25.83	□=0.6
$10^4 \text{m}^3 / 10^4 \text{mu}$	36.75		52.33			94.92			128.85			124.35			116.07					28.42		25.83	607.52

Table 3. Chart of Irrigation Water in Xiangride River Valley Areas

Month Period Item	3		4			5			6			7			8			9		10		11	□ □
	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First den days		
Net water consumption	8.16	17.96	16.16	3.60	4.96	24.89	25.66	27.70	26.00	28.11	28.86	27.21	23.80	20.24	20.54	17.45	18.98	5.29	5.32	17.43	8.99	377.31	
$10^4 \text{m}^3 / 10^4 \text{mu}$	26.12		47.72			78.25			82.97			71.25			56.97			5.29	22.75		8.99	377.31	
Gross water consumption	16.32	35.92	32.32	7.20	9.92	49.78	51.32	55.40	52.00	56.22	57.72	54.42	47.60	40.48	41.08	34.90	37.97	10.58	10.64	34.86	17.98	754.62	
$10^4 \text{m}^3 / 10^4 \text{mu}$	52.24		49.44			156.50			165.94			124.35			113.94			10.58	45.50		17.98	□=0.5	

Table 4. Chart of Irrigation Water Consumption in the Old Irrigated Lands ($12.61 + 2.61 = 15.22 \square 10^4 \text{mu}$)

Month Period Item	3		4			5			6			7			8			9		10		11	□ □
	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days		
Gross water consumption (10,000mu)	16.32	35.92	32.32	7.20	9.92	49.78	51.32	55.40	52.0	56.22	57.72	54.42	47.60	40.48	41.08	34.90	37.96	10.58	10.64	34.86	17.98	754.62	
Water consumption (152,000mu)	248.4	546.7	491.9	109.6	151.0	757.7	781.1	843.2	791.4	855.7	878.5	828.3	724.5	616.1	625.3	513.2	577.8	161.0	161.9	530.6	273.6	11485.3	

Table 5. Chart of Gravity Irrigation Water Consumption in Balong Region

Month Period Item	3		4			5			6			7			8			9			10			11	
	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	Middle ten days	Last ten days	First ten days	□ □			
Gross water consumption (10,000mu)	11.48	25.27	27.78	24.55	--	4.35	43.45	47.12	42.40	43.12	43.33	43.30	40.08	40.97	36.20	39.88	39.98	--	--	--	28.42	25.83	607.52		
Irrigation water consumption(153,819mu)	211.0	464.5	510.6	451.3	--	80.0	798.69	865.2	779.4	792.6	796.5	795.9	736.7	753.1	665.4	733.1	734.9	--	--	--	522.4	474.8	11167.4		
Gravity irrigation water consumption in Xiangride River Valley/ Balong region	459.4	1011.2	1002.5	560.9	151.0	837.7	1579.8	1709.4	1570.8	1648.3	1625.0	1624.2	1461.2	1369.2	1290.7	1246.3	1312.7	161.0	161.9	1053.0	748.4	22652.7			

Annex 4

1. Analysis of the influence on the variety of living things and landscape beauty

1.1 Analysis of the influence on the variety of living things

(1) Analysis of the influence on ecological types

The main ecological types in the project regions are desert, semi-desert and grassland ecological types. There are also plateau shrub and man-made farmland ecological types outside the project region. In the beginning stages, the exploitation of the project will damage the above-mentioned two ecological types within the project region, but man-made arbor-shrub forest, man-made farmland, man-made grassland and man-made towns will be set up gradually. In the very beginning, especially in the land exploitation stage, the alternate changes of ecological types will have negative effects. It is reflected that the damage of proto-ecology will inevitably lead to the declination of ecological function, and abnormal function of newly established ecological types, eventually result in overall ecological function decline, such as regional land desertification. Along with the newly established man-made ecological system which begins to give its full play, however, these negative effects will fall, and the overall ecological system will be greatly improved. Thus, to analyze from the aspects of overall ecological functions and ecological types, we can see that the project construction is beneficial to the development of ecological varieties.

(2) Analysis of the influence on the varieties of living things

In the project regions the main species are desert, semi-desert and grassland living things which matches the situation in ecological types. Concerning about animal species in the project regions, it consists mainly of Qaidam desert animal's species and Mongolia-Xinjiang animal species. Plant species consists mainly of Mongolia-Xinjiang species and middle-Asia species. There are 8 animal species, over 30 plant species.

After the implementation of the project, living species will increase continuously along with the improvement of ecological variety and the perfection of ecological system structure. Plant species will be added to 10-30 species, animal species will be added to 10-21 species, which will affect the variety of living species in the project regions positively.

2. Analysis of the influence on regional landscape

It is already stated that the implementation of the project will break down the desert, semi-desert and grassland ecological system, which is primitive and low efficient. Oasis agriculture ecological system, which is efficient and steady, will be established in addition to farmland windbreak belt forest system and farmland-grassland structure with strip shape. This will improve the present landscape situation. Furthermore, the improvement of rate of vegetation coverage, variety of living species will also be added to significance value to landscape.

Annex 5**Pesticides Likely to be used in Xiangride-Balong Agriculture Development Project**

1. Herbicide: grass-killer, avadex, methoproptryae,
2. Insecticide: flolimat, phoxim, menite
3. Bravo Daconil pest-killing vitriol

Basic qualities of pesticide which could be applied in the project area

Type	Pesticide	Target crops	Pest/grass to be killed	Dosage
Herbicide	Grass killer (medium toxic)	Wheat, highland barley, barley	Wild oak and grass	180mm/mu
	Avdex (medium toxic)	Wheat, highland barley, barley, legumes	Wild oak	200-250mm/mu
	Lumeton (medium toxic)	vegetable	Grass	40-50mm/mu (12.5% emulsion)
Insecticide	Flolimat (medium toxic)	Fruit tree, vegetable	Pest lava	40% emulsion dilution, 1000-2000 times spraying
	Phoxim baythion (extreme toxic)	Wheat, corn, fruit tree, vegetable	Cabbage caterpillar, cabbage moth, armyworm, wheat aphid	50% emulsion 50-70 mm/mu dilution spraying
	Menite (slight toxic)	Wheat, legumes, fruit tree, vegetable	Bacteria	20% emulsion 20-40 mm/mu dilution spraying
Bravo	Dacnil (slight toxic)	Vegetable, grain, oil	Many diseases	50% damp powder dilution, 400-500 times spraying
	Disinfect vitriol (medium toxic)	Vegetable, fruit tree,		64% damp powder dilution, 300-400 times spraying

**Western China Poverty Reduction
Project Financed by the World Bank**

**Report on Assessment of Environmental
Impacts in Gansu Project Area**

Environmental Protection Research Institute of Gansu Province
October 1998

Name of Project:

Western China Poverty Reduction Project Financed by the World Bank
Report on Assessment of Environmental Impacts in Gansu Project Area

The Project Entrusted by:

Leading Group Office of Gansu Poverty Reduction Project Financed by the World Bank

The Project Undertaken by:

Environmental Protection Research Institute of Gansu Province

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Appendix 1 – Rural Energy Development Plans for the 12 Project Counties in Gansu

1 OUTLINE

1.1 Introduction

After consultation, the National Planning Committee, the Ministry of Finance and the World Bank agreed to include Gansu, Qinghai and Inner Mongolia into Western China Poverty Reduction Project (WCPRP) financed by the World Bank. In June 1997, The Planning Committee Office issued document No.380 to inform these provinces to draw up proposals and do early preparation work.

The Gansu sub-project of WCPRP is a large-scale and comprehensive project, involving 12 counties and many subsectors. The World Bank project office of Gansu entrusted our Institute to carry out environmental impact assessment of the project in order to protect and improve the fragile environment and to provide a more scientific bases for environmental protection.,

After organizing the appropriate technicians to undertake on-the-spot investigations, collecting concerned data, consulting relevant experts and interviewing project farmers, we drew up the preliminary report in accordance with the World Bank Loan Guideline OD4.01, the World Bank JGF project NO.1-8 "Guideline for China Agriculture EIA", and March-1998 aide memoire of following conversations in Beijing with Mr. Schumacher, environmental expert of the World Bank. The report was revised in June 1998 on the basis of the review memoranda of the project preparation mission and also after meeting with Mr. Schumacher in Qinghai in August-1998. In October, 1998, the environment experts of pre-appraisal mission scrutinized the report in Lanzhou and put forward revisions in a complementary memorandum. From 19 to 26, October, 1998, we reviewed such issues as mitigation measures for potentially important environmental issues, mitigation cost, project subcomponents, monitoring costs, and design problems with leaders from World Bank Project Office of Gansu and other relevant experts. We revised and finalized the report again according to our common understandings.

Acknowledgement:

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1.2.1 Report Framework

1.2.1 Principal Documentation

- (1) Gansu Project Proposal of Western China Poverty Reduction Project Financed by the World Bank(July 25,1997);
- (2) Gansu Project Feasibility Study Report of Western China Poverty Reduction Project Financed by the World Bank (Including Each Sub-project Feasibility Study Report), 1998;
- (3) Certificate of Entrustment for EIA of Western China Poverty Reduction Project Financed by the World Bank, Gansu Leading Group of Western China Poverty Reduction Project Financed by the World Bank, March 26, 1998; and
- (4) Outline for EIA in Gansu Project Area under Western China Poverty Reduction Project Financed by the World Bank, Environmental Protection Research Institute of Gansu Province, April 1998.

1.2.2 Laws and Regulations

- (1) Constitution of the People's Republic of China, Articles No.9, No.10 and No.26;
- (2) Environmental Protection Law of the People's Republic of China, Articles No.19 and 20;
- (3) Water Pollution Prevention Law of the People's Republic of China, Article 30;
- (4) Forest Law of the People's Republic of China, Article No.4 sections 1, 2, 3, 4 and 5, Article 5;
- (5) Grassland Law of the People's Republic of China, Article 20;
- (6) Fishery Law of the People's Republic of China, Articles 23 and 26;
- (7) Land Administrative Law of the People's Republic of China, Article 10;
- (8) Water Law of the People's Republic of China , Articles 4 and 5;
- (9) Water and Soil Conservancy Law of the People's Republic of China, Articles 14,17 and 22;
- (10) Wild Animal Protection Law of the People's Republic of China, Articles 8 and 9;
- (11) Atmospheric Pollution Prevention Law of the People's Republic of China Articles 10, 13,15 and 27;
- (12) Noise Pollution Prevention Regulation of the People's Republic of China Articles 2, 3, 5, 15 and 21;
- (13) Several suggestions on Environmental management of Construction Projects, issued by National Environmental Protection Bureau (88) EC No.117;
- (14) Management Methods of Environmental Protection in Construction Projects, issued by National Environmental Protection Bureau, National Planning Committee and National Economic Committee (86) E No.003;
- (15) Several Suggestions on the Better Management of Construction Projects t, issued by National Environmental Protection Bureau (93) ES No.015;
- (16) Notice About the Better Management of EIA in the Construction Projects Sponsored by the Loan From International Financial Organizations, issued by National Environmental Protection Bureau, National Planning Committee, Ministry of Finance, Bank of China (93) ES No.324; and
- (17) Notice about implementation of "State Council's Decisions on the Several Environmental Protection Issues", issued by National Environmental Protection Bureau (96) E No.734. (Sep.12, 1996).

1.2.3 Technical Standards for EIAs

- (1) Technique Guideline for EIAs---Non-pollution Ecological Impact (1998);
- (2) Guideline for the World Bank Projects---Environment Appraisal OD 4.01, issued by the World Bank in July 1992;
- (3) A Corpus of EIA Data, World Bank technical document No.139, October 1993;
- (4) The World Bank JGF Project No.1-8 Guideline for China Agriculture EIA, issued by Development and Supervision Department of National Environmental Protection Bureau and Environmental Research and Monitoring Institute of the Ministry of Agriculture, May 1995;
- (5) Regulations on EIA Techniques of the Development of Natural Resources (Tentative) (December 1995);
- (6) Guideline for EIA Techniques (HJ/T2.1-2.3-93); and
- (7) Examination and Management of EIA of Construction Projects, senior training course for EIA technique of construction projects held by Asia Development Bank, China National Environmental Protection Bureau. March, 1992.

1.2.4 Environmental Standards for EIAs

1.2.4.1 Environmental standards

- (1) Air quality standard (GB3095-1996), second gradation;
- (2) Surface water quality standard (GB3838-88), Category III;
- (3) Underground water quality standard (GB/T14848-93), Category III;
- (4) Sanitary standard for drinking water (GB 5749-85);
- (5) Quality standard for irrigation water (GB5084-92);
- (6) Quality standard for fishery water (GB11607-89);
- (7) The allowed maximum content of gas pollutants for crop protection (GB9137-88); and
- (8) Sanitary standard for industrial enterprises design (TJ36-79).

1.2.4.2 Discharge Standards

- (1) Standard for the comprehensive gas pollutants (GB16297-96), for new pollution sources, second gradation;
- (2) Standard for the comprehensive sewage (GB8978-96), to use the criteria stipulated in the second phase;
- (3) Discharge standard for the gas pollutants produced by boilers (GB13271-91), area B;
- (4) Discharge standard for the gas pollutants produced by industrial furnaces (GB9078-96), to use parameter started from Jan.1, 1997;
- (5) Noise standard for the factory areas of industrial enterprises (GB12348-90); and
- (6) Standard for safely using agro-chemicals (GB4285-84).

1.3 Assessment Methods

This report is based on information collection, on-the-spot investigations, research activities, review of related regulations, laws and technical criteria. Environmental impact elements that could occur during the construction and operational phases of the project are identified and analyzed. These include issues such as soil erosion, plastic film disposal, insecticide and fertilizer pollution, feed balances for livestock, drinking water quality from rain-collection works, public health and energy, etc. As a result of the review of all aspects of the environment and the issues that might impact on it the report proposes practical mitigation measures and monitoring plans for the various environmental issues.

2. PROJECT SUMMARY AND ENGINEERING ANALYSIS

2.1 Project Summary

Project Name: Gansu Project of the Western China Poverty Reduction Project, financed by the World Bank.

Project Nature: New project

Estimated Investment: The total investment of the whole project is 1.183 billion Rmb, of which, the investment of planting and animal husbandry makes up 50.00%, infrastructure and irrigation 26.20%, labor export 12.00%, rural enterprises 8.00%, public sanitation 3%, and institution establishment and project management 3.50%.

2.2 Project Composition and Scale

The project consists of the five components described in the following paragraphs.

(1) Cropping and Animal Husbandry Projects

This component involves 127 sub-projects in 6 sub-sectors. There are 25 improved grain production projects, 13 cash crop projects, 30 economic forest projects, 40 animal breeding projects, 7 technical extension projects and 12 training projects. The project covers 1,970,577 households, which make up 20.5% of the project area's total population. The participating rural population amounts to 929,600 people, or 59.5% of the project area's total population. See Table 2-1 and map 2-1 for composition and scale of sub-projects.

(2) Rural Enterprises Projects

The rural enterprise projects include 41 sub-projects in 5 subsectors, of which: 13 are industrial enterprises (forage processing is included for six counties); 6 garment manufacturing; 13 commerce and trade enterprises; and 6 are rural markets; and 3 intensive livestock production enterprises. See Table 2-2 and map 2-2 for contents and scale of sub-projects.

(3) Labor Export Projects

The labor export project, which will be implemented at county and provincial levels, consists of 13 sub-projects in 5 subsectors. Among them are: one for improving inter-provincial labor mobility; one for intra-provincial labor mobility; one for labor mobility technical training; one for establishing a labor service system; and one for training the project's management. In the construction phase, 60,000 people will be exported, 10% in first year, 10% in second, 15% in third, 15% in fourth; and 20% in fifth and sixth respectively. At the end of construction phase, the import area will have a stable work population of 20,000.

(4) Infrastructure Projects

The infrastructure project consists of 48 sub-projects in 7 subsectors. These include: 16 terraced land development projects (11 for earth-faced terraces and 5 for stone-faced terraces); 10 rural water supply projects; 10 rural road construction projects; 1 suspension bridge project; 1 road bridge project; 7 10KV electric line projects; and 1 river basin improvement project. See Table 2-3 and map 2-2 for the scale and distribution of the projects.

(5) Irrigation Projects

The irrigation projects consist of 15 sub-projects in 6 subsectors including: 1 small-well irrigation project; 3 sprinkler-purchasing projects; 4 canal irrigation projects; 1 electrical-powered pumped irrigation project; 4 rain water collection and storage irrigation projects, 2 floodplain land reclamation projects. See Table 2-4 and map 2-2 for the scale and distribution of the projects.

2.3 Project Benefits

The internal rate of return (IRR) of the project is 26%. In the project area, 929,600 poverty-stricken people from 197,057 poverty-stricken households in 2,234 administrative villages will benefit from the project. In the sixth year of the project, the household living and working conditions of the project area will be improved drastically and their poverty situation will be reduced fundamentally. Significant indirectly-quantifiable benefits will also be derived from the erosion control measures which will be undertaken as part of this project. These will have an important impact in terms of moisture retention and reduced soil erosion. Other benefits will also be realized from the implementation of the environmental mitigation measures that are prescribed as part of this report. These include more efficient use of fertilizers and pesticides and reduced contamination of water from these sources, better use of grasslands, and better use of plastic mulch.

2.4 Environmental Issues Related to the Project

2.2.1 Analysis of the environmental issues

The principal environmental issues are identified as following:

- (1) Crops and animal husbandry projects:
The cropping and animal husbandry activities raise six principal environmental issues: soil erosion; fertilizer pollution; insecticide pollution; plastic film pollution, grassland degradation and disease prevention. See chart 2-1 for detailed analysis.
- (2) Rural enterprises projects:
The rural enterprises will produce solid wastes, liquid effluents, ash and dust, and noise pollution. See chart 2-2 for detailed analyses.
- (3) Analysis of environmental issues of infrastructure
The major environmental issues associated with the infrastructure projects are soil erosion, water pollution, and machine noise and dust. See chart 2-3 for detailed analyses.

2.2.2 Selection of the Environmental Impact Elements

According to above analysis results, the project will result in both positive and negative impacts on the natural ecosystem, on the agricultural environment, and on the social-economy of the region. These issues will result from activities related to the construction and operational phases. The screening of environmental impact elements is provided on Table 2-5.

Table 2-1 Composition of Cropping and Animal Husbandry Projects

Description	Project county	Scale (ha)
1. Grain Crops		
a. plastic mulch for corm	11 counties except Minxian	20,769.56
b. plastic mulch for wheat	Wushan, Zhangchuan, Tanchang, Minxian	1,388.18
c. virus-free potato	Zhangchuan, Gangu, Wushan, Minxian	6,866.20
d. wheat/corn inter-planting	Wudu, Kangxian	582.27
e. high production broad bean	Zhangchuan, Qingshui, Wushan, Gangu	1,680.51
2. Cash crops		
a. Plastic mulched crops	Wushan	215.48
b. hemp	Zhangchuan, Qingshui	1,041.08
c. Medicinal plants		
i. Hongqi	Lixian, Tanchang, Wudu, Xihe, Minxian	4,828.2
ii. Dangsheng	Wenxian, Lixian	673.07
iii. Danggui	Tanchang, Minxian	2,145.00
iv. Dahuang	Lixian	441.6
3. Economic forest		
a. Prickly ash	Lixian, Gangu, Qin'an, Wudu, Tanchang,	7,964.3
b. Walnut	Xihe, Wenxian, Kangxian	
c. Olive	Kangxian, Lixian, Wudu, Qingshui	2,216.7
d. Mulberry	Wudu, Wenxian	429.2
e. Apple	Kangxian	260
f. Pear	Lixian, Qin'an, Zhangchuan, Xihe, Gangu	2,486.5
g. Tea	Minxian, Zhangchuan, Gangu	556.8
h. Japanese larch	Kangxian, Wenxian	408.53
	Lixian, Wushan, Qingshui, Zhangchuan	1,227.5
4. Animal Husbandry		
a. Alfalfa production	Zhangchuan, Qingshui, Gangu, Wushan, Xihe, Tanchang, Wudu	5,188.487
b. Beef cattle	Qinan, Zhangchuan	1,056
c. Cattle	Zhangchuan, Wushan, Gangu, Qingshui, Lixian, Minxian	19,774
d. Ewes	Wu, Lixian, Tanchang, Zhangchuan, Qingshui, Minxian	89,312
e. Meat-pig	12 project counties	246,363
f. Sow breeding	Gangu	33.8
g. Carp	Mingxian	24
h. Soft shelled turtle	Wenxian	9,300(m ²)
5. Applied research	Zhangchuan, Qingshui, Qin'an, Wudu, Lixian, Tanchang, Kangxian	Undertaken in 7 counties
6. Training	Technicians and manager of 12 counties' townships and villages	

Table 2-2: Composition and Scale of the Rural Enterprise Projects

Description	Implementation Counties	Main products	Scale
1. Small and medium processing enterprises	14		
(1) Wudu tea processing (2) Kangxian tea processing (3) Wenxian tea processing (4) Wushan willow braiding processing (5) Zhangchuan straw braiding processing (6) Tanchang willow braiding processing (7) Wudu olive processing (8) Qin'an carpet processing (9) Wushan old plastic plant (10) Wudu livestock productprocessing (11) Zhangchuan carpet processing (12) Xihe straw braiding processing (13) Provincial processing base for grass industry	Wudu Kangxian Wenxian Wushan Zhangchuan Tanchang Wudu Qin'an Wushan Wudu Zhangchuan Xihe Qingshui, zhangchuan, Lixian, Xihe	Green tea Tea Tea Fruit basket Handicraft article Handicraft article Olive oil Carpet Plastic particle Pig hair Carpet Fruit basket	35 t 30 t 54 t 300 t 1560 t 300 t 81 t 129,000 ft ² 700 t 30t 3,1000 ft ² 1940 t
2. Processing	6		
(1) Xihe forage processing (2) Minxian forage processing (3) Wudu forage processing (4) Gangu forage processing (5) Lixian forage processing (6) Gangu oil material processing	Xihe Minxian Wudu Gangu Lixian Gangu	Forage Forage Forage Forage Forage Food oil	67000 t 19,000 t 14,400 t 35,000 t 75,000 t 3,400 t
3. Commerce and trade	12		
(1) Qingshui fruit storage cellar (2) Qin'an fruit storage cellar (3) Lixian fruit storage sites (4) Zhangchuan fruit storage sites (5) Tanchang medicinal plant processing (6) Wudu medicinal plant processing (7) Minxian medicinal plant processing (8) Wenxian medicinal plant processing (9) Lixian medicinal plant processing (10) Tanchang mountain vegetation processing sites (11) Wudu green prickly ash processing (12) Xihe medicinal plant processing (13) Kangxian green prickly ash processing	Qingshui Qin'an Lixian Zhangchuan Tanchang Wudu Minxian Wenxian Lixian Tanchang Wudu Xihe Kangxian	Apple Trading " " " Dangshen, Hongqi, Angelica Angelica, Hongqi pill Angelica Wendang Dahuang Salinized mountain vegetable Green prickly ash	1000 t 800 t 4,000 t 7,500 t 270 t 495 t 689 t 320 t 1,600 t 150 t 54 t 90 t 54 t
4. Rural Markets	6		
(1) Lixian rural market (2) Kangxian rural market (3) Gangu rural market (4) Minxian rural market (5) Wudu rural market (6) Tanchang rural market	Lixian Kangxian Gangu Minxian Wudu Tanchang		4500 m ² 1500 m ² 9000 m ² 4500 m ² 6000 m ² m ²
5. Intensive Livestock Production			
(1) Minxian breeding farm (2) Qin'an breeding farm (3) Zhangchuan breeding farm x 3	Minxian Qin'an Zhangchuan	Pig Pig, cattle Cattle	10,000 10,000 234beef cattle

Table 2-3: Composition and Scale of the Infrastructure Projects

Description	Implementation Counties	Scale
1. Farmland Development		
(1) Earth-faced terraces	11 counties except Minxian	21,150.36 ha 18,892.53 ha
(2) Stone-faced terraces	Wudu, Tanchang, Wushan, Wenxian, Kangxian	2,257.83 ha
2. Rural water supply		
(1) pipe line works	Wudu, Tanchang, Wenxian, Minxian, Qingshui, Kangxian	259,353 people 175,795 people
(2) non-pipe line works	Wushan, Gangu, Qin'an, Lixian	83,558 people
3. Rural Power Supply	Minxian, Lixian, Kangxian, Xihe, Wudu, Tanchang, Wenxian	1,008.316 km
4. Rural Road		
(1) Rural road	Wudu, Zhangchuan, Tanchang, Gangu, Qin'an, Wenxian, Minxian, Qingshui, Kangxian, Lixian	174.125 km
(2) Suspension bridge	Lixian	2 sites
(3) Road bridge	Lixian	110.1 m
5. Basin Mitigation	Minxian	32.037 km ²
6. Training	12 counties	5,936522 Rmb
7. Research	12 counties	3,083,000 Rmb

Table 2-4: Composition and Scale of the Irrigation Projects

Description	Implementation Counties	Scale
Irrigation		
(1) Small-well irrigation	Lixian	130 sites
(2) Purchase sprinkler	Zhangchuan, Wushan, Qingshui	972 sets
(3) Canal irrigation	Lixian, Wenxian, Minxian, Kangxian	102.15 km
(4) Rain-water collection and supplementary irrigation	Wudu, Zhangchuan, Qingshui, Lixian	9267 sites
(5) Electrical pump irrigation	Minxian	8 sites
(6) Flood plain reclamation	Tanchang, Minxian	107.40 ha

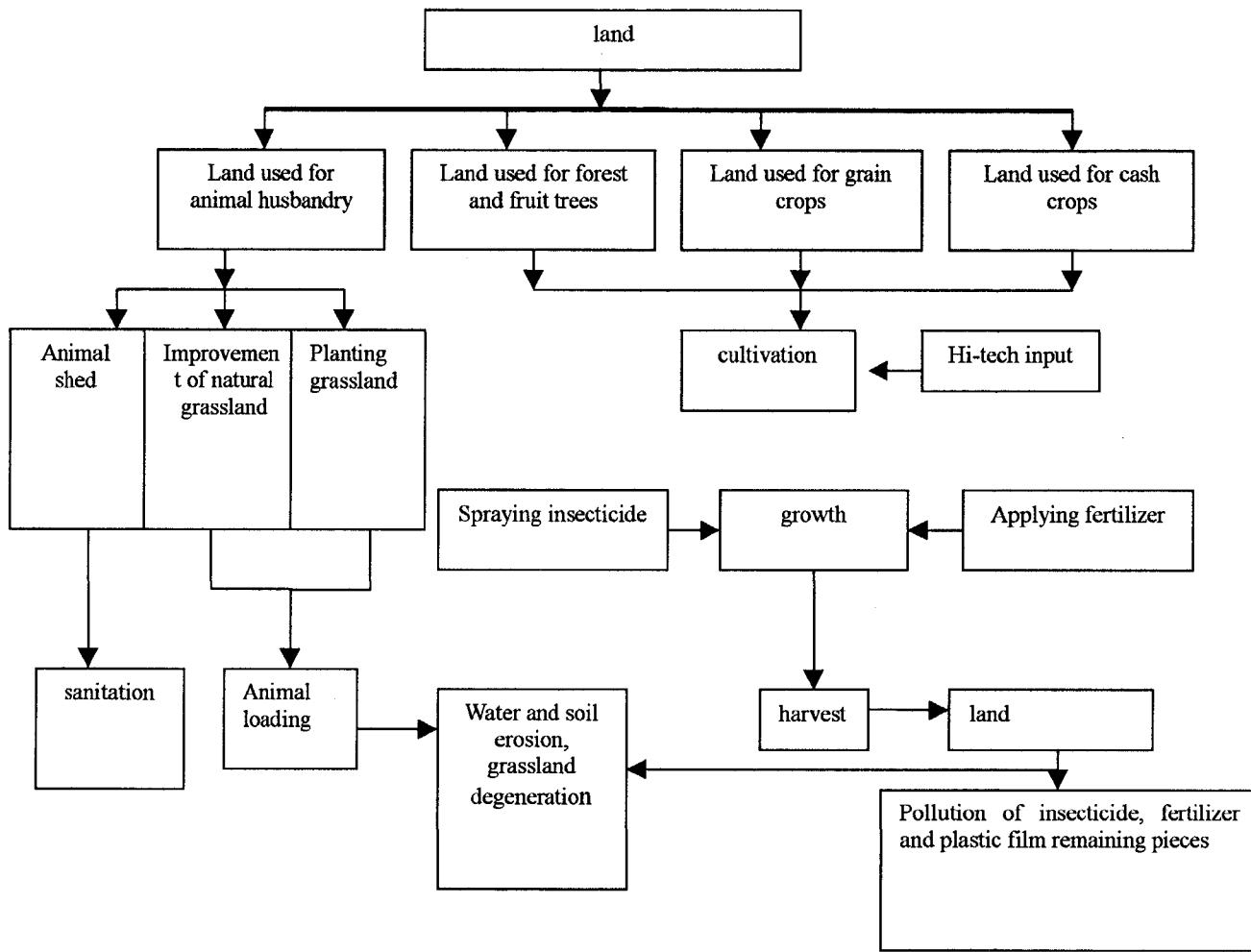


Chart 2-1: Construction Process and Environmental Issues of Cropping and Animal Husbandry

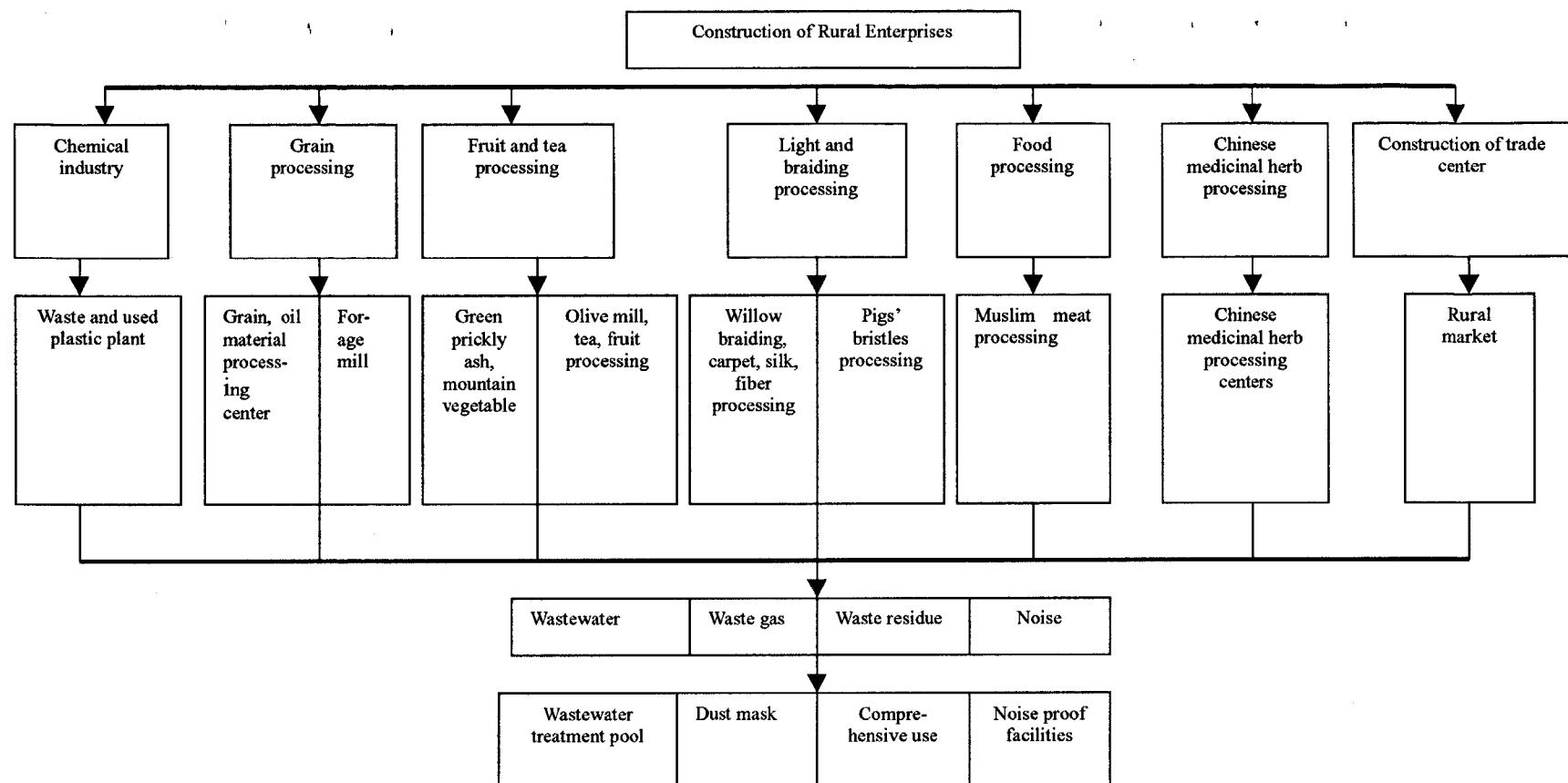


Chart 2-2: Construction Processes and Environmental Issues Related to Rural Enterprise

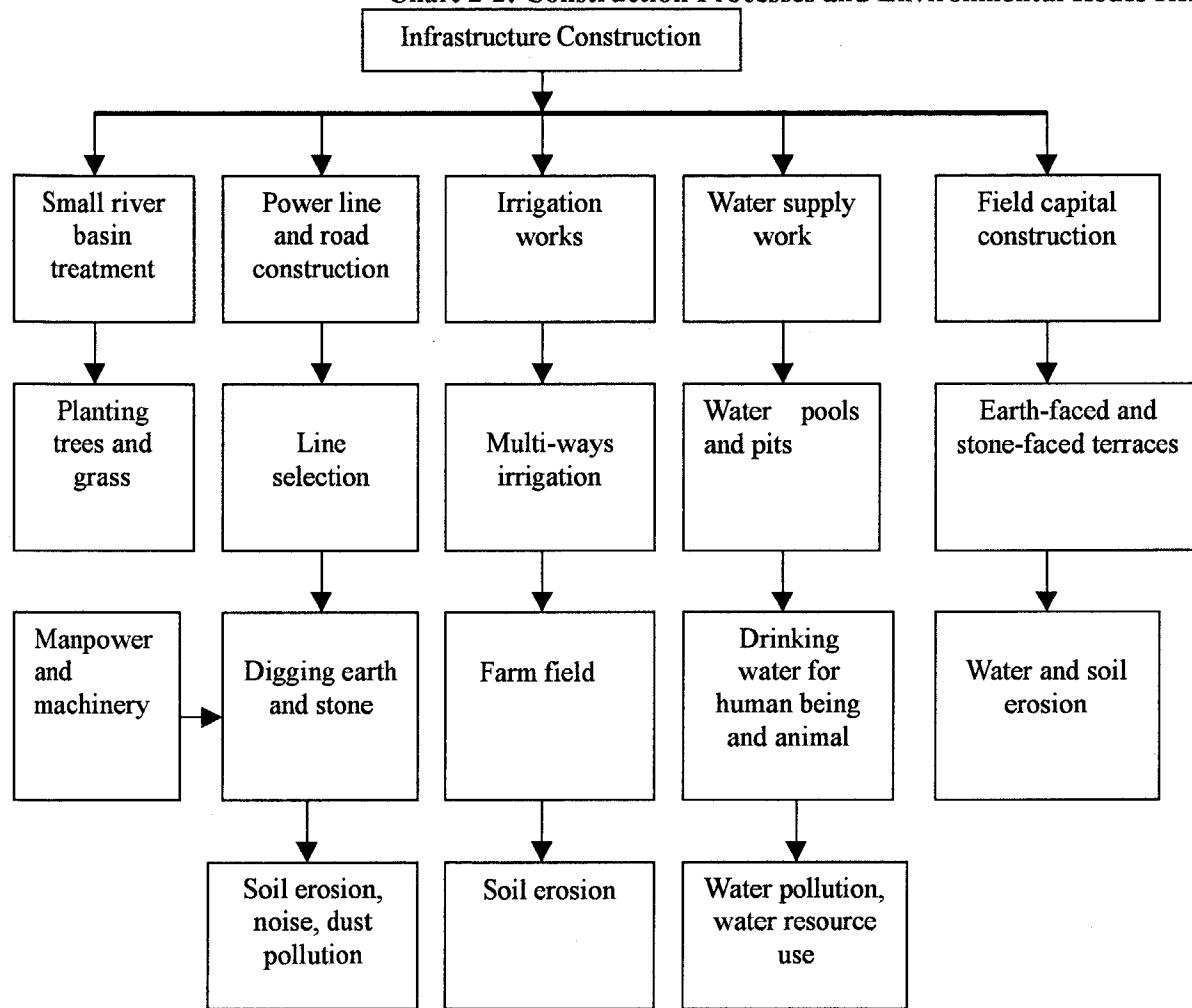


Table 2-5 Screening of the Environmental Issues

Items	Environmental elements	Construction phase							Operational phase										
		Crop Production	Animal Husbandry	Economic forest	Rural enterprises	Commerce and trade	Irrigation	Terrace land development	Infrastructure	Basin mitigation	Crop Production	Animal Husbandry	Economic forest	Rural enterprises	Commerce and trade	Irrigation	Terrace land development	Infrastructure	Basin mitigation
Natural ecology	Vegetation					-1	-1	-2	+3	-1	+3							+3	
	Water erosion	-2	-1	+1	-1	-2	-2	+2		+2				+3			+3		
	Water resource									-1				-1			+2		
	Wildlife						-1										-1	+3	
	Biodiversity																-1	+3	
	Nature reserve	-1				-1			+1								+2		
	Soil fertility	-1				-3		-1	+1	+3							+3		+2
	Crops					-1				+3				+3	+2			+2	
	Forest							-1			+3							+3	
	Planting grass							-1	+1						+1				
Agricultural quality	Grassland-loading capacity					-1		-1	+2	-1	+1						+1		+1
	Soil pollution							-1			-1								
	Drinking water quality						-1			-1								+2	
	Farmland landscape	-1				-1		-1	+1		+2	-1		+2	+3			+2	
	Noise			-1	-1		-2					-1					-1		
	Three wastes pollution			-1								-2							
	Agricultural production					-1			+3	+2	+2	-2	+2	+2	+3	+2	+1		
Society and economy	Land utilization			-1	-1			-2		+2		+2	+1	+1	+3	+3	-2	+1	
	Living quality								+2	+2	+1	+1	+1				+3		
	Labor export													+1				+1	
	Population quality								+1	+1	+1	+1	+1					+2	
	Social stability						+1												
	Public health						-1					-1							
	Infrastructure						-1										+2		

Note: “blank” no impact; “1” light impact; “2” middle impact; “3” great impact; “+” positive impact;
“-” negative impact

3. ENVIRONMENTAL CONDITION IN THE PROJECT AREA

3.1 Natural Environment

The project area is located at $32^{\circ} 35' - 35^{\circ} 00'$ N and $103^{\circ} 41' - 106^{\circ} 15'$ E. It is adjacent to Shanxi to the east, Sichuan to the south, and Gannan, Dingxi and Pingliang prefectures to the north and west. In Longnan Prefecture it includes the counties of Wudu, Tanchang, Lixian, Xihe, Wenxian, Kangxian; in Tianshui Prefecture the counties of Zhangjiachuan, Wushan, Qingshui, Gangu, Qing'an; and in Dingxi Prefecture, Minxian County.

The elevation of Longnan Prefecture's 6 counties and Minxian varies from 550m in the west to 4187m in the north. With mountains, valleys and deep gullies crisscrossing it, the area has an obvious vertically varied climate. The five counties of Tianshui Prefecture are distributed over loess hills. These consist of ridges and gullies, with uneven surfaces, sparse vegetation, poor and variable soils. The main distribution of soils in the project area is presented on map 3-1. The climate changes from sub-tropical humid in the south to temperate humid to desert and semi-desert in the north.

There are 112 rivers, with water resources amounting to 20.999 billion m³, of which 6.405 billion m³ is utilizable. The utilizable water energy amounts to 2.811 million kw.

Drought is the main natural disaster which regularly affects agricultural production. In severe drought conditions farmers may harvest nothing from their land. Frost, hail, plant diseases, insect pests and mud flows are also very severe problems. Details of the natural environmental conditions in the project counties are shown in Table 3-1.

In 12 project counties, there are white water river nature reserve areas and hill top nature reserve areas, which lie in Wenxian and Wudu. According to data from management sectors of two nature reserve areas and on-the-spot investigation, both nature reserve areas are not within the implementation areas of the project (please see Map 3-2 for details). To avoid affecting nature reserve areas in the construction and operational phase of the project, Management Methods for Forest and Wild Animal Nature Reserve Areas article 2, 4, 10, 11, 14 ratified by at state council on June 2, 1985 and put into force by ministry of forest on July 6, 1985, and Wild Animal Protection Law of People's Republic of China article 8, 9, should be strictly abided by.

3.2 Ecological Environment

3.2.1 Present land utilization condition

The total land of the project area is 1,448,690 ha, or 0.91 ha per capita. Of this there is:

- 207,627 ha, or 0.13 ha per head of arable land;
- 10,834 ha, or 0.068 ha per capita of orchard;
- 406,625 ha of land suitable for tree plantation (of which, treed land amounts to 223,861ha, or 0.14 ha per capita, giving a forest coverage rate of 15.45%);
- 494,510 ha of grassland (of which, 392,419ha, or 0.25 ha per capita the utilizable);
- 2,884,2.67 ha of water surface (of which 13,732 ha, 0.009 ha per capita can be utilized); and
- 2,271,43.6 ha of wasteland (of which, 202,605 ha, 0.13 ha per capita may be utilized).

The further utilization potential of the land resource is very large. The present land utilization conditions are shown on map 3-3.

3.2.2 Water and soil erosion

Some 12.73% of the total land area amounting to 1844 km² is subject to water erosion with an annual soil loss of 6,532,800 t. The annual N, P, K losses (from natural sources, excluding the farmers' applications) amount to 7,800 t, 21,400 t and 156,700 t respectively. Please see Table 3-2 for present water and soil erosion conditions of the counties.

Table 3-1:Natural Environmental Conditions in the Project Area

Project counties	Topography	River system in river basin	Climate	Meteorological phenomena	Main soils
Minxian	Mountain, hill and valley. Elevation: 2314.6m Metamorphic rock	Huanghe river basin Taohe river system	Temperate zone, semi-humid to high cold humid zone	Annual average temperature: 5.7° Annual rainfall: 588.2 mm No frost period: 163 days	Black mature soil, black soil, burgundy, brown earth
Tanchang	Mountain,hill and valley Elevation: 1403.8m Metamorphic rock	Changjiang river basin Bailongjiang and Minshui river systems	Temperate zone, semi-humid to high cold humid	Annual average temperature: 8.9° Annual rainfall: 630.3mm No frost period: 160 days	brown earth, black soil, black earth, hilly meadow soil
Lixian	Loess mound, earth and stone slopes and plain of river and valley Elevation: 1403.8m Loess	Changjiang river basin Jialingjiang and Xihan river systems	Temperate continental monsoon climate zone	Annual average temperature: 9.9° Annual rainfall: 488.3mm No frost period: 180 days	hilly brown earth, hilly brown forest soil, hilly steppe soil, hilly meadow soil
Zhangchuan	Loess mound, mountain and gully, earth and stone mountain and plain of valley Elevation: 1866.7 m Loess, sedimentary rock	Huanghe river basin Weihe and Guanchuanhe river systems	Temperate semi-humid climate	Annual average temperature: 7.0° Annual rainfall: 606.5 mm No frost period: 143 days	black mature soil, brown earth, loess soil, brown forest soil
Qingshui	Loess mound earth and stone mountain, river valley lands. Elevation: 1377.9 m Loess	Huanghe river basin Weihe and Niutouhe river systems	Temperate semi-humid climate	Annual average temperature: 8.8° Annual rainfall: 574.9 mm No frost period: 138 days	brown earth, black mature soil, loess soil
Xihe	Loess mound and gully area, earth and stone slopes and valley. Elevation: 1576.8 m Loess, sedimentary rock	Changjiang river basin Jialingjiang and Xihan river systems	Mid-temperate and temperate (some cold) area, edge area of warm temperate	Annual average temperature: 8.46° Annual rainfall: 533.8mm No frost period: 185 days	brown earth, hilly brown forest soil, red clay soil, moisture soil
Wenxian	Earth and stone gully area Elevation:1014.3 m Metamorphic rock	Changjiang river basin Bailongjiang and Minshui river systems	Transit area from north sub-tropics to warm temperate	Annual average temperature:14.9° Annual rainfall:442.7mm No frost period: 262 days	brown forest soil, brown earth

Project counties	Topography	River system in river basin	Climate	Meteorological phenomena	Main soils
Kangxian	Earth and stone mountain, middle low slopes and basin Elevation: 1220.3 m Sedimentary rock	Changjiang river basin Jialingjiang and Puzihe river systems	Transit area from sub-tropics to north warm temperate	Annual average temperature: 10.9° Annual rainfall: 807.5mm No frost period: 207 days	brown earth, brown forest soil, hilly meadow soil
Wudu	Earth and stone mountain, middle low slopes and basin, stone quality mountainous area Elevation: 1079.7 m Sedimentary rock and metamorphic rock	Changjiang river basin Jialingjiang and Bailongjiang river systems	North sub-tropics, warm temperate, humid cold, transition to temperate and cold	Annual average temperature: 14.5° Annual rainfall: 474.6mm No frost period: 210 days	hilly brown earth, hilly meadow soil
Qinan	Mound, gully area of loess plateau Elevation: 1222.5 m Loess	Huanghe river basin Weihe and Huluhe river systems	Warm temperate semi-humid area	Annual average temperature: 10.4° Annual rainfall: 507.3 mm No frost period: 149 days	loess soil, black mature soil, brown earth
Gangu	Mound, gully area of loess plateau Elevation: 1271.4 m Loess	Huanghe river basin Weihe river system	Warm temperate semi-humid area	Annual average temperature: 10.2° Annual rainfall: 473.1 mm No frost period: 153 days	loess soil, black mature soil, brown earth
Wushan	Loess hills, gullies, earth and stone hill land, and river valley area Elevation: 1495.0 m Loess	Huanghe river basin Weihe and bangshahe river systems	Temperate and semi-humid zone	Annual average temperature: 9.6° Annual rainfall: 480.7 mm No frost period: 156days	brown earth, loess soil, black mature soil, red clay, meadow soil.

Table3-2: Water and Soil Erosion Condition in the Project Area

Counties	Total area (km ²)	Water erosion area (km ²)	Percent (%)	Erosion module (t/km ² .y)	Erosion amount (10 ⁴ t/y)	Nutrient losses (10 ⁴ t/y)		
						N	P	K
Wenxian	1909	52	2.7	4821	25	0.03	0.08	0.62
Kangxian	7754	120	6.8	6527	78	0.09	0.26	1.96
Xihe	938	702	74.8	2347	165	0.20	0.54	4.11
Wudu	234	171	73.1	6670	114	0.14	0.37	2.84
Lixian	1917	156	9.1	5258	82	0.10	0.27	2.04
Tanchang	1103	129	11.7	1843	24	0.03	0.08	0.59
Gangu	814	92	11.3	3975	37	0.04	0.12	0.91
Wushan	606	79	13.1	3978	32	0.04	0.10	0.79
Qin'an	388	42	10.8	8523	36	0.04	0.12	0.89
Zhangchuan	385	102	26.4	4057	41	0.05	0.13	1.03
Qinshui	471	22	4.7	5026	11	0.01	0.04	0.28
Minxian	2043	177	8.7	52	9	0.01	0.03	0.23
Total	14487	1844	12.7		653	0.78	2.14	15.67

3.2.3 Insecticide

Insecticides are universally applied to prevent plant diseases and insect pest damage and to guarantee high production. The amount of insecticide used annually is 309 t, or 1.36 kg per ha. The general usage and compounds applied in the project area are shown in Table 3-3.

Table3-3: Standard Insecticides Used in the Project Area

Crops		Compound	Toxicity	Amount (g/mu)	methods	Safe intervening period	times
Grain crops	Plastic film-covered corn	Dipterex	□	100	Spraying		2
	Plastic film-covered wheat	Rogor	□	100	Spraying	7-14 days	2
		Fenxiuning	□	67	Spraying		5
	High-production potato	DDVP	□	250	Spraying	6 days	
Economic forest		Fumeisheng	□	50	Spraying		
		Phoxim	□	100	Spraying	10 days	6
		Chlorothaloinil	□	110-400	Spraying	4 days	
Cash crops		DDVP	□	100	Spraying		5
		phoxim	□	150	Spraying	10 days	3
		Sanmate	□	100	Spraying		2

The direct effect of fertilizer on the soil eco-system is to improve soil fertility by increasing the amount of readily available nutrients in soil. Commonly applied application per ha rates for corn with plastic mulch include: 30 t good-quality manure, 225 kg urea and 150 kg lime. Those for spring wheat using a plastic mulch are: 30 t good-quality manure, 375 kg urea, 450 kg phosphate fertilizer and 195 kg ammonium phosphate. For high yielding potatoes the per ha application rates are: 22.5 t good quality manure, 300 kg urea and 200 kg ordinary lime. Typical application rates for all crops are provided in Table 3-4.

Table 3-4: Some Typical Fertilizer Application Rates in the Project Area

crops		kinds	Amount (kg/mu)	Production in no fertilizer area (kg/mu)	Production in fertilizer area (kg/mu)	Increased by (%)	
Grain crops	Wheat	N fertilizer	10-20	93-111	142-240	26-158	
		P fertilizer	30				
		Organic fertilizer	3000				
	Corn	N fertilizer	18-23	160-172	251-380	45-138	
		P fertilizer	40				
		Organic fertilizer	2000				
	potato	N fertilizer	10-16	202-215	750-1467	249-626	
		P fertilizer	40				
		Organic fertilizer	2700				
Economic forest		N fertilizer	7-25	1510-1605	1800-2500	12-65.5	
		P fertilizer	26				
		Organic fertilizer	2000				
Cash crops		N fertilizer	4-20	85-92	130-200	41-135	
		P fertilizer	5				
		Organic fertilizer	1500-3000				

3.2.4 Biological resources

The diversified climate supports abundant plant and animal resources. But because of long periods of mis-use and over-use, the area of natural vegetation has been becoming smaller and the habitat of the wild animals has been destroyed and disturbed. At the present time, there are not many wild and rare animals and plants in the nature reserve area. Birds are distributed widely in the nature reserve areas. The animals take on an obviously vertical distribution, with small beasts only in the eastern area of low elevation and main protected large animals occur in the medium and high elevation areas. These are summarized in Tables 3-5 and 3-6. Most natural plant and animal populations have been highly degraded as a result of human populations over the past centuries. Only vestigial populations of many species now remain in the project area.

Table 3-5: Main Plant Resources in the Project Area

Resource	Common Name	Specific Name	Protection grade
Dominant forest species	Larch	<i>Larix principis-ruprechtii mayr</i>	Common
	China armand pine	<i>Pinus armandii Franch</i>	Common
	Chinese pine	<i>Picea asperata Mast</i>	Common
	Dragon spruce	<i>Pinus tabulaeformis Carr</i>	Common
	Linden	<i>Tilia tnan szysz</i>	Common
	Pagoda tree	<i>Sophora japonica L</i>	Common
	Mahogany	<i>Ailanthus altissima swingle</i>	Common
	Sallow thorn	<i>Hippoplae rhinoides L</i>	Common
	Ginkgo	<i>Ginkgo L</i>	Rare, national second
Medicinal Plants	Dangshen	<i>Codonopsis pilosula (Frich.) Nannf</i>	Common
	Angelica	<i>Angelica sinesis (olive) Diels</i>	Provincial common
	Astragalus root	<i>Astragalus membranaceus(Fisch) Bunge</i>	Common
	Hongqi	<i>Hedysarum Dolybotrys Hand.—Mazz</i>	Common
	The rhizome of Chinese goldthread	<i>Coptis chinensis Franch</i>	Common
	The bark of encommia	<i>Eucommia ulmoides oliver</i>	National first
	Rhizoma gastrodiae	<i>Gastrodia elata Blume</i>	National first
	The buld of fritillary	<i>Lilium broa nill, FE Brown exmic</i>	Common
	Rmbpu	<i>Magnolia officinalis Rehd. et wils</i>	Common
	The tuber of pinellia	<i>Pinellia ternata (Thunb.) Breit</i>	Common
	Chinese thorowax	<i>Bupleurum terebinthaceum Fisch</i>	Common
	Monkshood	<i>Aconitum carmichaeli Debx</i>	Common
Natural grassland species	Fennel	<i>Foeniculum vulgare mill</i>	Common
	Purple alfalfa	<i>Medicago sativa L.</i>	Common
	Wild alfalfa	<i>Medicago falcata L.</i>	Common
	Ci'ercao	<i>Cephalanoplos segetum (Bunge) kitam</i>	Common
	Sweet clover	<i>Melilotus suavedens ledeb</i>	Common
	Dandelion	<i>Taraxacum mongolicum Hand.Mazz</i>	Common
	Kujucai	<i>Sonchus oleraceus L.</i>	Common
	Wild barley	<i>Miscanthus sinensis Anders</i>	Common
	Shadawang	<i>Astragalus adsurgens</i>	Common
	Artemisia	<i>Artemisia subdigitata Mattf</i>	Common
	Yangmao	<i>Festuca ovina L.</i>	Common
	Niuweihao	<i>Artemisia subdigitata Mattf</i>	Common

Table 3-6: Principal Animal Resources in the Project Area

Resource	Common Name	Specific Name	Protection grade
Fish	Black carp	<i>Mylopharyngodon piceus</i>	Common
	Common carp	<i>Cyprinus cyprinus carpio(linnaeus)</i>	Common
	Crucian carp	<i>Carassius auratus auratus(linnaeus)</i>	Common
	Silver carp	<i>Hypophthalmichthys molitrix(uvier et iemes alenc)</i>	Common
	White soft shelled carp	<i>V.(onychostoma)sinus (Sauvage et Dabry)</i>	Common
Amphibians	Wan	<i>Batrachuperus tibetanus schmich</i>	Common
	Toad	<i>Omajor(Liu et Hu)</i>	Common
	Black ridge snake	<i>Ahaelinus spinalis Peters</i>	Common
	Fulianshe	<i>Amphiesma craspedohaster(boulenger)</i>	Common
	Wushaoshe	<i>Zaocys dhumnsdes(cantor)</i>	Common
Birds	Chukar	<i>Alectoris grisea(cantor)</i>	Common
	Jiji	<i>Chrysolophus pictus</i>	Common
	Tit	<i>Parus major subtibetanus</i>	Common
	Sparrow	<i>Passer montanus saturatus</i>	Common
	Bramble finch	<i>Fringilla montifringilla</i>	Common
	Orioles	<i>Cronistes dauidiana</i>	Common
	Thrush	<i>Garrulax canorus</i>	Common
Rodents	Rattus fulvescens	<i>Rattus fulvescens</i>	Common
	Goral	<i>Naemorhedus goral</i>	Common
	Bat	<i>Vespertilio murinus</i>	Common
	Yanshu	<i>Myospalax fontanieri</i>	Common
	Rock squirrel	<i>Sciurus davidi</i>	Common
Large Mammals	Wild boar	<i>Sus scrofa</i>	Common
	Sand badger	<i>Arctonyx collaris</i>	Common
	Hare	<i>Lepus capensis</i>	Common
	Yellow weasel	<i>Mustela sibirica</i>	Common
	Bear	<i>Ursus thibetanus</i>	Common
	Wolf	<i>Canis lupus</i>	National second
	Jackal	<i>Cuon alpinus</i>	National second
	Hedgehog	<i>Erinaceus europaeus</i>	Common
	Macaque	<i>Macaca mulatta</i>	National second
	Black bear	<i>Ursus thibetanus</i>	National second
	Ferret badger	<i>Melogale moschata</i>	Common
	Red fox	<i>Vulpes vulpes</i>	Common

3.3. Social Environment

3.3.1 Population and Labor Force

The 12 counties in the project area contain 185 townships, 2,234 administrative villages and a total of 929,600 people in 197,087 households. Of these 1,523,393 are employed in agriculture (33.3% total population; 34.77% of the total households; and 35.4% total agriculture population in the project counties respectively). The rural

labor forces consists of 805,438 people making up 52.87% of total agriculture population. Data from 1996, suggest that besides the labor force used for production, there was a surplus of 33.63%, which could provide enough labor forces for project construction.

3.3.2 Agriculture

The grain production in 1997 was 257,067 tons, providing approximately 169 KG of grain for each person. There were 937,184 peasants whose net income was less than 550 Rmb, who constitute 61.52% of the total agricultural population. In 1997, 76,251 tons of grain was imported. There were 419,493 live pigs on hand and 32,263 which were marketed. There were also 346,107 cattle and 241,163 sheep which produced a combined total of 25,990 tons of pork, beef, mutton and chicken.

3.3.3 Industry

Industry in project area consists basically of rural enterprises in the mining, agricultural products and by-products processing industry, fruits processing and service sectors. In 1997, the output value of township and countryside industry was 24,361,550 Rmb, for an average of 16 Rmb per person. Largely as a result of poor infrastructure and high transportation costs the scale of industrial enterprises is generally small and their economic benefits are low.

3.3.4 Transportation

There are 1,327 villages in project with road access. This constitutes 60.4% of the project villages, 44% of the administrative villages in project townships and 26% of the administrative villages in project counties. The poor transportation system is a key factor to restricting local economic development.

3.3.5 Power and irrigation

There are 1616 villages in project area that have electricity. This constitutes 74% of the project villages, 54% of the administrative villages in project townships and 32% of the administrative villages in project counties. The annual electricity usage in the countryside of the project area, is 26,393,397 kwh. This represents 49% of the electricity used by the project townships, and 23% of the project counties. The effective irrigation area is 10,896ha.

3.3.6 Science, education and health

There are 19,658 agricultural scientific and technical staff in the 12 counties that would provide services for the project area. This represents only 0.23/1000 people, which seriously restricts the possible adoption rate for new technologies.

There are now 2,241 schools in the project area, representing 39.39% of the schools in the project counties. The 10,970 students are studying in these schools, represent 29% of the students in the project counties; The enrollment rate for school aged children is 85.8%, representing 90% in the project counties; 69.4% of students finish school, representing 86% of the project counties. The education standard in project area is mostly very backward.

There are 141 hospitals, 1,975 special medical staff and 554 sick-beds in project townships, representing 2.1% of all kinds of health units, 19.12% of the special medical staff and 11.21% of the sick-beds in the 12 project counties. The conditions of contagious disease control, general health care and medical treatment is poor.

4. ASSESSMENT OF ENVIRONMENTAL IMPACTS

4.1 Assessment of Environmental Impact of Crop Production Projects

4.1.1 The Impact of Improved Crop Management on Water and Soil Erosion

Most of cropland is located in the hills where water and wind erosion can easily happen during the construction. When the project is completed, thanks to the technological investment, the scientifically managed planting area will be expanded by 10,286 ha, and the economic forest area enlarged by 15,429ha. It is estimated that this will prevent the loss of some 5,270,300 t of soil, equivalent to preventing the loss of 6,180 t N, 16,800 t P and 128,510 t K of naturally occurring soil nutrients.

4.1.2 Impact of Planting on Land Utilization Structure

- The economic forest area per head will increase from 0.453 mu to 0.630 mu.
- The areas planted to crops, grass, trees -planting area will increase by 57,239 ha, 23,465 ha and 18,571 ha respectively.
- The land utilization rate will increase from 59.79% to 65.23%.

The change in land utilization structure, represents a 3% increase in overall vegetation coverage. This will improve the project area's capacity for protection against high winds, drought and intense rainstorms. It will reduce water and soil erosion and improve the soil's capacity for retaining moisture and fertility. Meanwhile, it will make the project area's land utilization structure more rational so that it is conducive to the coordinating development of the economy, society and environment and to the realization of the sustainable development.

4.1.3 Impact of planting on soil fertility

The application of too much fertilizer may destroy the soil's structure, but will also contribute to groundwater pollution and create financial risk for the farmers. The expanded animal husbandry initiatives may contribute to the reduction of chemical fertilizer demand and will add organic matter to the soil. The addition of manure may improve the tilth of poor soils will be improved, and the soil ecosystem and contribute to more sustainable farming systems.

4.1.4 Impact of Plastic Film on the Environment

The use of plastic films can maintain warmer soil temperatures, reduce water evaporation and increase water utilization. The plastic films also promote the decomposition of soil organic matter. In this manner plastic films increase the utilization of readily available nutrients, improve soil physical and chemical characteristics, reduce soil hardness and prevent weeds from growing. However, if the plastic film is not removed in time, the residue will affect the crops' roots and the ability of the soil to pass water and air. This is known as white pollution. So, measures for removing and disposing of plastic films are included in the project to prevent this form of pollution.

4.1.5 Impact of insecticide on environment

According to research data, 10%-20% of total applied insecticide effects the target pests, 20%-30% of the rest enters the air and 50%-60% remains in soil. So, the application of insecticide can cause atmospheric, soil and water pollution and related health problems. By the end of the project insecticide use might increase by 120%, from 1.36 kg to 3.0 kg. This may cause some additional atmospheric, soil and water pollution if appropriate measures are not taken to ensure that usage levels are reduced by the application of integrated pest management procedures and other pesticide reducing technologies.

4.2 Assessment of Environmental Impacts of Animal Husbandry Projects

The impacts of animal husbandry on the natural grassland are mainly caused by cattle and sheep. To ensure that enough forage will be available for cattle and sheep, 1.25 mu of grassland will be seeded for each sheep and 2 mu of plastic mulched corn and 2 mu of plastic mulched wheat will be added for each cow. The total utilizable dry forage grass of the livestock will be 1,523,000 t/year. If every sheep unit needs 420 dry forage grass a year, the presently existing and newly increased 2760 thousand sheep units will consume 1159 kt a year and 364 kt will remain. The remainder will be consumed by the existing cattle and sheep. By these measures, the pressure of cattle and sheep on natural grassland will be reduced. As a result, the animal husbandry project is unlikely to do any harm to the natural grassland. The project will, however, promote comprehensive use of straw and the development of a straw based industry.

4.2.5 Impact of animal husbandry project on environmental sanitation

Presently, the project area has no large-scale production bases. Animals are mainly shed-produced. According to the on-the-spot investigation, in the project area, there have been no recorded occurrence of the transmission of diseases between human beings and animals. There is little or no pollution problem with the excrement and urine of extensively grazing cattle and sheep. Pig manure is more of a problem with 2.3-9.1 g ammonia and nitrogen per kg of fresh excrement and urine. In general the distance between pig sheds and living areas is more than 50 m, so that ammonia and nitrogen will have no effect on human beings. Strict guidelines are established for shed structure, living distance, animal health, and disposal and control of excrement and urine. If these are completely carried out, the project will not produce obvious environmental sanitation issues.

4.3 Assessment of Environmental Impacts of Rural Enterprise Projects

These will mainly be established as small scale family mills. They will be scattered through the project areas and may produce small amounts of the "three wastes" with simple ingredients. The main waste of the used plastic processing plants is waste water, which is caused by washing dirty plastic and which contains suspend material which is mostly soil. The discharge amount is 7 t a day. The olive processing plants will discharge some solid wastes along with 4 t of organic wastewater with suspended material per day.. The tea processing plants will only discharge a small amount of coal ash and waste gas from the baking and drying processes. The vegetable oil extraction plants, prickly ash and willow braiding processing plants are widely scattered, producing little noise, ash, dust and solid wastes. After being properly dealt with, most of the can be used. So, both in construction and operational phases, the rural enterprises will not significantly contaminate the surrounding areas. Meanwhile, with small investment, quick benefit, high revenues and short debt-returning time, these enterprises will have positive economic benefits.

4.4 Assessment of Environmental Impact of Infrastructure Project

The main environmental issues associated with infrastructure construction are the following:

- 4.4.1 The implementation of terraced land development projects will reduce water, soil and nutrient losses in the project area.
- 4.4.2 The implementation of water-supply projects will relieve the present lack of drinking water for human beings and animals. If the water-collection area is badly managed it may pollute the water. The polluted water can do harm to people and animals.
- 4.4.3 The construction of rural roads and electric lines will occupy arable land, which can make losses to some farmers, if not properly dealt with.

4.4.4 In the construction phase, all projects might result in short-term water and soil erosion in the principal areas of activity area. These may block adjacent streams and cause some vegetation to be destroyed.

4.5 Assessment of Environmental Impacts of Irrigation Projects

4.5.1 Positive impacts

- (1) The irrigation area will be expanded (in the project area in Tianshui prefecture, the irrigation area will reach 0.133 ha/household, in Longnan, it will be above 0.04 ha/capita), and the water resource will be fully utilized.
- (2) The drought disaster will be efficiently relieved and drought-affected area will reduce.
- (3) The crop production will be greatly increased and agricultural population can dress warmly and eat their fill.

4.5.2 Potential negative impact

- (1) If not being properly dealt with during the construction phase, the earth and stone caused by excavation may cause water and soil erosion, which can block the rivers, pollute water and produce mud-stone flow during intense rainstorms.
- (2) If the irrigation water quality does not reach the required standards, soil, crops and fruits may be polluted.
- (3) The poor irrigation methods may cause ground water levels to rise, causing secondary salinization. This is not expect to happen in this project area.

5. ENVIRONMENTAL MITIGATION AND MANAGEMENT PLANS

5.1 Organizations Responsible for Environmental Management and Monitoring

Under the direct guidance of leading group of the World Bank poverty reduction project of Gansu province, in coordination with provincial environmental protection Bureau and other relevant Bureaus, the World Bank project offices at prefecture, county and township levels are responsible for daily management and monitoring work. Please see chart 5-1 for the organization network of environmental monitoring and management.

5.2 Environmental Mitigation and Management Plans

The environmental mitigation and monitoring plans have been prepared on the basis of a full analyses of the project's features, possible environmental issues in the construction and operational phases and the present environmental condition of the project area. They conform to the principle of doing the best to avoid and relieve negative impacts of the project. The mitigation measures can be easily carried out, and the duties with respect to these are clear and of moderate cost. The monitoring responsibilities are very clear so that it is convenient for the management units to supervise these.

5.2.1 Environmental Mitigation and Management Plan for the Cropping Projects

The cropping project contains three sub-projects of grain crops, cash crops and economic forest. The possible environment issues mainly are water, soil and fertility losses, insecticide pollution and plastic film pollution. The environmental mitigation and management plan is prepared specifically terms of these issues. See Tables 5-1, 5-2, 5-3.

5.2.2 Environmental Mitigation and Management Plan for the Animal Husbandry Projects

The animal husbandry project contains such sub-projects as pig breeding, sheep breeding, cattle breeding, aquaculture and grass planting. The possible environmental issues are grassland degradation, environmental sanitation of sheds and excess nutrients in fishponds. In terms of these issues, the environmental mitigation and management plan has been prepared. See Table 5-4.

5.2.3 Environmental Mitigation and Management Plan for the Rural Enterprise Projects

The rural enterprise project contains such sub-subjects as industrial enterprises, processing and service industry, commerce and trade, rural market and breeding farms. The possible environmental issues are wastewater, waste gas, waste residues, noise pollution, and sanitation of sheds of cattle, sheep and pig, disposal of excrement and urine. The management mitigation and monitoring plans have been prepared with these issues in mind. It is not expected that all these projects will be developed in the manner shown and it is possible that rural enterprises other than those shown here will be presented. Each enterprise will therefore be assessed individually as it is presented for project financing. Please see Table 5-5 to 5-9.

5.2.4 Environmental Mitigation and Management Plan for the Infrastructure Projects

The infrastructure project contains such sub-projects as development of terraced farmland, rural water supply, and rural electricity-supply, rural roads and catchment reclamation. The possible environmental issues are water and soil erosion, nutrient losses, drinking water quality, requisitioned arable land and noise. The environmental mitigation and management plan has been prepared with these issues in mind. Please see Tables 5-10 to 5-13.

5.2.5 Environmental Mitigation and Management Plan for the Irrigation Projects

The irrigation project contains included small-well irrigation, sprinkling irrigation, canal irrigation, rain-collecting and supplementary irrigation, electrically pumped irrigation and floodplain reclamation to create farmland. The possible environmental issues are soil erosion, silt-choked river, water pollution and potential soil salinization. The environmental mitigation and management plans have been prepared in terms of three issues. Please see Tables 5-14, 5-15.

5.2.6 The Cost of Environmental Mitigation and Monitoring

The cost of environmental mitigation, which is included in the construction costs, is 1,440,920 Rmb. The cost of environmental monitoring is 400,000 Rmb. Please see Table 5-16.

Chart 5-1: Network of Monitoring and Management Organizations in the Project Area

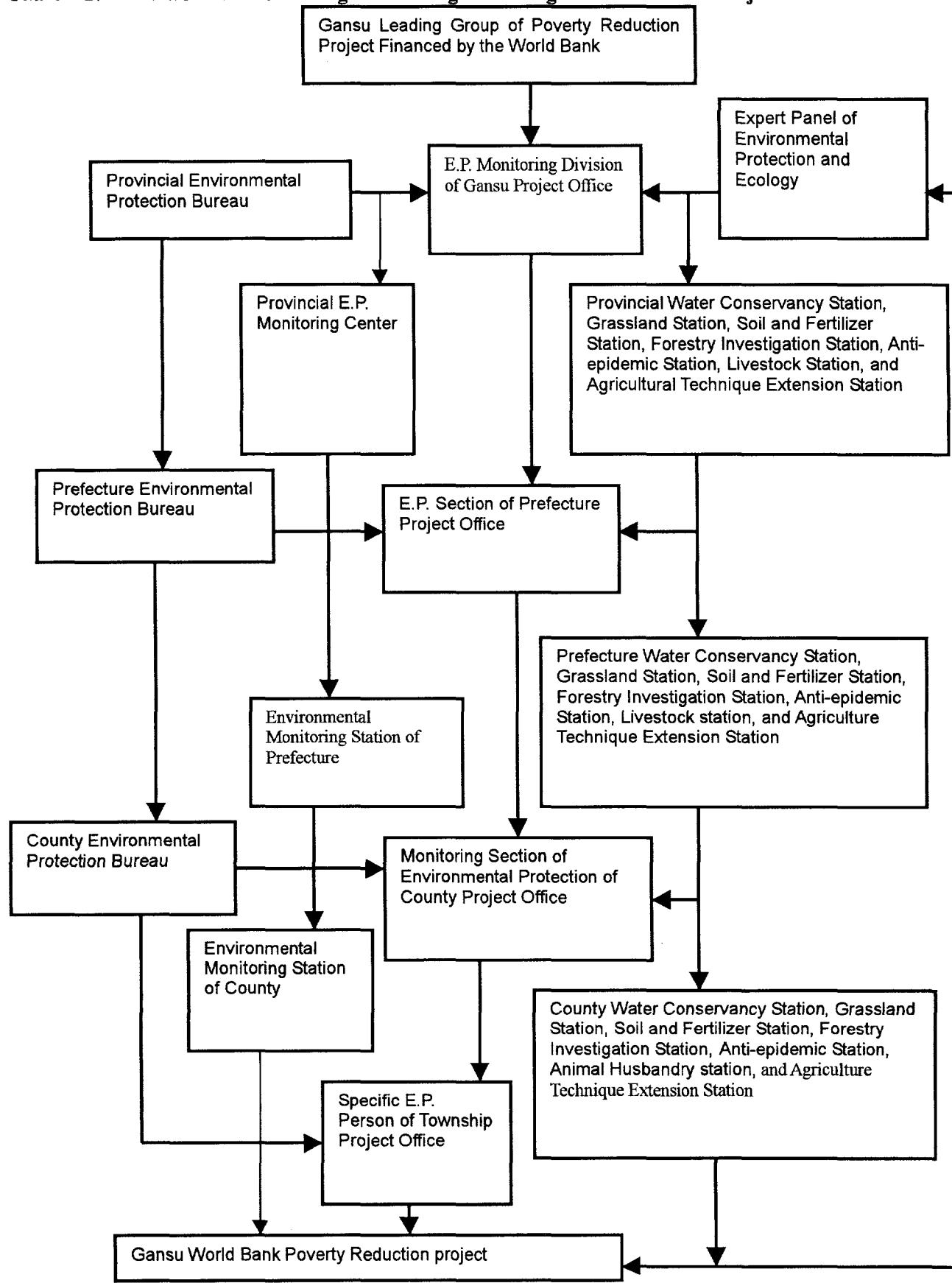


Table 5-16: Environmental Mitigation and Monitoring Cost of the Project

Project	Mitigation cost		Monitoring cost	
	Cost* (Rmb)	note	Cost (Rmb)	note
Crops			33,120	
Households breeding	457,116	Included in livestock component		Arranged in institution and project management cost
Rural enterprises	856,894	Arranged in construction content	199,800	
Infrastructure	126,920		294,000	
Total	1,440,930		400,000	

* The cost refers to the total cost in the construction phase, the cost will be arranged by Gansu project office. To avoid increasing construction fund of the project, the cost in the six years' construction phase is calculated. Afterwards, the cost will be involved among the routine environmental costs.

Table 5-1: Environmental Mitigation and Management Plans in the Project Area—Crops

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Plastic mulch grain (corn, wheat, potato)				<ul style="list-style-type: none"> Increase in the pollution area of the plastic film Pollution of agricultural chemistry (including insecticide and fertilizer) Water and soil erosion caused by cultivation 	<ul style="list-style-type: none"> To collect the old plastic film To use high efficient and low residue insecticide and protect natural enemies of pests. To reduce fertilizer ($N < 4\text{kg}/\mu\text{m}$, $P_2O_5 < 4\text{kg}/\mu\text{m}$) To advocate reduced-tillage and no-tillage 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Items: monitor remaining plastic film and insecticide residue Frequency: 2 counties/year (3 sites/county) Unit: corresponding sectors 	<p>Mitigation cost: included among the construction cost Monitoring cost: 720 Rmb/year</p>
Wheat and corn interplanting				Pollution of agricultural chemistry (including insecticide and fertilizer)	<ul style="list-style-type: none"> To control fertilizer ($N \leq 6\text{kg}/\mu\text{m}$, $P_2O_5 \leq 6\text{kg}/\mu\text{m}$) and add manure ($\geq 2.5 \text{t}/\mu\text{m}$) To control insecticide, and protect natural enemies To use pest/disease resistant seeds 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Item: remaining insecticide in soil Frequency: 2 counties/year (3 sites/county) Unit: corresponding sectors 	<p>Mitigation cost: included among the construction cost Monitoring cost: 360 Rmb/year</p>
Broad bean				Insecticide pollution	<ul style="list-style-type: none"> To use highly efficient and low residue insecticide and protect natural enemies To increase P fertilizer and control N fertilizer, $N: P_2O_5 = 1:2$ To use pest/disease resistant seeds 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Items: remaining insecticide in soil Frequency: 2 counties/year (3 sites/county) Unit: Corresponding sectors 	<p>Mitigation cost: included among the construction cost Monitoring cost: 360 Rmb/year</p>

Table 5-2: Environmental Mitigation and Management Plans in the Project Area—Crops

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Plastic mulch crops				<ul style="list-style-type: none"> • Waste plastic film pollution • Soil pollution caused by over-fertilizer • Vegetable pollution caused by excess insecticide use 	<ul style="list-style-type: none"> • To collect waste plastic film • To control fertilizer and add manure • To control insecticide amount and applying times, intervening period\geq20 days 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Items: remaining plastic film and insecticide • Frequency: 2 counties/year (3 sites/county) • Unit: corresponding sectors 	Mitigation cost: included among the construction cost Monitoring cost: 720 Rmb/year
Hemp				<ul style="list-style-type: none"> • Soil pollution caused by over-fertilization 	<ul style="list-style-type: none"> • To control fertilizer ($N\leq 5\text{kg}/\mu\text{m}$, $P_2O_5 \leq 5\text{kg}/\mu\text{m}$) and add manure • To guide farmers to use K fertilizer 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Items: N, P, K and the organic in soil • Frequency: 2 counties/year (3 sites/county) • Unit: corresponding sectors 	Mitigation cost: included among the construction cost Monitoring cost: 8400Rmb/year
Medicinal Plants	Vegetation destroyed, increased soil erosion, soil nutrient losses	<ul style="list-style-type: none"> • To build drainage ditches in the planting hills • To cover with straw in time • To protect vegetation around the planting area and prevent over-cultivation 	House-holds them selves	Water, soil and nutrient losses caused by surface water	<ul style="list-style-type: none"> • To plant on contours and prohibit planting down the slopes • To advocate no-tillage 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Items: N, P, K, the organic and sands in rivers • Frequency: 2 counties/year (3 sites/county) • Unit: water conservancy station 	Mitigation cost: included among the construction cost Monitoring cost: 1800 Rmb/year

Table 5-3: Environmental Mitigation and Management Plans in the Project Area—Crops

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Dry fruit (prickly ash, walnut, olive)				Insecticide pollution	<ul style="list-style-type: none"> To control insecticide and protect natural enemies To prohibit applying insecticide within a month when the prickly ash is ripe 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Items: organic P insecticide in the prickly ash Frequency: 1 time/3 years, 2 counties/time in the fruit-bearing period unit: prefecture agricultural science institute 	Mitigation cost: included among the construction cost Monitoring cost: 360 Rmb/year
Fruit (apple, pear)				Fruit contamination caused by insecticide, poisoning the pollinating insects	To prohibit applying highly poisonous insecticide in the blossoming period and within a month when fruits are ripe	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Items: remaining insecticide in apples Frequency: 1 time/3 years, 2 counties/time in the fruit-bearing period unit: prefecture agricultural science institute 	Mitigation cost: included among the construction cost Monitoring cost: 360 Rmb/year
Silk, tea				<ul style="list-style-type: none"> Soil pollution caused by over-fertilizer Product contamination caused by insecticide 	To guide farmers to apply fertilizer scientifically and prohibit applying insecticide to mulberry and tea, and use biological methods to fight pests	offices in counties and townships		
Japanese larch				Insecticide pollution	To reduce insecticide and protect natural enemies	offices in counties and townships		

Table 5-4: Environmental Mitigation and Management Plans in the Project Area

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Household pig-breeding	<ul style="list-style-type: none"> Negative effects on the pigs' development by improper shed sites Land waste caused by improper sheds structure 	<ul style="list-style-type: none"> To build sheds in sites accessible to sun and inaccessible to wind To standardize sheds structure and keep adequate distance between sheds and yards 	Construction unit	<ul style="list-style-type: none"> Transmittable diseases between man and animals Environmental pollution caused by improper treatment of excrement 	<ul style="list-style-type: none"> To prevent epidemic To dispose excrement in methane pits and sterilize sheds with CaCO_3 To advocate to breed pigs in the warm sheds in winter 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Supervision unit: county livestock bureau Prevention unit: township veterinary station Supervision tasks: examining sheds' sanitation and injecting epidemic prevention vaccine regularly 	Mitigation cost: 496,000 Rmb a year
Household cattle-breeding and sheep-breeding	<ul style="list-style-type: none"> Negative effects on the cattle and sheep development caused by improper sheds locations Land waste caused by improper sheds' structure 	<ul style="list-style-type: none"> To build sheds in sites accessible to sun and inaccessible to wind To standardize shed structure 	Construction unit	<ul style="list-style-type: none"> Grassland degradation caused by over-loading Water and soil erosion caused by over-grazing Environmental pollution caused by improper treatment of excrement 	<ul style="list-style-type: none"> To limit livestock amount and be cautious to keep balance between grass and animal To rationally dispose excrement to prevent environmental pollution To prevent epidemic regularly 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Supervision unit: county livestock bureau Supervision tasks: examining sheds' sanitation regularly Prevention tasks: injecting vaccine regularly 	Mitigation cost: 261,900 Rmb a year
Fish-breeding (carp, soft shelled turtle)	Soil erosion	To plant grass and shrub around the fish ponds	Construction unit	Ponds' nutrient richness and water pollution caused by the bad management	<ul style="list-style-type: none"> To change ponds' water regularly To sterilize water regularly 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Monitoring unit: aquatic products bureau Monitoring items: color and offensive smell, suspending articles, PH, Pb, Hg, Cr, Ni, As, floating articles etc. total 33 items (GB11607-89) 	Mitigation cost: 3,960 Rmb a year
Alfalfa	Water and soil erosion in the planting year caused by improper cultivation	To plant at the same height in the slope field and inter-plant in the plain land	households					
Ammonium pits	Water contamination and soil erosion caused by improper disposal of excavated earth and stone	To properly deal with excavation of earth and stone		Negative effects on animals' health by inadequately fermented forage	<ul style="list-style-type: none"> To completely enclose pits To make forage fully fermented 	W.B. project offices in counties and townships	Supervision unit: county livestock bureau	

Table5-5: Environmental Mitigation and Management Plan of Rural Enterprises

Project contents	Technological process	Possible environmental issues	Mitigation measures, cost and effects					Monitoring procedures, responsibilities and cost	
			Measures		Effects	Cost	Responsible unit	Procedures and responsibilities	Cost
			Construction phase	Operational phase					
Tea processing plant	Fresh tea—removing smell of green—rubbing and twisting—drying by baking—final product	Small amount of solid waste and gas	To make the plant area and around beautiful and green	To use solid waste to warm Kang and make fertilizer	The solid waste will be completely collected and reused		W.B. project offices in counties and townships		
Tea processing sites (5)	Fresh tea—rubbing and twisting—drying by baking—selecting—final product	Solid waste	Landscape the area around the production site	To use solid waste to warm Kang and make fertilizer	The solid waste will be completely collected and reused		W.B. project offices in counties and townships		
Willow -braiding sites (22)	Selecting material—soaking—taking off skin—drying---braiding—final product	Waste water with suspend objects	To construct simple waste water disposal pool	To make waste water flow into the pool for the preliminary treatment	The terminal wastewater will reach the GB5084-92 quality standard of irrigation water.	11,000 Rmb	W.B. project offices in counties and townships	The environmental protection monitoring sectors monitor effects of waste water treatment	2,200 Rmb a year
Straw-braiding sites (5)	Selecting material—washing—braiding—final product.	Waste water with suspend objects	To construct simple waste water disposal pool	To make waste water flow into the pool for the preliminary treatment	The terminal wastewater will reach the GB5084-92 quality standard of irrigation water.	6,500 Rmb	W.B. project offices in counties and townships	The environmental protection monitoring sectors monitor effects of waste water treatment	1,300 Rmb a year
Olive processing plant (5)	materials—washing—crashing—pressing—filtrating— final product	Waste water and solid waste	To use good-sealed crushers, construct preliminary disposal pool for waste water and adopt advanced techniques	To carefully maintain and manage crushers and guarantee the waste water disposal facilities to operate normally	The wastewater will fit for the standard of GB8978-96. The solid waste will be used for forage or fertilizer	8,000 Rmb	W.B. project offices in counties and townships	The environmental protection monitoring sectors monitor effects of waste water treatment	2,000 Rmb a year

Table5-6: Environmental Mitigation and Management Plan of Rural Enterprises

Project contents	Technological process	Possible environmental issues	Mitigation measures, cost and effects				Monitoring procedures, responsibilities and cost	
			Measures		Effects	Cost		Procedures and responsibilities
			Construction phase	Operational phase				
Carpet processing sites (41)	Cotton—hanging—weaving—carpet	Small amount of short-fiber dust	To equip with the bags to collect short-fiber	To collect short fiber into bags, with workers in masks.			W.B. project offices in counties and townships	
Used and waste plastic plant	Waste and used plastic—washing—drying---pressing---cutting into pieces—product	Waste water with soik and suspend particles	To construct preliminary waste water disposal pool	To carefully maintain and manage waste water disposal facilities and leach water to meet the standard	The removing rate of suspend objects and BOD will be 80% and 40% respectively, reaching GB5084-88 □standard of irrigation water.	25,000 Rmb	W.B. project offices in counties and townships	Environmental protection monitoring sectors monitor the effects of the wastewater treatment. 4,000 Rmb a year
Animal products processing sites (2)	materials—washing—drying—classifying—final product	Waste water with suspend objects and organic	To construct preliminary waste water disposal pool	To guarantee waste water disposal facilities to operate normally and discharge when it reaches standard	The removing rate of suspend objects and organic will be 70-80% and 40% respectively, reaching GB8978-1996 □standard of irrigation water.	10,000 Rmb, 5,000 Rmb a site	W.B. project offices in counties and townships	Environmental protection monitoring sectors monitor the effects of the wastewater treatment. 3,000 Rmb a year

Table 5-7: Environmental Mitigation and Management Plan of Rural Enterprises

Project contents	Technological process	Possible environmental issues	Mitigation measures, cost and effects					Monitoring procedures, responsibilities and cost	
			Measures		Effects	Cost	Responsible unit	Procedure and responsibilities	Cost
			Construction phase	Operational phase					
Crude forage processing sites (373)	materials—arranging—crushing— forage	noise of machine and dust	To use low-noise machine	To carefully maintain and manage facilities and make them operating normally, with operators in masks	The machine noise will be less than 90 dB, reaching GB12348-90 II standard.	220,500 Rmb	W.B. project offices in counties and townships	Environmental protection sectors monitor effects of controlling dust and noise.	4000 Rmb a year
Grass processing sites	Green grass—drying—crushing—making particles	Noise of machine and dust	To use low-noise machine	To carefully maintain and manage facilities and make them operating normally, with operators in masks	The machine noise will be less than 85 dB, reaching GB12348-90 II standard.	14,000 Rmb	W.B. project offices in counties and townships	Environmental protection sectors monitor effects of controlling dust and noise.	1500 Rmb a year
Oil material processing sites (50)	oil materials—washing—pressing—steaming and roasting—pressing oil—product	Waste water with solid suspend objects	To construct waste water disposal pool	To let waste water flow into disposal pools and then remove the suspend objects	The suspend objects can fit for GB8978-96 II standard (200mg/l)	25,000 Rmb	W.B. project offices in counties and townships	Environmental protection sectors monitor effects of disposing wastewater.	6000 Rmb a year
Fruit cellar (2)	fresh fruits—selecting—packing—storing	Waste water and solid waste	To construct simple waste water disposal pool and solid waste treatment sites	To let wastewater flow into disposal pools for treatment, use damaged fruits as forage and rotten as compost.	The discharged wastewater will reach GB5084-88 II standard of irrigation water and the solid waste will be comprehensively used.	70,000 Rmb	W.B. project offices in counties and townships	Environmental protection sectors monitor effects of disposing wastewater.	6000 Rmb a year
Fruit storage sites									

Table5-8: Environmental Mitigation and Management Plan of Rural Enterprises

Project contents	Technological process	Possible environmental issues	Mitigation measures, cost and effects					Monitoring procedures, responsibilities and cost	
			Measures		Effects	Cost	Responsible unit	Procedures and responsibilities	Cost
			Construction phase	Operational phase					
Medicinal plants processing sites (152)	Materials—managing—drying—selecting—packing	some waste roots	To construct sites for piling waste roots	To clean processing sites in time and put waste roots in piles	The waste roots will be completely collected for making fertilizer or forage	30.4 thousand Rmb	W.B. project offices in counties and townships		
Mountain vegetable processing sites (15)	Mountain vegetable—washing—selecting—drying—product	waste water from washing and the issue of overusing mountain vegetable resources	To construct simple waste water disposal pools and make plan for the development of mountain vegetable	The wastewater will be treated in the disposal pools and the mountain vegetable will be picked as planned.	The removing rate of suspend objects will be 80%, reaching GB5084—92 standard of irrigation water	7.5 thousand Rmb	W.B. project offices in counties and townships	The environmental protection sectors monitor the facilities of waste water treatment and effects	3 thousand Rmb a year
Green prickly ash processing sites (6)	Green prickly ash—selecting—salinized—product	Solid waste and waste water	To construct simple disposal pools for wastewater.	The waste water will be treated and the solid waste can be used for warming Kang or making fertilizer	The removing rate of suspend objects will be 80% and BOD 40%. The solid waste will be used comprehensively	3 thousand Rmb	W.B. project offices in counties and townships	The environmental protection sectors monitor effects of treatment	0.3 thousand Rmb a year
Rural markets (20)		solid waste, rubbish and influence of the sewage on the environment	To construct disposal pools , solid waste and rubbish collecting facilities, public toilet , septic tank and environmental protection institutions	To enhance the management of environmental sanitation, clean rubbish in time and discharge waste water after being treated in the disposal pools	The discharged waste water quality will reach GB5084-92 standard of irrigation water	300 thousand Rmb	W.B. project offices in counties and townships	Sectors of environmental sanitation and monitoring will supervise and monitor the operation and effects of environmental protect and put forward suggestions	

Table 5-9: Environmental Mitigation and Management Plans in the Project Area—Enterprises

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Beef fattening farm	<ul style="list-style-type: none"> The surface and underground water can be easily polluted by the improper sites The fattening effects can be affected by the irrational sheds' structure 	To construct the sheds strictly in accordance with the technical standards of the project	Construction unit	<ul style="list-style-type: none"> transmittable diseases between man and animals Environmental pollution caused by the improper treatment of the excrement 	<ul style="list-style-type: none"> To sterilize sheds with CaCO_3 regularly. To inject epidemic prevention vaccine regularly 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Supervision unit: county livestock bureau Supervision duties: to examine the sanitation of the breeding sites and injection situation of the vaccine regularly Epidemic prevention unit: township veterinary station Prevention tasks: injecting epidemic prevention vaccine (each time in spring and autumn) 	Mitigation cost: 234 Rmb a year
Breeding farm (pig)	<ul style="list-style-type: none"> The surface and underground water can be easily polluted by the improper sites The fattening effects can be affected by the irrational sheds' structure 	To construct the sheds strictly in accordance with the technical standards of the program	Construction unit	<ul style="list-style-type: none"> Inter-epidemic diseases between man and animals Environmental pollution caused by the improper treatment of the excrement H_2S and NH_3 pollution 	<ul style="list-style-type: none"> To inject vaccine for preventing swine fever, swine erysipelas and pork lung diseases each time in spring and autumn To sterilize sheds with CaCO_3 regularly. To properly treat the excrement and clean sheds in time 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> Supervision unit: county livestock bureau Supervision duties: to examine the sanitation of the breeding sites and injection situation of the vaccine regularly Epidemic prevention unit: township veterinary station Prevention tasks: injecting epidemic prevention vaccine 	Mitigation cost: 20,765 Rmb a year

Table5-10: Environmental Mitigation and Management Plans in the Project Area--Infrastructure

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Earth-faced terraces	Water and soil erosion	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To increase the height of land ridge (5-10cm) 	Construction unit	Water and soil erosion caused by unusually severe rain	<ul style="list-style-type: none"> • To plant grass on the ridge of earth-ridged terraced field • To set up drainage ditches among fields 	W.B. project offices in counties and townships households	<ul style="list-style-type: none"> • Monitoring unit: Water conservancy station • Monitoring items: Content of mud and sand • Monitoring frequency: 1 time/year, 3 days /time • Monitoring section: 3 sections for 3 rivers 	Monitoring cost: 5.94 thousand Rmb a year
	Nutrient losses	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To increase the height of land ridge (5-10cm) 	Construction unit	Nutrient losses in the severe rain period	<ul style="list-style-type: none"> • To strictly manage the vegetation on the ridge • To set up drainage ditches among fields 	W.B. project offices in counties and townships households	<ul style="list-style-type: none"> • Monitoring unit: Water conservancy station • Monitoring items: N, P and organic • Monitoring frequency: 1 time/3 years • sites arrangement: 3 sites/county, total 33 sites 	Monitoring cost: 6.12 thousand Rmb a year
Stone-faced terraces	Water and soil erosion	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To increase the height of land ridge (5-10cm) • To build drainage ditches 	Construction unit	Water and soil erosion caused by unusually severe rain	<ul style="list-style-type: none"> • To solid the field ridge and prevent artificial destroy • To set up drainage ditches among fields 	W.B. project offices in counties and townships and households	<ul style="list-style-type: none"> • monitoring unit: Water conservancy station • Monitoring items: Content of mud and sand • Monitoring frequency: 1 time/year, 3 days /time • Monitoring section: 3 sections for 3 rivers 	Monitoring cost: 2.70 thousand Rmb a year
	Losses of nutrients	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To increase the height of land ridge (5-10cm) • To build drainage ditches 	Construction unit	Nutrient losses in the severe rain period	<ul style="list-style-type: none"> • To solid the field ridge and prevent artificial destroy • To set up drainage ditches among fields 	W.B. project offices in counties and townships and households	<ul style="list-style-type: none"> • Monitoring unit: Water conservancy station • Monitoring items: N, P and organic • Monitoring frequency: 1 time/3 years • sites arrangement: 3 sites/county, total 15 sites 	Monitoring cost: 3.60 thousand Yuban a year

Table5-11: Environmental Mitigation and Management Plans in Project Area--Infrastructure

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Pipe network	Water and soil erosion caused by excavation of earth and stone in the rain season	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To properly deal with stone and earth 	Construction unit	<ul style="list-style-type: none"> • Water pollution caused by the bad management • The destroy of water-supply pipes by the bad management 	<ul style="list-style-type: none"> • To draw up detailed management regulations for water supply • To set up management agency and let specific persons manage and maintain pipes 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Monitoring unit: epidemic prevention station • Monitoring items: E.coli, total number of bacteria, suspend objects, BOD₅, COD, Hardness, iodine material, Hg, Mn, Zn, and fluoride, etc. in the drinking water. • Monitoring frequency: 1 time/year, 3 days /time. • Monitoring sites:3 sites/county 	Monitoring cost: 13 thousand a year
Channelled water	Water and soil erosion caused by excavation of earth and stone in the rain season	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To properly deal with stone and earth 	Construction unit	<ul style="list-style-type: none"> • Water pollution caused by the bad management • The destroy of drinking water facilities by the bad management 	<ul style="list-style-type: none"> • To draw up detailed management regulations for water supply • To set up management agency and let specific persons manage and maintain pipes 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Monitoring unit: epidemic prevention station • Monitoring items: E.coli, total number of bacteria, suspend objects, BOD₅, COD, hardness, iodine material, Hg, Mn, Zn, and fluoride, etc. in the drinking water. • Monitoring frequency: 1 time/year, 3 days /time. • Monitoring sites:3 sites/county 	Monitoring cost: 7.56 thousand a year

Table5-12: Environmental Mitigation and Management Plans in Project Area--Infrastructure

Project contents	Possible issues and measures in the construction phase			possible issues and measures in the operational phase			Monitoring plan	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Rural power lines	The destruction of the landscape and land over-occupation caused by poor planning and construction of the power lines	<ul style="list-style-type: none"> • To rationally plan power lines • To properly deal with excavation of stone and earth 	Construction unit	Public safety issue caused by the bad management	<ul style="list-style-type: none"> • To properly manage power lines • To maintain power lines in time • Project offices to extend knowledge of electricity to farmers. 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Supervision and management unit: W.B. project offices in counties and townships and power sectors • Supervision and management tasks: organizing relevant persons to examine and maintain power facilities 	Mitigation cost is included among the construction cost
Rural roads	<ul style="list-style-type: none"> • Soil erosion caused by constructing in the rain season The blocking of streams by excavation of stone and earth • The public grievance and losses of benefits to the farmers caused by bad treatment of land occupation The destruction of the landscape 	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To properly deal with stone and earth • To compensate farmers according to corresponding laws and regulations for land requisition • To rationally plan and construct roads 	Construction unit	<ul style="list-style-type: none"> • Traffic safety • Traffic-lifting dust • Noise 	<ul style="list-style-type: none"> • To set up traffic signs according to traffic standards • To plant trees in the roadsides to reduce noise and dust • Control the use of vehicle horns 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Supervision and management unit: traffic bureau • Supervision and management tasks: traffic safety management, setting up traffic signs and planting trees on the roadside 	Mitigation cost is included among the construction cost

Table 5-13: Environmental Mitigation and Management Plans in the Project Area—Infrastructure

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Supervision and management plans	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Suspension bridge	<ul style="list-style-type: none"> • Soil erosion • Blocking rivers 	<ul style="list-style-type: none"> • To properly deal with excavation of earth and stone in time • To unblock rivers 	Construction unit	Traffic safety	<ul style="list-style-type: none"> • To set up signs for safe traffic • To maintain and manage by the specific persons 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Supervision and management unit: traffic bureau • Supervision and management tasks: traffic safety management, bridge management and maintenance 	
Road bridge	<ul style="list-style-type: none"> • Blocking traffic • Construction dust • Construction noise • Construction safety 	<ul style="list-style-type: none"> • To unblock traffic • To set up management regulation on construction and traffic safety and prohibit constructing against regulations 	Construction unit	Traffic safety	<ul style="list-style-type: none"> • To set up signs for safe traffic • To maintain and manage by the specific persons 	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Supervision and management unit: traffic bureau • Supervision and management tasks: traffic safety management, bridge management and maintenance 	
Catchment reclamation	Water, soil and nutrient losses	<ul style="list-style-type: none"> • To avoid constructing in the rain season • To properly deal with excavation of earth and stone in time • To mitigate basins in accordance with technical standards 	Construction unit				<ul style="list-style-type: none"> • Monitoring unit: county water conservancy station • Monitoring items: earth and sand, N, P, K, organic in the river that receives eroded soil • Monitoring frequency: 1 time/year, 3 days/time • monitoring section: 3 	Monitoring cost: 3.6 thousand Rmb a year

Table 5-14: Environmental Mitigation and Management Plans in the Project Area—Infrastructure

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Monitoring plans	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Small-well irrigation	<ul style="list-style-type: none"> • Water and soil erosion • choking rivers 	To properly deal with excavation of earth and stone in time and prohibit piling on the bank and in the ditches	Construction unit	The reduction of the groundwater depth caused by over irrigating	To rationally tap and maintain supplement and use balance of underground water	W.B. project offices in counties and townships	<ul style="list-style-type: none"> • Supervision and monitoring unit: water conservancy station • Supervision tasks: water and soil erosion, silting situation in rivers • Monitoring task: the descent of the underground water 	
Sprinkler irrigation				The destruction of the sprinklers by bad management	To maintain, repair and manage sprinkler by the specific persons			
Canal irrigation	<ul style="list-style-type: none"> • Water and soil erosion • choking rivers 	To properly deal with excavation of earth and stone in time and prohibit piling on the bank and in the ditches	Construction unit	Water seepage Canal silting	To pave canal with concrete materials To clean canal silt	W.B. project offices in counties and townships, and households	<ul style="list-style-type: none"> • Supervision unit: water resources bureau • Supervision task: water and soil erosion, canals' silting situation, canals' paving quality and efficiency 	

Table 5-15: Environmental Mitigation and Management Plans in the Project Area—Infrastructure

Project contents	Possible issues and measures in the construction phase			Possible issues and measures in the operational phase			Supervision and monitoring plans	Investment of the environmental protection
	Environmental issues	Mitigation measures	Responsible unit	Environmental issues	Mitigation measures	Responsible unit		
Rain-collection and supplementary irrigation	Soil erosion	<ul style="list-style-type: none"> • To avoid constructing in the rain seasons • To prohibit piling excavation of stone and earth on the slopes and in the ditches 	Construction unit	<ul style="list-style-type: none"> • Reduction in the column of the water pit caused by silts • Water pollution • Public safety 	<ul style="list-style-type: none"> • To clean silts in time • To prevent excrement and leaves to fall into the water pit by means of covering and locking it 	W.B. project offices in counties and townships, and households	<ul style="list-style-type: none"> • Supervision unit: water resources station • Supervision tasks: silting situation in pits and sanitation of the water-collecting sites • Monitoring items: SS, COD, BOD₅, PH • Monitoring sites: 5 sites/county • Monitoring frequency: 1 time/year • Monitoring unit: prefecture monitoring station 	Monitoring cost: 6.48 thousand Rmb a year
Electrically pumped irrigation	Soil erosion	<ul style="list-style-type: none"> • To avoid constructing in the rain seasons • To prohibit piling excavation of stone and earth on the slopes and in the ditches 	Construction unit	<ul style="list-style-type: none"> • Silting of the canal • Ground subsidence • Soil secondary salinization 	<ul style="list-style-type: none"> • To clean silts in time • To adopt sprinkler irrigation, seepage irrigation and drip irrigation and prohibit irrigating with unlimited water in the large field • Train farmers 	W.B. project offices in counties and townships, and households	<ul style="list-style-type: none"> • Supervision unit: water resources station • Supervision tasks: irrigation methods, irrigation techniques and construction of the irrigation facilities 	
Flood plain reclamation	The silting issue of the rivers caused by improperly dealing with excavation of stone and earth	<ul style="list-style-type: none"> • To avoid constructing in the rain seasons • To prohibit piling excavation of stone and earth on the bank 	Construction unit	The surface soil erosion, bare rock and poor soil caused by lacking canals and bank	<ul style="list-style-type: none"> • To construct coordinating canals and banks • To adopt the advanced irrigation techniques (sparkling, seepage and dropping) 	W.B. project offices in counties and townships, and households	<ul style="list-style-type: none"> • Supervision unit: water resources bureau • Supervision task: rivers' silting situation 	

6. SCIENTIFIC RESEARCH AND TRAINING PLAN FOR THE ENVIRONMENTAL PROTECTION OF THE PROJECT

6.1 Scientific Research Plan of the Project

After undertaking on-the-spot investigation and relevant scientific experiments in the project area of Gansu, Mr. Schumacher, an environmental expert from the World Bank, thought that reduced-tillage and plastic film-covering technique may control water and soil erosion effectively, improve soil structure and increase output in the project area of Gansu. He suggested carrying out trial research.

(1) Project name

Demonstration research on reduced-tillage and plastic film-covering technique in Gansu project area of western China poverty reduction project financed by the World Bank.

(2) Project background

The project area belongs to water erosion area of the northwest loess plateau and high mountains and deep gully erosion area of Longnan prefecture, rainfall being concentrated and severe, water and soil erosion serious. The total land of the project area is 14,486.90 km², of which, the area with water and soil erosion is 1844 km², the annual corrode quantity reaching 6532.8 kt, the annual lost nutrients, N, 7,800 t, P, 21,400 t; K, 156,700 t. The economic losses are enormous.

(3) Research objectives

Applying reduced-tillage and plastic film-covering technique can improve soil structure, control water and wind erosion, reduce nutrient losses and pollution by agro-chemicals. It also permits farmers to extend the normal growing season. As a result of this it reduces farmers' risks and promotes better yields.

(4) Research contents

- a. Research on the relationship between reduced tillage and plastic mulch with soil moisture retention and fertility;
- b. Research the relationship between reduced tillage and plastic mulch with improved soil structure;
- c. Research the relationship between reduced tillage and plastic mulch with insecticide remaining in soil;
- d. Research on connection of reduced tillage and plastic mulch with yields; and
- e. Research on standards for reduced tillage and plastic mulch.

(5) Research methods

- a. Compare effects of much-tillage, deep-tillage, reduced-tillage and no tillage on the same soil;
- b. Compare effects of much-tillage, deep-tillage, reduced-tillage and no tillage of different soils in the same region;
- c. Compare effects of much-tillage, deep-tillage, reduced-tillage and no tillage of different crops in the same region; and
- d. Comparing effects of much-tillage, deep-tillage, reduced-tillage and no tillage of the same crop in the various environment.

(5) Anticipated results

- a. Improvement of soil structure;
- b. Improved soil capabilities of retaining moisture and fertility;
- c. Reduced insecticide remaining in soil;
- d. Increased yields; and
- e. Provide the standard for reduced-tillage and plastic mulch techniques.

(6) Activities arrangement

- a. Domestic academic exchange for phrasal achievements, one time, each year (See Wang Haibo – Hebei);
- b. To consult domestic experts irregularly;
- c. To organize agricultural technicians in the project area to undertake on-the-spot investigation irregularly; and
- d. Details will be arranged later.

(7) Responsible unit

Gansu project office of Western China poverty reduction project financed by the World Bank

(8) Research expenses

- a. Land rent: 20,000 Rmb
- b. Instrument and equipment cost: 100,000 Rmb
- c. Experimenters' wages: 100,000 Rmb
- d. Test cost: 40 ,000 Rmb
- e. Academic exchange cost: 60,000 Rmb
- f. Outcome publication cost: 20,000 Rmb

Total: 340,000 Rmb

(9) Cost origin

This research plan is the applied research of the planting and animal husbandry project. Its cost will be arranged by Gansu W.B. project office.

6.2 Training Plan for the Environmental Protection

6.2.1 Trainees

The environmental management and monitoring staff from all levels' project offices, townships and villages.

6.2.2 Training contents

- a. Environmental protection and its importance;
- b. Requirements of the World Bank on environmental protection and environmental mitigation and management plan;
- c. The basic procedures and requirements on environmental management of the non-pollution projects stipulated by State Environmental Protection Chief Bureau;
- d. Environmental protection and implementation of the environmental laws;
- e. Education and propaganda of the environmental laws; and
- g. Monitoring training of the environment protection.

6.2.3 Training methods

- a. To invite famous environmental experts to give lectures, carry out consultations and answer questions;
- b. Discussions and talks between experts and trainees;
- c. To carry out education and propaganda activities on the environmental protection;
- d. To organize matches on knowledge of the environmental protection;
- e. To make field investigations; and
- f. To have examination at the end of the course.

6.2.4 Training objectives

The main training objective is to promote public awareness of environmental protection so that the ecological environment can't be destroyed by man, water and soil resources can be rationally utilized, "three wastes" pollution can be efficiently controlled, and ecology, society and economy can develop coordinately.

6.2.5 Responsible unit and training time

- a. Provincial W.B. project office will organize the training held in Lanzhou in the middle of March each year.
- b. The prefecture project office will organize the field investigation every two years at the middle of July.
- c. County project office will organize training for E.P. staff of townships and villages, and spread laws.

6.2.6 Training expenses

Investigation and training cost: 2,921,000 Rmb.

6.2.7 Cost arrangement

The environmental protection training is one of training contents of the planting and animal husbandry project. The cost will be arranged by Gansu W.B. project office in the training expense of the planting and husbandry project.

7. IMPACTS OF LAND REQUISITION AND COMPENSATION PLAN

7.1 Affected Area by Land Requisition

To fully comprehend the impacts of land requisition the project office of each county, in cooperation with county land management bureaus, carried out detailed investigations of affected villages and households, starting in March 1998. The details of these studies and the resulting information on land acquisition and compensation are contained in the "Land Requisition and Compensation Plan", which has been submitted separately to the World Bank.

The investigations show that 1,931 households with 9,552 population will be affected by land requisition. As shown in Table 7-1, the requisitioned land will be mainly used for infrastructure construction, rural road and rural enterprises.

Table 7-1 Impacts of Land Requisition

Counties	Project	Affected area by land requisition		
		Townships	households	Population
Zhangchuan	Straw-braiding processing plant	Maliangshan	1,549	7,856
	fattening	Huchuan, Malu, Quzi		
	Rural road	Chuanwang, Zhangmian		
Wenxian	Rural road	Hengdan, Koutouba	42	193
Kangxian	Rural road	Douping, Changba	29	124
Wudu	Green prickly ash processing plant	Luotang, Sanke, Majie	98	423
	Livestock product processing	Ganquan, Majie		
	Tea processing plant	Wuma, Yuhe		
	Rural market	Ganquan, Luotang, Liangshui, Hanwang		
	Raw drug processing plant	Longxing, Lunba, Ganquan, Anhua, Majie, Chengjiao, Sanhe, Yuhuang, Toufang, Weinan, Yulun, L unfeng, Guohe, Boling, Hanling		
	Forage processing plant	24 townships		
	Rural road	Wuma, Ganquan, Lunfeng, Hanling, Majie, Luotang, Sanhe		
Tanchang	Rural road	Xingzai, Shizi	33	141
Mingxian	Rural road	Mazichuan, Baozi, Xizai	180	815

7.2 Plan for Land Requisition

In the six-year construction phase, 1,271.18 mu of land will be requisitioned, of which, 953.8 mu, is wasteland and the 317.38 mu arable land. The yearly plan for land requisition is shown on Table 7-2.

7.3 Compensation Plan for Land Requisition

According to "Land Administrative Law of People's Republic of China" article 47, the compensation fees for land requisition include the costs for: resettlement; fixed assets; and young crops. The land compensation fee is

equivalent to 6 to 10 times the land's average annual production based on the previous three years. The resettlement fee depends on the agricultural population needing resettlement. The remaining compensation and management fee is calculated according to implementation methods for the land administration law of Gansu province. The compensation plan shown in Table 7-2 has been calculated according to the compensation standards discussed above.

Table 7-2: Yearly Plan for Land Requisition

Counties	Requisitioned area (Mu)			Yearly plan for requisition (Mu)					
	Total area	Dry land	Non-arable land	1	2	3	4	5	6
Zhangchuan	149.5	87.0	62.5	1.0	84.5	64.0			
Minxian	391.7	63.1	328.7	391.8					
Tanchang	257.9	34.7	223.2		206.5	51.4			
Wudu	229	77	152	30.5	40.5	45	40	40	33
Kangxian	153	30.6	122.4	153					
Wenxian	75	10	65	75					
Total	1,256	302	954	651	332	160	40	40	23

Table 7-3: Compensation Plan for Land Requisition

Counties	Compensation fee (Rmb)					
	Total	Young crops	Land accessories	Land	Resettlement	Unpredicted
Zhangchu an	689,781	58006		476,550	135,499	19,727
Minxian	388,110	20,186		2,583,76	98,245	11,304
Tanchang	177,495	8,328		111,264	54,044	3,859
Wudu	382,335	24,640		227,520	119,924	10,251
Kangxian	266,824	19,180	12,680	180,540	47,658	6,766
Wenxian	112,044	2,190	35,150	56,150	15,575	2,979
Total	2,016,589	132,530	47,830	1,310,399	470,945	54,885

Except the compensation cost in the Table, additional 119684.93 Yuban land management cost is arranged in the total compensation cost.

8. ANALYSES OF ENVIRONMENTAL AND ECONOMIC BENEFITS

The Gansu project of western China poverty reduction project financed by the World Bank consists of an integrated agricultural development. The project will improve environmental conditions, through improving control of soil erosion. When completed, it will also lay a solid foundation for the sustainable development of agriculture.

8.1 Social Benefits

The implementation of the Poverty Reduction Project will greatly promote development of rural productive forces, change poverty and the backward condition of the project area and provide a great amount of material and spiritual wealth to society. These are mainly embodied in the following:

- (i) Farmers' incomes will increase and the issue of "dressing warmly and eating one's fill" will be solved for the poverty -stricken population. In the sixth year of the project, the annual per capita income in the project area, calculated according to the 1997 base prices, will be 1,684 Rmb, 1,178 Rmb higher than the present income level. A total of 929,600 poverty-stricken persons from 197,059 poverty-stricken households will dress warmly and eat their fill.
- (ii) The project will provide many employment opportunities and rural surplus labors will be rationally utilized. As estimated, the planting and animal husbandry projects will need 51,994,455 working days, the rural enterprises can provide employment opportunities for 1,1401,000 people and labor export will make provide employment for 82,602 persons. By doing these, the rural surplus labor, amounting to 46.2% of the total, will be employed.
- (iii) Improvements will be achieved in: the social service system; in farmer's scientific and technological knowledge and literacy; and women social status will be promoted. When the project is completed, the rural scientific and technological circulation service system will be basically established. This will consist of: comprehensive service stations for agricultural techniques at townships; agricultural technique extension stations in the administrative villages; and demonstration households in the natural villages. Through the open supply-sale system of townships and villages, the use of agricultural inputs will increase. Appropriate extension techniques will be used to develop technical training for farmers and improve their scientific and technological knowledge. There will be no less than one person mastering 1 to 2 wealth creating techniques in the 90% households. The status of women will be improved.
- (iv) The infrastructure conditions will be greatly improved, and issues such as: the lack of drinking water for humans and animals; the lack of electricity; and traffic inconvenience will be resolved. When the project is completed, the percentage of administrative villages with roads will increase from 65.77% to 95%. Some 228,835 persons and 610,000 animals will get access to drinking water. The townships with rural markets will have electricity.

8.2 Economic Benefits

In the sixth year of the project, the total production value will be 1,265,732,430 Rmb, and the net production value 1,190,757,966 Rmb. The net income per head will increase by 1,178 Rmb and the target of overcoming poverty will be realized. The financial and economic analyses provided in Table 8-1 show the economic benefits.

8.3 Environmental Benefits

The crop production and breeding projects will promote development of the agricultural product processing industry. This can make the most of the climatic and biological resources of the project area, increase the land utilization rate, and enhance the capacity to overcome natural disasters. They are also conducive to the development of the economy in a more environmentally aware manner.

Table 8-1 Analysis of Financial and Economic Benefits

Items	Finance		Economy	
	IRR(%)	NPV (10^3 Rmb)	IRR(%)	NPV (10^3 Rmb)
Planting and breeding	38	101399.539	22.9	411320.528
Labor export	29	86169.896	28	72772.116
Rural enterprises	27.83	123930	27.7	286032.962
Total	26	1658975.791	20.2	682750.06

- (i) The technical plan of the project is rational. The project will not only promote economic development, but also promote sustainable development of the agricultural production system and ecological protection system. The project area mainly consists of poverty-stricken villages in the remote mountain areas. With a scattered population and minor construction activities, and low mobility, the environment will not be polluted. Further destruction of the original vegetation will be reduced by being careful to preserve water and soil resources during the construction.
- (ii) The cropping project may improve the ecological environment of farmlands. Although fertilizer and insecticide applications are likely to increase, this will be done under strong guidance of the service system to households and in strict conformity to relevant operating rules. They should thus have little impacts on the environment. The white pollution will be efficiently controlled through incentives for the exchange of old plastic film for new film. The used plastic film will be reprocessed. By proper use of fertilizer, the moisture, fertility, and soil atmosphere will be improved and a sound soil environment created. The forest, fruits, tea, medicinal plants and cropping projects will increase forest coverage while promoting the development of the commodity economy in the project area. This will preserve water and soil, and contribute to a cleaner environment.
- (iii) The breeding project can provide a great deal of organic manure to farmlands. This can reduce and fertilizer pollution, improve soil structure, increase organic content of the soil, and promote sound development of the natural ecological system in the project area.
- (iv) The rural enterprises are scattered, and of small scale and combined with the living and working demands of the local people. The "three wastes" should be comprehensively used. If not, by abiding by environmental protection principles of "clean" design, operation and production, the enterprises should limit their discharge quantity within the allowed standard of state, and no pollution should be made.
- (v) In the infrastructure and irrigation projects, protecting slope fields, constructing drainage ditches and avoiding construction in the rainy season can efficiently prevent water and soil erosion. The implementation of all environmental protection measures will guarantee that there is no environmental destruction associated with these activities.

9. PUBLIC SURVEY

9.1 Purposes and Importance

The purposes of the public survey were to: learn how the poverty-stricken households and the social parties concerned understand the project; to know the basic situation of the beneficiaries; and to let public give their opinions and suggestions on the environmental issues produced by project implementation. This would ensure scientific and democratic decision-making. The practical and efficient measures for the environmental protection put forward by the public can improve the plan, design and implementation of the and can assist in bringing the full economic and social benefits of the project into play.

9.2 Methods of Investigation

This project involves a broad scope and many people. In order to understand the attitudes of the poverty-stricken households to the project we adopted a variety of survey methods. These included: holding discussion meetings; issuing questionnaires; consulting experts; interviewing deputies to the National People's Congress, and members of the Chinese People's Political Consultative Conference; and speaking with academic societies. In the 12 project counties (185 townships, 2,234 villages), we issued 5,000 questionnaires, held 8 discussion meetings, and consulted 30 experts and 10 academic societies.

9.3 Investigation Objects

Among the people interviewed farmers made up 53.98 %, agricultural technicians 11.31%, workers 10.29 %, urban residents 4.68%, teachers and students 6.47%, deputies to the National People's Congress and members of the Chinese People's Political Consultative Conference 10.62% and staff of the environmental protection bureau 2.65%. The people interviewed were from different strata, professions and were of both genders. Most were poverty-stricken people having a close relationship with the poverty reduction project.

9.4 Results of the Investigation

Of the 5000 questionnaires issued 4521 were returned (a 90.42 % return rate). From the questionnaires, we can see that most of the people interviewed are from the labor force of the project area. Most of them received junior or senior middle school education. Only a minority were illiterate. They know something about the poverty reduction project and hope this project can be implemented as soon as possible. Besides, they hope to use science and technology to guide agricultural production so that the economic benefits are improved. The results of investigation are presented in Table 9-1.

The results of the investigation shows the following:

- 97.31% of the people who know about the project;
- 94.66% think the design of the project is rational,;
- 93.10% think this project can help them escape poverty;
- 95.02% think this project will further the development of the local economy; and
- 79.70% of them think this project can promote the ecological protection.

The public's attitude to the project is positive and 98.47% of them hope this project can be implemented as soon as possible, while 18.38% of them think this project will influence the environment.

The experts and academic societies think this project can play a positive role in helping poverty-stricken households escape poverty. But they emphasize that the implementation of the project must be concerned with the environment and appropriate mitigation and conform to the principles of sustainable development.

Table 9-1:The Results of the Public Investigation

Edu-cational level	Illiterate	483	Sex	Male: 3943 Female: 578	Age	≤30	1339								
	Primary school	1344				31-45	2388								
	Junior middle school	1326				46-60	749								
	Above senior middle school	1368				>60	45								
	The degree of your understanding to Gansu project					Understand	3,672 81.22%								
						Understand some	728 16.09%								
						Not understand	109 2.42%								
Do you think the design of the project is rational?						Rational	4,279 94.66%								
						irrational	63 1.39%								
						Don't care	150 3.32%								
What's your attitude to the construction of the project?						Favor	4,452 98.47%								
						Oppose	12 0.27%								
						Don't care	57 1.26%								
What role will the project play in the development of local economy?						Positive effect	4,296 95.02%								
						Negative effect	16 0.36%								
						No effect	197 4.35%								
The implementation of the project will increase employment, are you a beneficiary?						Yes	3,713 82.12%								
						No	352 7.79%								
						Not clear	219 4.84%								
How the project influence your living quality?						Improved	4,209 93.10%								
						Lowered	11 0.24%								
						No influence	219 4.84%								
Does the project have impact to environment?						Yes	831 18.38%								
						Very little	1,519 33.61%								
						No	2,084 46.09%								
How do you think of the operation of environmental facilities in the existing enterprises?						Good	2275 50.33%								
						Not good	809 17.89%								
						No idea	444 9.82%								

10 CONCLUSIONS AND SUGGESTIONS

10.1 Conclusions

- 10.1.1 With adverse ecological environment, poor land and little basic farmland, the agriculture in the project area is rather backward.

High mountains, deep gullies, steep slopes, little arable land, scattered, thin and poor soils characterize the project area. The soil generally lacks nitrogen and seriously lacks phosphorus. The potassium content is relatively high. The soil has a low moisture and nutrient holding capacity. The available arable land per head is only 0.318 ha, of which, the basic farmland 0.064 ha. The land area in which less than 0.67 ha/capita is available occupies more than 90% of the project area. The production per mu is only 117.8 kg,. In some mountain areas, such destructive cultivation methods as slash-and burn cultivation and slope reclamation are existing.

- 10.1.2 The cropping and animal husbandry projects will play positive roles in controlling water and soil erosion, increasing soil fertility and animal carrying capacity of grassland, preventing white pollution and improving regional ecological environment.

Planting grass and economic trees in the waste hills and slopes can increase vegetation coverage rate and control water and soil erosion efficiently. Returning $>25^{\circ}$ slope fields for grass, enlarging grass-planting area and developing legumes can relieve the forage deficit. Increasing manure and properly applying fertilizer are positive for improving soil structure and increasing soil fertility. The plastic film has function in maintaining moisture and fertility, increasing utilization rate of water resource, improving soil structure and increasing yields. The white pollution will be avoided by collecting old plastic film and exchanging old plastic film for new one, and the waste plastic film will be comprehensively used.

- 10.1.3 The rural enterprises are on the small scale and scattered, with few and scattered "three wastes". The impacts of the project on environment will be minimized by adopting clean techniques and strictly limiting discharge quantity. The details of the mitigation measures will be established when the projects are assessed after being presented for review.

- 10.1.4 The infrastructure project can change present rural conditions of the absence of water and electricity and transportation. This will lay a good foundation for other projects to exert their social, economic and environmental benefits and promote development of secondary and tertiary industries.

- 10.1.5 The implementation of the project can improve public wellbeing and accelerate extension and use of technologies which are positive for developing rural markets and organizing the export of labor.

- 10.1.6 The environmental mitigation and management plan can guarantee measures for preventing such soil erosion, and insecticide and fertilizer contamination caused by development of cropping and animal husbandry and by infrastructure construction. They must be implemented by specific responsible persons.

- 10.1.7 The experts, community representatives and public of the project area think that the project are conducive to the improvement of the ecological environment and escaping poverty to become rich.

In a word, the project is scientific and reasonable, the technical plan practical, the comprehensive benefits obvious. The implementation of the project will assist 929,600 poverty-stricken people from 2,234 villages in 12 counties to throw off poverty, dress warmly and eat their fill.

10.2 Suggestions

- 10.2.1 To improve awareness of protecting and rationally utilizing resources and to avoid over-use of resources and to promote the sustainable development idea.**
- 10.2.2 To reinforce management activities in environmental mitigation and monitoring and to establish strict project management regulations.**

Appendix 1

Rural Energy Development Plans for the 12 Project Counties in Gansu Under the Western Poverty Reduction Project

Wudu, Tanchang, Xihe, Lixian, Wenxian, Kanxian, Gangu, Wushan, Qinshui, Zhangjiachuan, Qinan, and Mingxian are state designated poverty counties in Gansu Province. Wudu, Tanchang, Xijhe, Lixian, Wenxian, and Kanxian counties belong to Longnan Prefecture where the Yangtze River Project is being implemented; the other counties belong to Tianshui Municipality where it is dry and characterized fragile ecological conditions and frequent natural disasters.

These regions represent two different ecozones in which common problems exist which are the “Three Lows” and “Three Shortages”. The “Three Lows” represent for low yield, low income and low quality of farmers; the “Three shortages” represent shortage of fertilizer, shortage of feed and fodder, and shortage of fuel. Environmental conditions are harsh because of historical misuse of natural resources. As a result, local farmers live a very hard existence and the local economy has been slow to develop. Farmers have to cut grasses and trees for fuel because of severe shortage of alternate and affordable energy resources. This causes increased surface water flows and soil erosion. The impacts of this are felt down the Yellow and the Yangtze River systems. Although great efforts have been made by government organizations at various levels, shortage of rural energy continues to restrict development of rural economies and the success of poverty reduction programs. Therefore, resolving problems of rural energy scarcity in the 12 project counties will not only supply farmers with sufficient fuel, but will also help reduce poverty and control water and soil erosion in the upper reaches of the Yellow and the Yangtze Rivers.

1. Social and Economic Background in the 12 Counties

Located in remote, mountainous, arid and semi-arid areas, the 12 counties are respectively under the administration of Longnan Prefecture, Tianshui Municipality and Dinnxi Prefecture. The total land area in the 12 counties amounts to 52,027,900 Mu, and arable land 8,299,300 Mu. The total grain production in 1996 accounts for 1,024,900 tons, average grain production per mu reached 123.5 kg, and average grain consumption 240.75 kg per capita. There were 982,700 heads of big livestock in 1996. The average net income per capita in 1996 was 757.3 Rmb. The area of water and soil erosion amounts to 36,509,600 Mu, accounting for 70.17% of the total land area in the 12 counties.

There are 185 project townships and 2234 project villages in above 12 counties.

Between 1995 and 1997 Gansu Province allocated 970,000 Rmb to rural energy development. Of this 435,000 Rmb were allocated in 1995, 350,000 Rmb in 1996 and 185,000 Rmb in 1997. This level of investment is too low to resolve the problem of energy shortage. Details of the investment are shown in Table 2.

2. The Supply for and Demand of Rural Energy at Present

The rural energy in the 12 counties consists of principally of straw, fuel and livestock dung, which is equivalent to 295,900 tons of standard coal and average energy supply is 204 kg of standard coal per capita. Actual energy demand is 515,500 tons of standard coal, which is an average energy demand of 337 kg of standard coal per capita. At least 5500 Kcal of effective energy is needed every day to meet the energy requirements of a household with 5 persons. However, only 3,162 Kcal of energy is available, i.e., energy shortage amounts to 42.5%, or there is no energy in 5 months. This provides an indication of why farmers have to chop trees and cut grasses. The supply and demand of rural energy is presented in Table 4.

There have recently been great achievements in energy supply issues in the 12 counties with assistance of government at various levels.

Gansu Province has allocated 1,285,000 Rmb in rural energy development in the 12 project counties since 1995 (Table 2). On the basis of this the following have been achieved:

- 42,000 Mu of fuel trees have been planted;
- 1800 coal saving stoves have been extended;
- 2,810 energy saving Kang (earth bed) have been established;
- 520 ecological demonstration households have been set up;

- 1525 demonstration households using bio-gas have been set up;
- 2 micro hydro power stations with a capacity of 72,000 watts each have been established.

These measures have generated an increment of energy that equals to 6,080 tons of standard coal. Energy saving amounts to 2,233 tons of standard coal, which greatly improves the energy supply. However, energy supply has not been completely resolved. Further measures still need to be taken to improve the energy supply.

3. Strategies and Components of Rural Energy Development

3.1 Strategies

In order to resolve energy shortage problems, the following principles should be applied:

- (a) "Different measures should be taken in different areas",
- (b) "Diversified energy should be developed",
- (c) "Efficiency will be based upon comprehensive use of energy"; and
- (d) "Energy development should incorporate energy saving strategies".

It is expected that sound ecological conditions and sustainable environmental development should be achieved through using these principles. It is proposed that percentage of electrical power, coal and other newly developed energy sources should be increased and that the use of biological energy sources should be decreased. At present, energy used in daily life should be saved and the use of solar energy stoves should be promoted. In addition, bio-gas should be developed. Trees and grass planting should be focused on so as to create more energy resources.

3.2.1 Components

The plans of the development of rural energy include the following measures:

- (a) Extending 2,244,000 coal saving stoves;
- (b) 488,000 fuel saving Kang will be established;
- (c) 12,000 ecological households will be established;
- (d) 213,900 solar energy stoves will be set up; and
- (e) 457,500 mu of fuel forest will be developed.

Detailed development plans are enclosed in Table 3.

In order to initiate above plans, it is necessary to invest 173 millions Rmb in 12 counties, of which 60.51 millions Rmb will be special treasure bonds, and 55.63 millions Rmb will be provincial counterpart fund. Provincial counterpart fund consist of following items:

- (1) Fuel wood development: 1.89 millions Rmb per year;
- (2) Key ecological counties investment: 500,000 Rmb per year;
- (3) Annual energy construction budget: 450,000 Rmb;
- (4) Micro credit for ecological construction: 3.5 millions Rmb, and
- (5) Contribution from farmers' saving: 56.86 millions Rmb.

4. Benefits Analysis

This project will be completed by 2004. Energy shortages will be resolved and vegetation will be well protected. Local environmental and living standards will be significantly improved.

4.1 Energy Benefits

Energy supply will be increased from 295,900 tons of standard coal in 1997 to 392,300 tons of standard coal, increasing 32.6%, and saving 150,200 tons of standard coal. Energy developed will be equivalent to 96,400 tons of standard coal. As a result, energy supply will be more than demand. (Table 4).

4.2 Economic and Social Benefits

Annual economic benefits will reach 171.8 millions Rmb after the project is finished, and the ratio of investment and benefits will be 1:0.99. However, social benefits are significant.

4.3 Ecological Benefits

1.99 millions Mu of vegetation will be protected after the project is finished. Farmers will stop chopping trees and digging out grasses. Details can be seen in Table 3.

5. Guarantee Measures of the Project

The project has been considered as one of projects supported by state's 10 billions Rmb of treasure bonds. In order to make the project implemented successfully, following measures will be taken:

- (1) Gansu Provincial Energy Office will be responsible for the project;
- (2) Local Energy Offices will coordinate with Provincial Energy Office to conduct the project;
- (3) Special staff will be chosen to prepare for and conduct the project;
- (4) Rural energy management sectors will be responsible for supplying services and for training so as to guarantee the success of the project.

6. Fund Raising

Special state's treasure bonds: 60.51 millions Rmb;
Provincial counterpart fund: 55.63 millions Rmb; and
Farmers' contribution: 56.83 millions Rmb.

Gansu Center for Rural Energy Comprehensive Development
2 July 1998

**ENVIRONMENTAL IMPACT ASSESSMENT (EIA)
FOR THE WORLD BANK LOAN "POVERTY REDUCTION"
PROJECT IN INNER MONGOLIA**

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1. INTRODUCTION

1.1 Origin of the Project

Located in the northern part of China, Inner Mongolia Autonomous Region is an economically backward region with a large poverty stricken population. The 15 counties/ banners lie in the hilly area and extend to the northern side of Yinshan Mountain. The region is semi-arid area and contains a mixture of agriculture and animal husbandry. There is little rain and the high winds often carry sand. The soil is poor, and the ecological environment is fragile. Due to the rapid growth of the human population in the past century, the overuse of the land resources, cultivation of marginal land and overgrazing, land deterioration has occurred over large areas. The local people live in poverty and their socio-economic conditions are poor. Thus, there is a vicious cycle of poverty - land desertification – and increased poverty. The 15 project counties/banners are all the nationally designated poverty areas. There are 863 thousand inhabitants in the project area, constituting 31.35% of the total population, whose per capita net income is below the national poverty standard. In view of population, resources and environmental conditions, the area is one of the poorest places in China.

The implementation of the poverty reduction project will permit the realization of the advantages of this vast area of land and grassland. It will allow it to achieve its development potential, and to better utilize its labour resources. The combination of agriculture and animal husbandry in the project area, will contribute to the improvement of the adverse environmental situation and provide the opportunity for local people to emerge from poverty. Hence, the Inner Mongolia Poverty-Reduction Leading Group has decided to implement “the World Bank Loan Poverty Reduction Project in the Western Part of China” (hereinafter, the project) in the 15 counties and banners. The project will cover a wide range of activities including: the comprehensive development of agriculture and animal husbandry; irrigation development; soil and water conservation; improvement of grassland and the construction of rural infrastructure. The implementation of the project will increase irrigated land by 35.4 thousand ha, and will add 1.2 million sheep-units. It is designed to help 539,000 people to emerge from poverty.

There is potential for the project may give rise to environmental problems such as: secondary soil salinization of irrigated land, grassland deterioration from over stocking, and chemical pollution. However, the negative impacts can be reduced provided the appropriate mitigation measures are taken and sound management and monitoring systems established. This would include measures such as: the combination of irrigation and drainage; establishing the numbers of livestock based on the amount of feed available; the reasonable use of farm chemicals and fertilizer; and the strengthening of environmental management and monitoring. In order to guarantee that there will be no other disadvantage impacts on the environments in the area and the smooth implementation of the project, a comprehensive environment impact assessment is absolutely necessary.

1.2 Basis for the EIA

1.2.1 Project Proposal and Feasibility Study Report for “the World Bank Loan Poverty-Reduction Project in the Western Part of China” in Inner Mongolia

1.2.2 Environmental impact assessment laws and concerned regulations in China

1.2.2.1 State Laws and Regulations

“Environmental Protection Law of the People’s Republic of China”

“Air Pollution Prevention Law of the People’s Republic of China”
“Water Pollution Prevention Law of the People’s Republic of China”
“Noise Prevention Regulation of the People’s Republic of China”
“Agriculture Law of the People’s Republic of China”
“Grassland Law of the People’s Republic of China”
“Water and Soil Conservation Law of the People’s Republic of China”
“Historical and Cultural Relics Protection Law of the People’s Republic of China”
“Wild Animal Protection Law of the People’s Republic of China”
“Environmental Protection Management Regulations for Construction Project”
“Memorandum on the Environmental Protection Management Regulations for Construction Project”
“Some Note Points on the Environmental Protection Management Regulations for International Loan Project” (Environmental Monitoring Report, 1993 No.324)

1.2.2.2 Local Laws and Regulations

“Environmental Protection Regulations of Inner Mongolia Autonomous Region”
“Operational Directive of Environmental Protection Management for Construction Project of Inner Mongolia Autonomous Region”
“Operational Directive of Agricultural Environmental Protection Regulations of Inner Mongolia Autonomous Region”

1.2.2.3 Technical Guidelines for EIA by World Bank (OD4.01),

1.2.2.4 Technical Guidelines

Technical Guidelines for EIA by the NEPA of China --- General Introduction (TJ/2.1-93)
Technical Guidelines for EIA by the NEPA of China --- Atmosphere (TJ/2.2-93)
Technical Guidelines for EIA by the NEPA of China --- Surface Water (TJ/2.3-93)
Technical Guidelines for EIA by the NEPA of China --- Nonpolluting Ecological Impact (HJ/T19-93)

1.2.2.5 Certificate of Commission for Carrying out EIA

The commission of Environmental Impact Assessment of the World Bank Loan Poverty Reduction Project in the Western Part of China in Inner Mongolia.

1.2.2.6 Other Concerned Documents and References

“Memorandum” by the World Bank Technical Group in May 13, 1998
“Outline of the EIA for World Bank Loan Poverty Reduction Project in Inner Mongolia”
“Memorandum by the State Environment Protection Bureau the “Outline”
“World Bank Technical Paper No. 139: Collection of Documents for EIA”

1.2.3 Category of EIA

As the Project is jointly supported by the World Bank and various domestic resources in China, the contents of EIA should meet both the requirement of the World Bank specifications and the requirement of Chinese Government.

Based on the Annex E of OD4.01 of World Bank document and the Environmental Protection Standard—Technical Guideline of EIA of People’s Republic of China as well as the preliminary analysis of environmental impact of the project, it is concluded that most project impacts are minor, few, if any, are irreversible and the mitigation measures are easily established. Therefore, the project is considered to be a Category B project.

1.3. Scope and standards of the EIA

1.3.1 Scope of the EIA

1.3.1.1 Socio-ecological Environments

All the 15 counties/banners involved in the Project are included in the scope of the EIA. Key points are in the 136 townships for the implementation of the Project.

1.3.1.2 Ecological Environments

For land based developments, such as soil conservation projects, livestock developments etc., the area of influence is considered to cover a perimeter 2-8 kilometers around the site. For linear developments, such as roads the area of influence is generally considered to be a belt 200 meters wise, point sources such workshops and factories the area of influence is considered to extend 0.1-1 kilometer around the site.

1.3.1.3 Water Environments

All water bodies involved in the Project.

1.3.2 Standards of the Assessment

Standards for the EIA are as follows:

- (1) "Agricultural Irrigation Water Quality Standard" GB5084-92
- (2) "City Noise Standard" GB3096-1993 (There are 4 classes for residential areas and 2 classes for schools)
- (3) "Air Quality Standard" GB3095-1996 (Class 2)
- (4) "Noise Standard in the Boundary of Industrial Sites" GB12348-90 (Class 3)
- (5) "Soil Environmental Quality Standard" GB15618-1995
- (6) "Surface Water Environmental Quality Standard" GB3838-88
- (7) "Underground Water Quality Standard" GB5749-85

1.3.3 Duration of the EIA

4 years in the construction period and 10 years in the operation period

1.4 Purpose of Environmental Protection

1.4.1 The purpose of the EIA is ensure that:

- Indigenous people, domestic facilities and agricultural and animal production are not damaged in the Project areas.
- Agricultural ecosystems are protected and improved.
- Utilization of land and biological resources is upgraded.
- Sustainable agricultural development and improved ecosystem management are achieved.

1.4.2 Damage on the natural ecosystem and loss due to pollution must be reduced to a minimum.

1.4.3 Land desertification, overloading of the ecological capacity, and environmental pollution are to be avoided.

1.5 Methodology for the EIA

Activities undertaken in preparing the included: data searching and collection; site investigation; collection and analysis of soil and water samples; review of similar studies. On-the-spot investigations have been made into the main environmental issues in the project area. Both quantitative and qualitative analysis were used. Positive and negative effects of the project have been comprehensively evaluated. At the same time, special attention has been paid to the key points of the EIA. Based on all those activities, mitigation measures have been established and the management and monitoring plan developed.

1.6 Concerned Agencies and Work Assignment

1.6.1 Introduction of the Assessment Agency

The preparation of EIA of the World Bank Loan Poverty-reduction Project in Inner Mongolia Autonomous Region is the responsibility of the Environmental Science Research Institute of Inner Mongolia Autonomous Region (ESRIIM).

ESRIIM is the key institute in the environmental science research in Inner Mongolia with 45 scientific researchers, of whom 13 persons HAVE high-ranking technical titles, 25 persons have middle technical titles. It has technicians of various specialties engaged in environmental science research. It has laboratories specialized in assessment of environmental effects and research laboratories specialized in assessment of ecological effects. with high or middle technical qualifications are responsible for such jobs. ESRIIM holds the Class A Environmental Effect Assessment Certificate issued by the State Environment Protection Agency of China.

ESRIIM started its environmental assessment work in 1985. Since then it has completed more than 50 items of environmental assessment tasks of varied scope, and in different sectors and areas. Many persons have been specially trained in training workshops organized by the World Bank and the Asian Developmental Bank, and have received certificates of qualification. They have worked for many environmental impact assessments the World Bank and the Asian Developmental Bank. In the course of this they have gained sound theoretical and practical work experience.

1.6.2 Work Assignment

ESRIIM is in charge of the overall project assessment work while the Inner Mongolia Forestry Survey Institute is in charge of ecological survey and assessment.

1.6.3 Report Authors

Zhang Shuli has been responsible for writing the whole report.

Tao Li has been responsible for the environmental assessment of the components of rural infrastructure and animal husbandry.

Pangaowa has been responsible for presenting the existing environmental .

Wang Ji was in charge of public participation.

Maguili, Li Xiaoxia, Zhang Wenhui and Zha0 Linan Li Xiao Xia have taken part in the work and the investigation into the field.

2 SUMMARY OF THE PROJECT AND ANALYSIS OF ENGINEERING WORKS

2.1 Title of the project

The title of the Project is: World Bank Loan Poverty-reduction Project in Inner Mongolia Autonomous Region of west China.

2.2 Content and Scope of the Project

This project will be implemented along the northern foot of the Yinshan Mountains in the Inner Mongolia Autonomous Region. It includes a population of 539 thousand, in 916 villages, 136 townships in 15 state poverty counties/banners. These include: Guyang County, Darhanmumigan Joint Banner, Wuchuan County, Siziwang Banner, Chahar Right Wing Middle Banner, Chahar Right Wing Rear Banner, Shangdu County, Huade County, Taibusi Banner, Duolun County, Keshiketen Banner, Linxi County, Barlin Right Banner, Wongnute Banner, Kerqin Right Wing Middle Banner (See attached map for their specific geographical locations). The Project covers a total land area of 138,000 km² with a total population of 3,317,000 persons. The project includes 43 components of comprehensive agricultural development in irrigation and drainage, rural enterprise, infrastructure construction, organization establishment and project management and administration.. It involves cropping, animal raising, forestry, water conservancy, crop and animal product processing, transportation and electrical transmission. The contents and scope of the components are listed in Table 1.

2.3 Project Investment and Its Arrangement

Total investment for the Project is 830 million Rmb (amounting to 100 million U.S. Dollars), distributed in 136 townships in the 15 counties/banners, covering 43 (subprojects) components of the Project. The arrangement for different components are: 498.4366 million Rmb for agriculture and animal husbandry development (60.50% of the total investment), 195.0454 million Rmb for irrigation system construction (23.50%), 63.1904 million Rmb for infrastructure construction (7.62%), 26.234 million Rmb for township enterprises (3.16%), 26.9135 million Rmb for organization, construction, monitoring, project preparation and management expenses (3.26%), and 20 million Rmb for social service organization (2.41%).

Table 1 Contents and Scope of the Components in the Project

Components	Unit	Scope	Investment	Remarks
Agricultural Development				
Filmed maize in irrigated field	Ha	10284.0	49843.66	newly increased
Filmed maize in dry land	Ha	8622.1		improved
Wheat in irrigated land	Ha	9623.7		newly increased
Wheat in dry land	Ha	20929.8		improved
virus-free potato	Ha	25165.5		improved
Rice	Ha	327.7		newly increased
Buckwheat in dry land	Ha	6311.5		improved
Pea in dry land	Ha	1412.7		improved
Soybean in irrigated land	Ha	3205.6		newly increased
Hybrid sunflower in dry land	Ha	1980.3		improved
Beef cattle	Head	41750		newly increased
Sheep	Head	242334		newly increased
Cashmere goat	Head	33534		newly increased
Swine pig	Head	20171		newly increased
Pork Pig	Head	232265		newly increased
Rabbit	Head	12296		newly increased
Chicken	Head	2973		newly increased
larch	Ha	396.5		newly increased
Wild apricot	Ha	2076.9		newly increased
Fenced pasture	Ha	2125		newly increased
Ensilage cellar	Site	13725		newly increased
Alfalfa	Ha	4784.5		newly increased
Milkvetch	Ha	11018.5		newly increased
Shelter forest of shrub	Ha	126272.0		newly increased
Infrastructure Development				
Electric powered Irrigation	Ha	9491.3	19504.54	newly increased
Deep well irrigation	Ha	4720.5		newly increased
Family well irrigation	Ha	7332.9		newly increased
Water cellar	Site	3356		newly increased
Pipeline irrigation	Ha	7306.6		newly increased
Water conservation forest	Ha	6125.7		newly increased
Terrace land	Ha	9162.6		newly increased
High elevation water pumping	Ha	1136.5		newly increased
Leaching proof ditches	M	3817.8		newly increased
Mobile pumping irrigation	ha	1549.6		newly increased
Check dam for building farmland	ha	246		newly increased
Road	Km	45	6319.04	improved
Electric power line	M	866800		newly increased
Drinking water supply	Site	118		newly increased
Agricultural Processing				
Grain and feed processing	Site	261	2623.4	newly increased
Farm machinery	set	209		newly increased
Miscellaneous				

Components	Unit	Scope	Investment	Remarks
Organization construction and monitoring and training center	Site	15	2691.35	newly increased
Education and social service			2000	newly increased

2.4 Implementation Period and Goals of the Project

2.4.1 Implementation Period of the Project

The preparation stage of the Project is to be completed in 1998. The implementation of the Project is to be started in 1999 and the implementation period will be 6 years.

2.4.2 Goals of the Project

2.4.2.1 General Goals of the Project

- (1) All the poor households of farmers and herdsmen emerge from poverty with their economic income obviously increased.
- (2) Improvement of production conditions for farming and animal husbandry and of ecological status in the project area.
- (3) Improvement of social services and infrastructures in the project.
- (4) Promotion of sustainable social and economic development in the project area.

2.4.2.2 Detailed Targets of the Project

- (1) In the farming area, every original poor person should have 500 kg of grain and every original poor pastoral-area household holds 30 sheep units of livestock.
- (2) Per capita net income for poor farmers should be over 1128 Rmb and for herders 1692 Rmb, based on the fixed price in 1997.
- (3) Per capita farmland with high productivity should increase to 2-3 mu in which 0.5 mu consists of newly increased irrigated land.
- (4) Per capita ecological improvement land (pasture or tree land) should reach 1.0 mu in cropping areas.
- (5) Per capita fenced pasture (with well, irrigation and feed processing facilities) should reach 1.5 mu in pastoral areas.

2.5 Analysis of Engineering Works and Summary of the Environmental Problems Involved

2.5.1 Environmental Impact Analysis of the Project

According to the composition of the project and the different potential impacts related to the various components in the Project, the development works are classified into 7 categories, as shown in table 2-2. These impacts of these have been divided into in two periods: project construction and project operation.

Table 2-2 Selection of EIA factors

engineering items		Implementation period				Operation period				Rural enterp.	
						Irrigation	Soil conserv.	Rural enterp.	Infrastructure		
environmental resources											
Physical resources	Surface water	-1					+1	-1		-1	
	Ground Water						+1	-1		-1	
	Air	-1				-1	-1	+1			-1
	Noise	-1				-1	-1				-1
	Soil & Erosion	-2	-2	-1	-2	-1	+2	+3		-1	-1
	Solid waste	-1							-1	+2	
	Vegetation	-2	-2	-1		-1		+3			-1
	Wild animal	-1	-1			-1	-1	+3	+1		+2
	Wild plant	-1	-2			-1	-1	+3			-1
	Crop	-1		-1				+2	+3	+1	+2
	Biodiversity			-1	-1			+3	-1	-1	-1
	Natural Scenery.	-2	-2	-1			+2	+2	+1		+1
	Land use	-2	-1	-1			+1	+3	+3	+1	-1
	Social develop.						+3	+3	+3	+1	+2
	Culture & educ.						+2	+1	+1	+1	+1
	Living standard						+2	+2	+3	+1	+1
	Public health	-1					-1	+2			-1
	Public safety	-1					-2				-1
	Historical relics	-1									
Biological resources	Immigration										
Social environments											

Notes: Blank = no impact; + = positive impact; - = negative impact.

1 = slight impact; 2 = moderate impact; 3 = severe impact

2.5.1.1 Infrastructure Construction for Agriculture

The contents of the component include: 45 km newly built country road (quality: Class 3, base width: 8.5 m, top width: 7.0 m, surface sealed with premixed sand-clay, speed limit 60km/h), 866.8 km electric power line, 118 drinking water supply sites. Machine operations are extensively employed during constructions.

In the infrastructure construction works, occupation and damage the land surface are inevitable. Some solid wastes, dust and noise may have some impacts on the environment. After the completion of the construction work, automobile residue gases, dusts, noise and road accidents may have some impacts on environment.

2.5.1.2 Irrigation and Drainage System

Irrigation and drainage systems include all types of wells, ditches, water pumping stations, pipelines and irrigated lands. They cover a total irrigated land area of 35.54 thousand ha and include 498.84 km of lined canals. Construction of the irrigation system may occupy some land, destroy surface soil and vegetation, and cause soil erosion. During its operation, over use of underground water may cause falling of the water table and land salinization. Over use of agricultural chemicals and plastic films accompanied with the irrigation system may cause soil structural changes and environmental pollution.

Totally 3,365 water cellars will be built. Impacts on environment may include: destruction of surface soil and vegetation, soil erosion, sanitation problems caused by disposed domestic wastes during construction work.

Water quality may deteriorated if not properly maintained, which may cause public health problems.

2.5.1.3 Soil and Water Conservation Project

Totally 15,534.3 ha of land will be used for water and soil conservation purpose, which will benefit the long term-improvement of the ecological environment in the region. However, the construction works, such as soil excavation, may cause some problems in terms of soil erosion, destruction of surface vegetation, and interference with wildlife habitats. Poor management during operation period could cause problems of land desertification and loss of fertile land resources.

2.5.1.4 Rain-fed Agriculture

This involves 64,421.9 ha of land. The major issue associated with this component is wind erosion caused by large scale cropping. In addition, improper use of agricultural chemicals and plastic films may cause soil structure and environmental pollution.

2.5.1.5 Animal Production

This is mainly the raising of cattle, sheep, goats, pigs, rabbits and chickens, including 41,750 cattle, 275,868 sheep, 252,436 pigs, 122,960 sets of rabbits and 2,973 sets of chickens. Animal raising may cause grassland deterioration due to overgrazing. Animal wastes may also affect surface water quality and public hygiene.

2.5.1.6 Grassland Improvement

This consists of the production of alfalfa and milkvetch (8,507.8 ha), construction of fenced pastures (2,125 sites), and construction of silage pits (13,725 sites). It may bring some environmental problems in terms of soil erosion and decrease of biological diversity of the grassland region.

2.5.1.7 Township Enterprises

Township enterprise mainly include the establishment of 261 feed grain processing plants and the purchase and use of 209 sets of agricultural machinery (tractors). The processing plants may cause some noise and dust problems. Use of agricultural machinery has the potential to increase soil erosion in the project area.

2.5.2 Possible Major Environmental Problems Caused by the Project

The principal environmental issues associated with the implementation of the project may thus be summarized as follows:

- (1) Soil erosion caused by rainfed cropping practices.
- (2) Grassland deterioration and decrease of biological diversity caused by over use of grassland resources.
- (3) Falling of underground water table and land salinization caused by over use of under ground water resource.
- (4) Environmental pollution caused by improper use of agricultural chemicals and plastic film.
- (5) Air pollution and noise caused by rural township enterprise .
- (6) Destruction of surface soil and vegetation, landscape change, soil erosion, dust and noise caused by road construction.

3 ENVIRONMENT STATUS IN THE PROJECT REGION

3.1 Summary of Environment

The Project region is located in the central part of Inner Mongolia Autonomous Region ($N40^{\circ}42'$ - $44^{\circ}15'$, $E109^{\circ}40'$ - $120^{\circ}43'$), on northern side of the Yinshan Mountains. To its north is the Mongolian Plateau. To the east is the Kergin Sandy Land and on the west it is boarded by the Wulashan Mountains. The region is a long stripe of land of some 932 km from the east to the west. Natural and social ecological features of the Project region are summarized below (Table 3-1).

Table 3-1 Characteristics of the Different Ecological Zones in the Project Region

Basic Feature	Wulanchabu zone (Incl. Guyang)	Taibushi and duolun zone	Chifeng zone	Keyouzhong zone
Geographical location	$E109^{\circ}19'$ - $114^{\circ}49'$, $N39^{\circ}37'$ - $42^{\circ}39'$	$E114^{\circ}51'$ - $116^{\circ}45'$, $N41^{\circ}46'$ - $42^{\circ}39'$	$E118^{\circ}26'$ - $120^{\circ}45'$, $N43^{\circ}14'$ - $44^{\circ}22'$	$E119^{\circ}34'$ - $122^{\circ}18'$, $N44^{\circ}14'$ - $46^{\circ}42'$
Topography and landscape	Plateau, low mountain, hills	Low hills, sandy land, fluvial plain, river terraces	Mid-low hills, sandy land	sandy land, river terraces
Climate				
Rainfall range	250-400mm	350-430mm	250-530mm	350-400mm
Average rainfall	325mm	390mm	381mm	375mm
Average tem.	1.2 - 4.6°C	1.4 - 1.6°C	4.5°C	5.6°C
Average wind speed	3.8 s/m	3.6 s/m	3.7 s/m	3.2 s/m
Gale days	50 days	76.3 days	10-70 days	66.7 days
Frostfree period	90-120day	100-110day	110-130day	90-120day
Soil type	Brown chestnut and meadow soils	Brown chestnut, meadow, sandy and black chestnut soils	Brown chestnut, meadow, sandy, brown and black chestnut soils	Sandy, brown chestnut, black chestnut and meadow soils
Soil erosion	Wind erosion serious	Wind and water erosion serious	Wind and water erosion serious	Wind and water erosion fairly serious
Agric feature				
Cropping system	1 harvest/year	1 harvest/year	1 harvest/year	1 harvest/year
Main crops	wheat, potato, buckwheat and oat	wheat, potato, buckwheat	wheat, potato, buckwheat, maize, beans, rice	wheat, potato, maize
Vegetation	Typical grassland, arid grassland	Typical grassland, sandy vegetation	Typical grassland, swamp vegetation	Typical grassland, meadow grassland, swamp vegetation
Socio-economy				
Pop. Density	23.7 people/ km^2	39.1 people/ km^2	17.4 people/ km^2	24.1 people/ km^2
Per capita land area	22.67 mu/person	8.48 mu/person	6.82 mu/person	7.7 mu/person
Per capita income	721 Rmb	1051Rmb	823 Rmb	900 Rmb

Basic Feature	Wulanchabu zone (Incl. Guyang)	Taibushi and duolun zone	Chifeng zone	Keyouzhong zone
Main River	Eibugai river	Lan river	Xilamulun and Laoha rivers	Huolin river
Water quality	Clean	Clean	Clean	Clean
Air condition	Clean	Clean	Clean	Clean
Natural reserves	Liqigou Bawa River source	Caimushan	Baiyunaobao, Dali Lake, Wupaizi	Kerqin swamp and bird refugee

3.2 Natural Reserves

There are 9 natural reserves in the Project region for which the details are shown in Table 3-2.

Table 3-2 General Description of the Natural Reserves

Name	Class	Geograp. location	Location	Size (ha)	Protected species	Relation to project area
Kergin	State	E121°40"-122°14", N44°51"-44°17"	Keyouzhong Banner, Xingan League	126987	Birds, landscape and grassland vegetation	In the project region but not in the implementation district
Dalinoor	State	E116°22"-117°, N43°11"-43°27"	Keshiketeng Banner, Chifeng City	119413	Birds, grassland ecosystem	None
Bayinaobao	Region 1	E117°06"-117°16", N43°30"-43°36"	Keshiketeng Banner, Chifeng City	6737	Picea forest ecosystem	None
Baiwanghe	Banner	E113°66", N41°23"	Jining City Wulanchabu League	1500	Drinking water reserve	None
Caimushan	Banner	E116°35"-116°54", N42°24"-42°32"	Duolun, Xilingule League	2600	Meadow grassland ecosystem, forest in sandy hills, lake and endangered plant, bird and animal species	None
Saihanwula	Banner	E118°18"-118°55", N43°59"-44°27"	Balinyou Banner, Chifeng City	100400	forest	None
Wupaizi	Banner	Wongniute Banner	Wongniute Banner, Chifeng City	100	Swamp land and rear birds	None
Liqigou	Banner	E110°31"-111°53", N40°47"-41°23"	Wuchun, Huhhot City	7196	Picea forest, secondary betula forest, endangered animals	None

Name	Class	Geograp. location	Location	Size (ha)	Protected species	Relation to project area
Dalengshan	Banner	Linxi	Linxi, Chifeng City	1000	Picea and other plant species	None

Among the 9 natural reserves, Kerqin and Dalinoor natural reserves are State class ones, the others are under the administration of county/banner governments. Apart from the Kergin natural reserve, others are not in the project areas.

3.3 Ecological Environment Status

3.3.1 Land use

Land area of the Project is 13.85 million ha. Land use types are listed in Table 3-3

Table 3-3 Land uses in the Project region

Land use	Area (million ha)	%
Cropping land	1.675	12.1
Grassland	9.891	71.4
Forest	1.303	9.4
Water area	0.884	0.6
Others	0.897	6.5

As shown in the Table 3-3, cropping and grassland is the major use of land resources in the Project region. In the 1.675 million ha cropping land, 0.155 million ha is irrigated land (only 9.25% of the cropping land), the other 1.52 million ha (90.75%) is mainly rainfed hilly land. Grassland is 9.891 million ha, which makes up 71.4% of the total land. Per capita land area in the Project region is 62 mu, in which 9.2 mu is cropping land and 0.85 mu is irrigated land. Generally speaking, cropping land in the region is of poor quality and therefore the crop yields are low and unstable.

3.3.2 Soil Environment Status

The soils are the result of the complex influences of topography and geographical features, parent materials, climate and vegetation. The principal soil include: brown chestnut soil, grey chestnut soil, brown-dark soil, meadow soil, and sandy soil. Soil nutrient status is low in the west part of the region and slightly higher in the east part. Table 3-4 shows the main features of these soil types.

Table 3-4 Dominant Soil Types and typical characteristics the Project Region

Wulanchabu zone (incl. Guyang)		Taibushi-Duolun zone	Chifeng zone	Keyouzhong zone
Soil type	Brown chestnut	Brown chestnut	Grey chestnut, sandy, brown chestnut	Meadow, brown chestnut
Organic content(%)	0.69	1.2	0.85-1.80	1.35-2.40
Total N(%)	0.0419	0.0827	0.1032	0.1535
Total P(%)	0.0631	0.0781	0.0872	0.0981
Total K(%)	98.5-152.7	76-148.0	89-167.5	130.0
pH	8.12	8.23	7.82	8.20-8.92

3.3.3 Vegetation, Plant and Animal Resources

3.3.3.1 Type and Feature of Vegetation as Well as Plant Resources

Vegetation in the Project region includes: forest vegetation, grassland vegetation, sandy land vegetation, swamp vegetation and crop land vegetation. The main features of the vegetation are listed in Table 3-5.

Table 3-5 Main Features of the Vegetation in the Project Region

Vegetation type	Community characters				Dominant /constructive species
	Height (cm)	Coverage (%)	Biomass (kg/mu)	Species No. (No./m ²)	
Crop land			Wheat:60 Buckwheat:45 Potato:1350 Maize:400		Wheat, maize, oat, potato, linseed, pea, buckwheat, beans, rice
Grassland	10-35	20-30	85-120	8-18	Stipa spp., Leymus spp. Artemisia spp., Lezpedeza spp., etc.
Meadow	15-45	30-45	130	12-20	Achnasorum spp., Leymus spp., Carex app., etc.
Manmade Forest		54		1-2	Elm, poplar, caragana

Plant components of the flora in the region include Daurica-mongolian species, northern China species, North-eastern China species, and Eastern Asian species. Main dominant/constructive species in the region include *stipa spp.*, *Aneulolepidium chinensis*, *Cleistogenes squarosa*, *Festuca arundinacia* sp., *Agropyron cristatum*, *Tancetum sibiricum* in the typical grassland and *Caragana* sp., *Stipa* sp., *Artemisia frigida*, *Ajania pallasiana*, *artemisia* sp. In the arid and semiarid grasslands. Plant resources are listed in the Table 3-6

Table .3-6 Plant resources in the project region

Resources type	Main species
Crop	Wheat, oat, potato, linseed, rapeseed, <i>Panicum</i> spp., <i>Setaria</i> , millet, beans, maize, rice
Herbage plants	<i>Stipa</i> spp., <i>Leymus</i> spp., <i>Cleistogenes</i> spp., <i>Carex</i> spp., <i>Agropyron</i> spp., <i>Artemesia</i> ., <i>Caragana</i> spp., <i>Ajannia</i> spp., etc.
Trees	<i>Caragana</i> spp., poplar, elm, willow, Chinese pine, larch, etc.
Other economical plant	Wild apricot, seabuckthorn, wild grape, wild cherry, <i>Ephedra sinica</i> , <i>Glycyrrhiza</i> spp., <i>Astragalus mongolicum</i> , dandeline, etc.

3.3.3.2 Animal Resources

The project region is located in the middle temperate zone, belonging to the Mongolian-Xijiang geographical region in terms of animal distribution. This region is generally marked with simple structure of the animal community and low abundance of species. The main animals in the region include Mongolian horse, Mongolian cattle, sheep, goat, donkey, mule, pig, chicken, rabbit, and some wild animals and birds such as deer, marten, racoon and fox. Some animal or birds which are in the State/Region Protection Lists are occasionally found in the Project region. Details of the wild animal/birds resources are listed in Table 3-7.

Table 3-7 Wild Animal/Birds In The Project Region

Type	Scientific name
Amphibian	<i>Bufo gargarizans cantor</i>
	<i>B.raddei strauch</i>
	<i>R.nigromaculata Hallowell</i>
	<i>R.chensinensis</i>
Reptile	<i>Eremias argus Peters</i>
	<i>Phrynocephalus frontalis strauch</i>
	<i>Calamaris spinalts (peters)</i>
	<i>Aegistrodon sp.p</i>
Bird	
Anseriformes	<i>Tadorna ferruginea (pallas)</i>
	<i>T.tadorna (Linnaeus)</i>
	<i>Cygnus (Linnaeus)</i>
	<i>A.platyrrhynchos (Linnaeus)</i>
Falconiformes	<i>Accipiter gentilis(Linnaeus)</i>
	<i>A.nisus (Linnaeus)</i>
	<i>C.aeruginosus (Linnaeus)</i>
	<i>F.tinnunculus (Linnaeus)</i>
Galliformes	<i>Alectoris graeca (meisner)</i>
	<i>Phasianus colchicus (Linnaeus)</i>
Charadriiformes	<i>Vanellus vanellus (Linnaeus)</i>
Lariformes	<i>Sterna hirundo (Linnaeus)</i>
Columiformes	<i>Syrrhaptes paradoxus (Pallas)</i>
Passeriiformes	<i>C. rufescens (Vieillot)</i>
	<i>Galerida cristata (Linnaeus)</i>
	<i>Hirundo rustica (Linnaeus)</i>
	<i>L. cristatus (Linnaeus)</i>
	<i>L. sphenocercus cabanisi</i>
	<i>C. monedula (Linnaeus)</i>
	<i>P. mentanus (Linnaeus)</i>
	<i>Pica pica (Linnaeus)</i>
	<i>Cervus fruilegus (Linnaeus)</i>
Gruiformes	<i>Grus grus (Linnaeus)</i>
	<i>G. japonensis (Muller)</i>
	<i>Otis tarda (Linnaeus)</i>
Mammalian	<i>Lynx lynx (Linnaeus)</i>
	<i>Lepus tolei Pallas</i>
	<i>Ochotona daurica Pallas</i>
	<i>Eutamias sibiricus Laxmann</i>
	<i>M. aspalax Pallas</i>
	<i>S. dauricus Brandt</i>
	<i>Marmota sibirica Radde</i>
	<i>M. mandarinus Milne-Edwards</i>
	<i>Meles meles (Linnaeus)</i>
	<i>M. sibirica Pallas</i>

4. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

4.1 Summary Environmental Issues, Mitigation Measures, Monitoring Procedure and Responsibilities

The project components have been identified previously as: agricultural infrastructure construction, Irrigation system, water and soil conservation, rainfed cropping, animal husbandry, grassland improvement, and rural township enterprise. The environmental issues, the possible mitigation measures during project construction and operation, and the monitoring procedure and responsible agencies for the Project are listed in Tables 4-1 to 4-16. The purpose of these tables is to provide a clear and concise plan of what will be done in order to manage and monitor the potential impacts that might be associated with project implementation. These tables also provide a simple manual that can be used by those responsible for the implementation of the various project components to ensure that they have taken into account all the important issues in their implementation plans and budgeting activities.

Table 4-1 Environmental Issues, Mitigation & Monitoring Plans of Rural Infrastructure

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
Rural Infrastructure Construction 1. road	1) No.: 1 2) Construction scale: The total length is 45 km. 3) Class of road: class 3 width of roadbed: 8.5 m Engineering works of roadbed: earthwork: 284,750 m ³ stonework: 29,185 m ³	1) Geomorphology and topography: Inner Mongolia Plateau, low hills and hilly land. 2) Thickness of earth layer: A=22cm, B=35cm; C=50cm 3) Soil category: sandy chestnut soil 4) Soil erosion modulus: 3,281 t/km ² /Y 5) Wind speed and direction average wind speed: 3-5 m/s; the top wind speed: 34m/s(spring); days of strong wind: 70 days/y (generally in spring); wind direction: west and north west; strong wind season: from March to May 6) Average annual rainfall: The rain mainly concentrates in the period from July to Sept.; average annual rainfall: 170mm; the largest rainfall: 325.8 mm; the smallest rainfall: 89.8 mm. 7) The frost-free period: about 95 days. 8) The species of plants: The plants are mainly the species of steppe, e.g. Needlegrass, Chinese Aneurolepidium, Fringed Sagebrush, Shrub Lespedeza and Caragana, etc. 9) There are no historical and cultural remains along the both sides of the road. 10) Land utilization: natural pasture and small area of artificial pasture. 11) The grassland is degraded	Soil erosion	1) Strictly avoid construction during the time of strong winds or heavy rainfall 2) Avoid removal of earth from steep slopes whose gradient is more than 15°. 3) Avoid dumping of waste rock, stones and earth into rivers, streams or gullies. 4) Build protection at the places where soil erosion occurs easily, i.e. drainage ditches. 5) Deploy the roadbed earthwork in vertical direction rationally: Make balance between filling and excavation. 6) Reduce the temporary occupation of the area to the shortest time possible. 7) Plant w Caragana and Astragalus on both sides of the road. 8) At places where earth is removed, grow forage grass before rainy season to restore vegetation cover so as to prevent soil erosion.	Construction unit	1) Supervise that the construction is implemented according to the laws of soil and water conservation of the country and its design. 2) Supervise the implementing situation of the measures of soil and water conservation 3) Executor: The Monitoring Station of Grassland and Ecology in Damao Banner 4) Supervisor: Environmental Protection Bureau in Damao Banner	1) Strengthen the protection of the plants grown on both sides of the road. Replant in time those that are not survived. 2) Strengthen the management and maintenance of the drainage ditches of the road.	The management department of the road	1) Monitoring content: the erosion degree caused by the construction and the effect of soil and water conservation. 2) Monitoring spot: the soil erosion areas along the road where soil erosion may occur and 3 spots are set up. 3) Monitoring frequency: 1time/32 4) Executor: The Monitoring Station of Grassland and Ecology in Damao Banner 5) Supervisor: Environmental Protection Bureau in Damao Banner	1) 35,000 Rmb for planting trees, shrubs and grass on both sides of the road. 2) The cost for monitoring: 6,000 Rmb.
				1) Avoid extending the limits of the areas from which soil is removed. 2) All the activities must be within the limited area. Minimize the area so as to reduce disturbance. 3) Constructors must avoid unnecessarily cutting trees, shrubs and grass around construction sites. Keep off the pastures as much as possible	Construction unit	The activities are supervised by the grassland management station in Damao Banner	1) Reclaim the area that is disturbed by the construction Grow forage grasses to restore vegetation cover. 2) Set up signs forbidding vehicles from travelling on grassland.	The traffic management station in Damao Banner	Supervisor: the grassland management station and the traffic management bureau in Damao Banner	
				Avoid operating near the residential places at night.	Construction unit	The activities are supervised by the traffic management station in Damao Banner	When vehicles pass through residential areas, the horns are not allowed to blow loudly. The noise is strictly controlled within the range of the regulations of the country.			
				1) The places where stones and sand are stored and where the earth are removed should be far away from residential district 2) Avoid construction during the time of strong wind.	Construction unit		Strengthen the maintain and management to the surface of road, such as measures of level and press. Set up signs to limit the speed of vehicles at places where there is a village.		Supervisor: the traffic management bureau in Damao Banner	
			Dust							

Table 4-2 Environmental Issues, Mitigation & Monitoring Plans of Rural Infrastructure

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
Rural Infrastructure Construction 1. road	2) Bridge and culvert	The distribution of wild animals: Within the districts along the road there is no bird or wild animal habitat. There are common local species, such as larks, sparrows, etc.	Wildlife destruction	Strictly avoid the destruction of wildlife habitat and capture or killing of birds	Construction unit	It is supervised by the Environmental Protection Bureau in Damao Banner.	Write obvious signs to remind vehicle of going through slowly at the places birds and wildlife move about.	The traffic management station in Damao Banner	Supervisor: The traffic management department	
		1) Small bridge: No.:4 Total length: 43.2m 2) culvert: No.: 50 Total length: 544.78m 3) Foads (Road surface where water can flow across): No.:3 Total length: 353m	Surface water: The road that is planned to be built goes across a seasonal river.	Surface water disturbance	1) The places where earth or rock is removed must not be near riverbed or canal bed. 2) The waste earth of the construction must not be dumped into the river or interfere with normal water flow. 3) There should be water conservation facilities around the bridges and culverts so as to prevent river bed erosion and maintain the traffic safety.	Construction unit	1) Monitoring contents: SS in the surface water. 2) Monitoring spot: The river near the road that is planned to be built. Set up 2 monitoring spots. 3) Monitoring frequency: once/year (May) 4) Executor: The environmental monitoring station of banner/county 5) Supervisor: The Environmental Protection Bureau of banner/county	Examine and check the bridges and the culverts regularly to maintain the safety of the road.	The same as the above	The road management department supervises the safety of the bridges and culverts.
		The causes that may influence the traffic safety are: the poor conditions of the road, the high speed of vehicles and driving a car against traffic regulations	Traffic safety	Manage the traffic reasonably so as to avoid traffic jam during construction.	Construction unit	It is supervised by the traffic management bureau	1) Put up traffic signs according to standard traffic regulations. 2) Public security and traffic departments must work out the necessary transportation and management regulations to guarantee the traffic safety (including the safe transportation of dangerous materials).	The same as the above	It is supervised by the traffic management bureau in Damao Banner.	

Table 4-3 Environmental Issues, Mitigation & Monitoring Plans of Rural Infrastructure

Contents		Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
1)	2)				Mitigation measures	Responsibility person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
Rural Infrastructure Construction 1. Engineering works for power supply	1) Engineering works of high voltage for power supply	1) No.7 2) Construction scale: 866.8 km	1) Geomorphology and topography: plain and hilly land; low hills and hilly land. 2) Average wind speed: 3-5m, the strong wind period: March to May. 3) Average annual rainfall: 200-400 mm, that mainly in July to Sept. And which makes up for 75%. 4) Vegetation type: The farming crops take the dominant part. They are wheat, corn, naked oats, buckwheat and oil crops. 5) Land utilization: The farming land takes the main part. There is small area of natural pasture, artificial pasture and trees. 6) The soil is mainly sandy soil.	Soil erosion Destruction of soil and vegetation cover Dust and noise Public safety	1) Strictly avoid construction during times of strong wind and heavy rain. 2) Avoid discarding materials randomly during construction and remove wastes promptly after the completion of construction.	Construction unit	It is supervised by the local environment protection bureau.				
	2) Engineering works of low voltage for power supply				1) Strictly avoid random expansion of the construction margins. 2) The constructors and vehicles should keep off the soil and vegetation cover.	Construction unit	It is supervised by the local Environmental Protection Bureau.	Reclaim the districts that are destroyed and restore the vegetation cover.	Construction unit	It is supervised by the local Environmental Protection Bureau	
					1) Avoid constructing during the time of strong wind (from March to May). 2) Strictly avoid construct near the residential districts at night.	Construction unit	It is supervised by the local Environmental Protection Bureau.				
					1) Work out the administrative regulations for safe construction. 2) Build fence around transformer and put up sign to warn danger.	Construction unit	It is supervised by the local power department.	Examine and check whether the measures and facilities for safe are in goad condition regularly.	The local Power Bureau	It is supervised by the local Power Department	The local Power Department Pay the salary costs for monitoring..

Table 4-4 Environmental Issues, Mitigation & Monitoring Plans of Rural Infrastructure

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
3 Engineering works for wells and cisterns water supply	1) No.:4 Construction scale: 76 2) Wells with motor pumps: 76 cistern: 76 water point: 118 well for checking and repairing: 195	1) Geomorphology and topography: plain and hilly land, low hills and hilly land. 2) Average wind speed: 3-5m/s. The strong wind period is from March to May and the wind direction is west or northwest. 3) Average annual rainfall: 170-350mm. It concentrates during the period from July to Sept., which makes up for 75%. 4) Vegetation type: The farming crops take the dominant part, e.g. wheat, oats, corn and oil crops. 5) Land utilization: The farming land takes the dominant part and there is some artificial pasture, undeveloped land and tree land. 6) The distribution of wild plants and animals: the common local species. 7) The drinking water quality of man and animal: It accords with the GB5749-85 fundamentally. 8) Soil: sandy loam 9) Average soil erosion modulus: 3200t/km ² /Y 10) The water quality issues: The runoff of the surface water flows into wells and the earth and sand taken by wind enter into cisterns. 11) The factors that may influence the public safety: There are no covers on some cisterns that man and animal may fall into by mistake, there are some power facilities without safe and protecting measures that man and animal get electric shocks by mistake.	Soil erosion	1) Avoid construction during periods of heavy rain and strong wind. 2) Pile up the earth and stones as near the worksite as possible. 3) Clear the worksite promptly after construction.	Construction unit	It is supervised by the local Environmental Protection Bureau.				
				Destruction of soil and vegetation	1) Strictly avoid expansion of construction sites. 2) Strictly forbid contractors to destroy the vegetation cover nearby.	Construction unit	It is supervised by the local Environmental Protection Bureau.	Reclaim the disturbed soils and restore vegetation cover.	Construction unit	Reclaim the disturbed soils and restore the vegetation cover
			Dust and noise	1) Avoid constructing during the time of strong wind (from March to May). 2) Strictly avoid construct near the residential districts at night.	Construction unit	It is supervised by the local Environmental Protection Bureau.				
				Surface water disturbance	Strictly avoid dump the waste things of the construction to the rivers or ditches nearby.	Construction unit	It is supervised by the local Environmental Protection Bureau.			
			Water quality	The mouths of wells and cisterns should be 0.5-1.0m higher than the ground surface so as to prevent impurity getting into water.			1) Prevent the contaminated runoff from entering wells and cisterns. 2) Put sealing covers on wells, cisterns and pressure pots and assign special personnel to take care of them.	The Local Water Conservancy Department	1) Monitoring content: PH, total hardness, nitrate, fluoride, volatilizing phenol, Hg ⁺ , Cr ⁶⁺ , PO ₄ the total number of Escherichia coli, water table. 2) Monitoring frequency: Once/3 years. 3) Monitoring spot: drinking water spot. 4) Executor: The environmental monitoring station of banner or league. 5) Supervisor: The Environmental Protection Bureau of banner or league	Monitoring cost: 30,000 Rmb

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			
				Mitigation measures	Responsible person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
			Public safety	1) Work out the regulations of safe construction. 2) Put covers on wells and build safe fences and lock them. 3) Build fence around transformer and put up sign to warn danger.	Construction unit	1) Education workers to do their work in safety. 2) Executor: Construction unit 3) Supervisor: the local water conservancy department	1) Examine and check whether the safe devices are in good condition.	Construction unit	It is supervised by the local Water Conservancy Department	Investment in environment protection

Table 4-5 Environmental Issues, Mitigation & Monitoring Plans of Irrigation System

Table 4-6 Environmental Issues, Mitigation & Monitoring Plans of Irrigation System

Contents		Survey of the item	Environment context	The possible environmental issues	Mitigation measures	Responsible person	Monitoring procedure and Responsible	Investment in environmental protection
Irrigation system engineering works	1. Groundwater irrigation engineering works			<p>13) The amount of fertilizer and manure applied into the land at present: NH_4CO_3: 5-10 kg/mu Urea: 2-5 kg/mu DAP: 1-5 kg/mu Manure: 1,000-2,000 kg/mu</p> <p>14) The used amount and the range of plastic film is small.</p> <p>15) The recovery rate of plastic film is 10-30%. plastic</p> <p>16) The residue rate of film is 70-90%.</p> <p>17) The outbreak of pest and the used situation of farm chemicals are in the attached list(Note Appendix Table 1-1)</p> <p>18) The most part of the soil in the project area is sandy loam. The capacity of holding water and fertilizer is poor, so farm chemicals and fertilizer easily leach into the ground to pollute underground water.</p> <p>19) Plastic film is mainly used for maize to raise soil temperature and moisture content in order to raise output. The maize grown under plastic film is 10,136.3 ha in the project area and the usage amount is 60-75 kg/ha.</p>	<p>The effects of farm chemical pollution on health</p> <p>1) Increase manure and decrease fertilizer. 2) Apply fertilizer and manure rationally based on existing nutrition contents of soil 3) Apply fertilizer by layers to increase fertilizer utilization efficiency. According to the different growing periods of crops, apply more times with little amount each time (seed, 3 leaves, tillage). Balanced nutrient use. 4) Reduce the amount of agricultural chemicals and select chemicals of high effect, low residue and low toxicity. Protect natural animals of pests. Check whether the quality of farm chemicals reach to the standards. 5) Use agricultural chemicals safely according to "the State Standards of Agricultural Chemical Use"—GB4285-84. As for the proper usage amount of farm chemicals, please refer to the Appendix Tables I-1, I- 2 and I-3. 6) Strengthen the propagation of safe use agricultural chemicals and fertilizer. Take comprehensive measures to control pests and disease and do a good job of the field management. Train farmers to direct them how to control pest and disease and the method to use farm chemicals in safety.</p>	<p>The working station of soil and fertilizer or the station of plant protection</p>	<p>Monitoring content: A: The pest species . B: The types of agricultural chemicals and herbicides and the amounts used, the residues. C: N \squareP \square organic phosphorous pesticide in the soil etc. 2) Monitoring frequency: once/year for pest and once/3-5 years for farm chemicals. 3) Executor: The Environmental Monitoring Station of banner/county/ league. 4) Supervisor: The Environmental Protection Bureau of banner/county.</p>	<p>The cost for monitoring 210,000 Rmb</p>

Table 4-7 Environmental Issues, Mitigation & Monitoring Plans of Irrigation System

Contents	Survey of the item	Environment context	The possible environmental issues	Mitigation measures	Responsible person	Monitoring procedure and Responsible	Investment in environmental protection
	(4) Drawing water for irrigation 1) No.: 3 project banner/county 2) Construction scale: 1,136.5 ha.	The environment context is the same as the 19 factors above	The possible environment issues are the same as the first 6 above	The mitigation measures are the same above	The same above	The same above	
Irrigation system engineering works 2. Surface water irrigation engineering works	5) Water cellar construction 1) No.: 2 project banner/county 2) Construction scale: 3356: 779 in Chayou-hou banner and 2,577 in Wengnute banner. They can supply water for dibbling of 1,101 ha.		Sedimentation	Clear up the sediment in ditches and water cellars in time	Farmers and village head	The work is supervised and managed by the local PMO	
			Water quality	Take measures to prevent withered branches and leaves, impure materials and animal dung entering into wells or water cellars	Farmers and village head	The work is supervised and managed by the local PMO	
			Public safety	Set up protection fence and locks around wells, cellars and power facilities and keep children away	Contractor	The work is supervised and managed by the local PMO	
			Soil erosion	1) Avoid constructing during the time of heavy rain and strong wind. 2) Strictly avoid discarding waste earth and stones on slopes and gullies where soil erosion easily occurs.	Village head	The work is supervised and managed by the local PMO.	
Irrigation system engineering works 3. Pipe and ditch irrigation engineering works	6) Pipeline irrigation No.: 8 project banner/county. Construction scale: 7,306.6 ha	1) Annual average temperature: 1.3-5.8°C; frost-free period: 90-140 days. 2) Annual average rainfall amount: 200-400 mm; evaporation amount: 2100-2380 mm. 3) The most part of soil in the project area is sand loam. (The diameter of the sand grain is >0.01 mm) The content of sand grain make up for 75-85%.	Soil erosion	1) Avoid construction during periods of heavy rain and strong wind. 2) During the construction, strictly avoid discarding waste earth and stones on easily eroded slopes or s. 3) After construction, replace original layers of earth promptly plant trees and grow grass. 4) Build shelterbelts on both sides of ditches.	Contractor	It is supervised and managed by the administrative department of county/banner.	
			Sedimentation	Clear up the sediment in ditches promptly	Farmers	It is supervised and managed by the local PMO.	

Table 4-8 Environmental Issues, Mitigation & Monitoring Plans of Water and Soil Conservation

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
Water and soil conservation works	1) Forest for erosion control 2) Construction scale: 6,125.7 ha.	1) characters of geomorphology and topography: Hill land and hills 2) average wind speed: 3-5 m/s 3) annual rainfall: 200-400 mm, in which, 70% in July, August, September, climate character is that strong wind and drought are in same season 4) average erosion modulus: 3200 t/km ² ·a Wind erosion modulus in the northern side of Yinsan Mountain: 4400-9500 t/km ² ·a 5) Organic matter content in soil: 1.0-3.0%. 6) Soil texture: sandy loam 7) Wind erosion and desertification of soil are serious. Water and soil erosion in some hills is serious 8) The pasture is overgrazed 9) Wild animal species: There are hawks, larks, wild chicken, wild rabbits and foxes, etc.	Grassland deterioration	1) Avoid construction during periods of strong wind and heavy rain. 2) Build high ridges and grow grass, shrubs and trees on the ridges on the terrace built from slope land. 3) Carry out the construction strictly according to the stipulation under the direction of local forestry and water conservation personnel 4) There should be some space between rows of trees/shrubs so as not to affect grazing. 5) Take effective measures to protect the head of erosion gully, for example, build ridges. 6) Plant trees for erosion control on the north side of mountain where the soil layer is thick and take measures to make tree pits keep soil and water; Avoid planting trees on the south side of mountain and on the top of mountain where the soil layer is thin, and reestablish grass and shrubs at these places. 7) Carry out the construction strictly according to the technical stipulation of the engineering works so as not to destroy the vegetation cover outside the construction site.	Contractor	1) monitoring item: soil erosion and control effect. 2) monitoring frequency: twice 3) executor: banner/county water conservation station 4) supervisor: banner/county water conservation bureau				The cost for monitoring: 1000 Rmb×15 county/banner ×2years = 30,000 Rmb.
	2) Larch 3) Anus apricot		Wildlife enhancement and the affection on animal diversity	1) Avoid the breeding areas and habitat of animals and birds nest etc. 2) Educate constructors to protect wild animals and give them training of ecology. 3) Protect originally good vegetation cover 4) Keep the diversity of wildlife	Contractor	It is supervised and managed by the PMO of county/banner	1) Strengthen the propagation to protect wildlife. 2) Set up some propagation boards and signs. No one is allowed to destroy the exercising and existing places of wildlife. 3) Whenever there are wild animals, which should be protected according to the regulations of the country, protective measures must be taken at the very place. No one is allowed to disturb them. At the same time, notice the concerned environmental department and forestry department to deal with the affair.	The Wildlife Protection Department	It is supervised and managed by the Environmental Protection Department of Forestry Bureau.	

Table 4.9 Environmental Issues, Mitigation & Monitoring Plans of Water and Soil Conservation

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible person	Monitoring procedure and responsibility	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
Water and soil conservation works	1) Number: 7 2) construction scale: 12,672ha.		Land deterioration and loss				1) Strengthen the tending and management of the planted trees to raise the survival rate. 2) Replant trees, shrubs or reestablish forage grass to restore vegetation cover. 3) Raise the awareness of the cadres at all levels to protect environments	The local Soil And Water Conservation Station or Forestry Station	1) monitoring item: soil erosion degree and the control effect 2) monitoring frequency: twice 3) executor: banner/county environmental monitoring station 4) supervisor: banner/county Environmental Protection Bureau	The cost for monitoring: 1000 Rmb×15 county/banner×2 years = 30,000 Rmb
			Wind erosion and land desertification	1) Avoid constructing during the time of strong wind and heavy rain 2) Construct shelterbelts of shrubs along contour lines. 3) Carry out the construction strictly according to the stipulations and under the direction of local forestry and water conservancy personnel. 4) There should be some space between rows of shrubs so as not to affecting grazing. 5) Take effective measures to protect the head of erosion gully, for example, build ridges. 6) Carry out the construction strictly according to the technical stipulation of the engineering works so as not to destroy vegetation cover outside the construction site. 7) As the above 7).	Contractor	It is supervised and managed by the PMO of the county/banner.	The same as the above.	The same as the above	It is supervised and managed by the departments of forestry and soil and water conservation	
	4) Shelterbelt of shrubs 5) terrace built from slope land 1) Number. 10 2) Construction scale: 9,162.6 ha,		Soil erosion	The same as 1), 2), 5) and 7) of the above	Contractor	The same as the above	Strengthen the maintenance of the ridges	The local soil and water conservation station	The Soil and Water Conservation Bureau of county/banner.	

Table 4-9 Environmental Issues, Mitigation & Monitoring Plans of Dry Land Farming

Contents	Survey of the item	Environment context	The possible Environmental Issues	Mitigation measures	Responsible person	Monitoring procedure and Responsible	Investment in environmental protection	
Dry Land Farming	1. maize grown under plastic film 2. Wheat in dry land 3. Virus-free potato 4. Buckwheat in dry land 5. Pea in dry land	1) No.: 9 2) Construction scale: west:3,222.6 ha east: 5,399.5 ha 1) No. 9 2) Construction scale: West: 19,197.1 ha. East: 1,732.7ha. 1) No.:10 2) Construction scale: 25,165.5ha. 1) No.: 3 2) Construction scale: 6,311.5 ha. 1) No.: 1 2) Construction scale: 709.7 ha.	1) Average wind speed: 3-5 m/s 2) Average annual rainfall: 200-400 mm 3) Soil erosion modulus: 3,200 t/km ² /y 4) Wind erosion area: 50-90% 5) Soil texture: sandy loam 6) Organic matter of soil: 1% 7) Total N content in the soil (N): 0.05-0.16% 8) Available P in the soil (P): 1-7 mg/kg 9) Available K in the soil (K): 80-170mg/kg 10) Soil CEC: 6-11.0 me/100g 11) The amount of fertilizer that is to be used in the project manure: 15-30 T/ha. ammonium bicarbonate: 150-450 kg/ha. DAP 45-150 kg/ha. Urea: 30-225 kg/ha. Amount of fertilizer and manure used at present: Manure: 7.5-22.5 t/ha. Ammonium bicarbonate: 75-150 kg/ha urea: 30-150 kg/ha DAP:30-150 kg/ha 12) The amount of pesticides used in the field is small. 13) The amount of plastic film used in the field is small. (60-75 kg/ha.) 14) The rate of film taken off: about 10-30% 15) The residual rate of plastic film: about 70-90% 16) The utilization rate of excrement and urine of man and animal: 100%	Wind erosion of soil Water erosion of soil Loss nutrition content Affection of farm chemicals and fertilizer on health Collection and treatment of plastic film	1) Choose proper farming machine to plough and roll and press the top soil after ploughing in time. 2) Build various farmland shelterbelts of trees, shrubs and grass according to the concrete site factors. 3) Make every effort to convince farmers not to cultivate in an up and down slope pattern and to adjust farming patterns to follow the land contours; the implementing situation of reduced tillage or no-till, the situation of taking measures to conserve soil and water and the control effect. 4) Research and look into the reduced tillage and zero-tillage 1) Adjust farming patterns to follow the land contours. All the land must be cultivated along contours. 2) Build terrace land and check dams etc. according to the concrete conditions. Build shelterbelts and drainage ditches in the land. 3) Build high ridges in the farmland where water erosion happens easily and grow shrubs and grass on the ridges. Apply fertilizer and manure by layers or apply them deeply and strengthen the supervision of measures for prevention and control of soil erosion. Use appropriate fertilizer applications (balanced plant nutrition and increase the use of manure and persuade farmers not to burn manure). Carry out the training and extension on fertilizer use. Hasten the steps to build farmland shelterbelts and give regular medical examinations to the people. Pay attention to the safe use of farm chemicals and fertilizer. Train farmers on safe chemical handling and application. Persuade them to buy good quality farm chemicals and fertilizer.NB not necessarily from state shops. 1) Collect plastic film by machine or by hand. 2) Work out some policies such as "Used trade-in New" to encourage farmers to collect plastic film 3) Use the existing supply and marketing cooperatives to collect plastic film and reprocess it.	Constructor and the man in charge of the project	1) Monitoring contents: effect of farmland shelterbelts; the survival rate, the growing quantity and height of trees, shrubs and grass; the soil erosion degree, the area of farming patterns to follow the land contours; the implementing situation of reduced tillage or no-till, the situation of taking measures to conserve soil and water and the control effect. 2) Monitoring frequency: twice 3) Executor: The environmental monitoring station and soil and water conservation station of banner/county. 4) Supervisor: The Environmental Protection Bureau or the PMO of banner/county	The cost for researching reduced tillage or no-till: 250,000 Rmb. The cost for monitoring: 90,000 Rmb

Table 4-10 Environmental Issues, Mitigation & Monitoring Plans of Dry Land Farming

Contents	Survey of the item	Environment context	The possible Environmental Issues	Mitigation measures	Responsible person	Monitoring procedure and Responsible	Investment in environmental protection
6. Hybrid sunflower seed in dry land	1) No.: 1 2) Construction scale: 1,980.3 ha.	17) The unreasonable use of farm chemicals and fertilizer may cause poisoning of man and animal.	Pollution of agricultural chemicals	<p>1) Raise the using amount of manure and reduce the using amount of fertilizer rationally.</p> <p>2) Apply fertilizer based on the nutrient content of soil and concepts of balance plant nutrients</p> <p>3) Train farmers in safe use of fertilizers and farm chemicals. The use of fertilizer should be adjusted to maximize farmer income and reduce risk.</p> <p>4) Educate and train farmers to use comprehensive way to control pest and disease.</p> <p>5) Reduce the using amount of pesticide and select those with high effect, low residue and low toxicity.</p> <p>6) Use pesticide strictly according to "the national Standards for the Use of Farm Chemicals -GB4285-84" and work out safe regulations.</p> <p>7) Effectively promote respect of safe use of pesticides and fertilizer.</p>			

Table 4-11 Environmental Issues, Mitigation & Monitoring Plans of Animal Husbandry Production

Contents	Survey of the item	Environment context	The possible Environmental Issues	Mitigation measures	Responsible person	Monitoring procedure and Responsible	Investment in environmental protection	
Animal husbandry production	1. Cattle, sheep and goat	1) Cattle No.:14 Implementation scale: 41,750 2) Sheep No.: 13 Implementation: 242,334 3) Cashmere goat No.: 5 Implementation: 33,534 Total: No.: 32 Implementation scale: 484,618	1) Geomorphology and topography: low hills and hilly land and high plateau 2) Rainfall amount: Rain mainly falls during the period from July to Sept. Average annual rainfall: 200-400 mm. 2) Sheep No.: 13 the largest: 626.5 mm the smallest: 166.0 mm 3) Weed speed: average wind speed: 3-5 m/s the top speed: 6.4 m/s the minimum speed: 2.3 m/s main direction of wind: northwest 4) Grassland area: 2,910,300 ha. 5) The original stocking number (sheep unit): 5.563million 6) Herbage yield: 20-240 kg/mu 7) Animal husbandry" grazing the whole year with supplement feed from Nov. To April.. 8) Newly-increased stocking number of the project: 484,618 9) The are signs of overgrazing in all the pastures	Over grazing accelerates the deterioration of grassland	1) Set livestock number based on herbage supply available, improve pasture and expand the area of artificial pasture and improved pasture. Fix the stocking number based on the available feed. 2) Graze rationally. Carryout limitation of grazing and forbidding grazing system 3) Enlarge ammoniation quantity of straw and increase fenced pasture area. 4) The feed supply of newly increased livestock mainly comes from the newly increased forage grass and crop straw. It must not depend on natural pastures. 5) Raise livestock in barns in winter 6) Strengthen the prevention and cure of pest of the pastures.	The local working station of grassland. Herdsman.	1) Monitoring contents: herbage yield, grass height, the cover rate of grass, the straw converting rate, change of climate such as, temperature and rainfall. 2) Monitoring frequency and spot: Lay out 3 spots in each banner/county, monitor once 3) Executor: The environmental monitoring station and grassland station and meteorology station of banner/county 4) Supervisor: The administrative departments of grassland and meteorology bureau.	The cost for monitoring: 360,000 Rmb
			Surface water pollution	1) Strictly avoid locating animal barns or manure storage near water sources. 2) Treat the water used for washing barns in sedimentation ponds and strictly avoid disposal into the drinking water sources and streams or rivers.	The local environmental monitoring station. Herdsman.	1) Monitoring contents: COD, BOD5, E.coli, total number of bacteria. 2) Monitoring frequency: oncc a year 3) Monitoring spot: the spots that are near to barns, the river where live stock move about. 4) Executor: The Environmental Monitoring Station of banner/county 5) Supervisor: The Environmental Protection Bureau	The cost for monitoring: 60,000 Rmb	
			Health	1) There must be some distance between residential site and animal barn. 2) Clean animal barns regularly and place manure in piles to make it ferment. 3) Strengthen the prevention and cure of the diseases that may be passed from animals to man.	The local Sanitation and Antiepidemic Station. Herdsman	The local Sanitation and Antiepidemic Stations supervise and manage the public health and contagious diseases of livestock.		

Table 4-12 Environmental Issues, Mitigation & Monitoring Plans of Animal Husbandry Production

Contents	Survey of the item	Environment context	The possible Environmental Issues	Mitigation measures	Responsible person	Monitoring procedure and Responsible	Investment in environmental protection
Animal Husbandry Production	2. pig No.: 9 Construction scale: 20,171 2) Pig No.: 13 Construction scale: 232,265 3) Total: No.:22 Construction scale: 252,436	1) Barns are close to residential sites. 2) There are signs of overgrazing and rangeland deterioration in all the pastures. 3) The domestic animals will be raised in sheds. 4) Stock numbers to be increased by: 0.734 million. 5) Other factors - the same as the above.	The acceleration of the deterioration of pastures	1) The feed should mainly come from agricultural residues. 2) The forage grass should mainly comes from artificial pastures, such as alfalfa, caragana, etc. 3) Strictly forbid farmers to pull forage grass by root to raise domestic animals, such as rabbits.	The local grassland station. Raiser	1) Monitoring contents: herbage yield, grass height, the cover rate of grass, the straw converting rate, change of climate such as, temperature and rainfall. 2) Executor: Grassland station and meteorology station of banner/county. 3) Supervisor: The administrative departments of grassland and meteorology bureau.	
	1) Rabbit No.: 3 Construction scale: 12,296 (group) 2) Chicken No.: 1 Construction scale: 2,973 (group)		Surface water pollution	1) Strictly avoid the construction of animal barns or piling of dung near to water sources. 2) Treat the water used for washing on the spot and strictly avoid water disposal into the drinking water sources.	Raiser	1) Monitoring contents: COD, BOD ₅ , E.coli, the total number of bacteria. 2) Executor: The environmental monitoring station of banner/county. 3) Supervisor: The environment protection bureau.	
3. The other domestic animals			Health	1) There must be some distance between residential sites and animal barns. 2) Clean animal barns regularly and place dung into piles to make it ferment into manure. 3) Strengthen the prevention and cure of the diseases that affect man and animals.	Raiser	The local Sanitation and Antiepidemic Station supervise and manage the public health and contagious diseases of livestock.	

Table 4-13 Environmental Issues, Mitigation & Monitoring Plans of Grassland Improvement

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible Person	Monitoring procedure and Responsible	Mitigation measures	Responsible Person	Monitoring procedure and Responsible	
Grassland Improvement 1. Fenced Pasture and artificial Forage Grass	1) Alfalfa No.: 3 Construction scale: 4,784.5ha. 2) Astragalus No.: 11 Construction scale: 11,018.5ha 3) Fenced and Improved Pasture: No.: 7 Construction scale: 2,125 sites	1) Geomorphology and topography: Plain and hilly land; low hills and hilly land. 2) Annual average temperature: 1.3-5.8 3) 10 °C accumulative temperature: 1800-3100 °C 4) Frost-free period: 90-140 days 5) Annual average rainfall: 200-400 mm, that mainly falls between July to Sept and makes up for 75%. The highest rainfall: 626 mm The lowest rainfall: 166.0 mm 6) Wind speed: Average wind speed: 3-5 m/s The top speed: 6.4m/s The minimum speed: 2.3 m/s The strong wind period: March to May. 7) Soil erosion: mainly wind erosion, soil erosion modulus: 3200 t/km ² ·Y 8) Grassland type and plant resources: typical grassland with typical grassland species 9) Grassland deterioration status: There are signs of deterioration in all pasture. 10) Wildlife distribution: local common species. As for the common species of plants and animals, please refer to the attacked list.	Soil erosion Reduction of biological diversity Affection of wildlife distribution	1) Avoid growing forage grass and building fenced pasture and silage pit in the season of high winds. 2) Build shelterbelts around the fenced pasture. 3) Shrub strips should alternate with forage grass strips in pastures and grow shelterbelts of Caragana around the pastures. 4) Grow forage grass along land contours in the area of hilly land. If there are rare species of plant or animal, such as grey crane, hawk and fox, etc, take measures to protect. As for the common species, no one is allowed to disturb or destroy. Strickly forbid catching and kill wild animals.	Construction unit Construction unit Construction unit	1) Monitoring contents: Soil erosion degree, survival rate of shelterbelts and forage grass, herbage yield, grass height and vegetation cover. 2) Monitoring spot: Lay out monitoring spot within the implementing area of the project. 3) Monitoring frequency: twice/year. 4) Executor: The soil and water conservation station or grassland station of banner/county. 5) Supervisor: The soil and water conservation bureau of county or banner. It is supervised by the local management station of grassland. It is supervised by the local grassland station.	1) Monitoring contents: Soil erosion degree, survival rate of shelterbelts and forage grass, herbage yield, grass height and vegetation cover. 2) Monitoring spot: Lay out monitoring spot within the implementing area of the project. 3) Monitoring frequency: twice/year. 4) Executor: The soil and water conservation station or grassland station of banner/county. 5) Supervisor: The soil and water conservation bureau of county or banner. 1) Adopt the method of mixtures of various forage grass or the method of alternation of various grass to increase the biological diversity. 2) Strengthen the management of artificial pasture. 1) Propagate the importance of protecting wildlife. 2) Strengthen the protection and the management of the plants and animals within the protection of the country 3) Protect the habitats of wild animals and birds. No one is allowed to disturb them.	Construction unit The local grassland station The local grassland station	1) The cost of shelterbelts of fenced pasture: 424,000 Rmb. 2) The cost for monitoring: 40,000 Rmb. It is supervised by the local management bureau of grassland. It is supervised by the local management bureau of grassland.	

Table 4-14 Environmental Issues, Mitigation & Monitoring Plans of Grassland Improvement

Contents	Survey of the item	Environment context	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Respons-ible Person	Monitoring procedure and Responsible	Mitigation measures	Respons-ible Person	Monitoring procedure and Responsible	
		11) Natural protection district: There is one in the project area of Keyouzhong banner. See attached figure.	The construction does not affect the area					The local forestry monitoring station	It is supervised and managed by the local Environmental Protection Bureau.	
2. Silage	No.: 7 Constructi on scale: 13,725 pits	The same as the above	Soil erosion	Avoid construction during the time of heavy rain and strong wind.	Construc- tor	It is supervised by the PMO of county or banner.				

Table 4-15 Environmental Issues, Mitigation & Monitoring Plans of Rural Enterprise

Contents	Survey of the item	Technological process	The possible environmental issues	Construction stage			Operation stage			Investment in environment protection
				Mitigation measures	Responsible Person	Monitoring procedure and Responsible	Mitigation measures	Responsible person	Monitoring procedure and Responsible	
Rural Enterprise Construction	1. Fodder processing	Sites: In siziwang Banner and Chayouhou Banner. Number: 261 Annual processing capacity: 24,200 Ton FQ-40B Grinder or 93RFOD-380 Cutting Machine	1) straw-cutting-microorganism treatment-ammoniation-ensiling of feed 2) straw/grain-grinding-mixing with additives-feed	Mechanical noise and dust	1) Select the machines with low noise and good seals. 2) Install machine firmly and put pad for vibration reduction 3) The sealing function of workshop must be good.	Local township government	It is supervised by the PMO of county/banner.	The operator must wear dust-protection mask and noise-protection earplug.	Local township government	It is supervised by the PMO of county/banner.
	2. Agriculture mechanization operation	Sits: In Siziwang, Cayouhou, Keshiketeng, Balinyou, Wengniute Banner and Linxi County Number: 209 sets Annual workload: 2.5212 million mu. Tractor model: Tieniu-654L (model)	1) Machine ploughing 2) tractor-seeder-sowing 3) machine application of fertilizer/ manure 4) machine recovery of plastic film or deep fertilizer application	Noise and waste gas produced by the agricultural machinery	1) Select low noise agricultural machinery. 2) Select the agricultural machinery that suits to reduced tillage. 3) Suggest purchasing the machinery after studying and inspecting reduced tillage in USA, Canada or at home.	Local township government	It is supervised by the PMO of county/banner.	1) Improve the maintenance and repair of the machines. 2) Install pollution reduction devices that accord with the standards of the country. 3) Avoid operating during night at the place near residential district	Local township government	It is supervised by the PMO of county/banner.
			Dust raised by the machines				Avoid operating during the time of strong wind in spring.	Local township government	It is supervised by the environmental protection department of county/banner.	
			Waste oil produced during repair and maintenance				Collect and dispose of used oil safely.	Local township government	It is supervised by the environmental protection department of county/banner.	

4.2 Institutional Structures for Implementation of the Environmental Management Plan

4.2.1 Management System

4.2.1.1 Government Management System

Inner Mongolia Environment Protection Bureau (IMEPB) will be responsible for coordinating the environmental agencies and supervising environmental issues in the Project region. League environment protection bureaus will take the environmental monitoring for this Project into their work plans. County/banner environment protection bureaus will perform the routine management monitoring works. Environment protection bureaus at different levels are responsible for supervising the corresponding World Bank Loan Project Management Offices in the environmental issues.

4.2.1.2 Department Responsible for the World Bank Loan Project

4.2.1.2.1 Regional World Bank Loan Project Management Office

The Regional World Bank Loan Project Management Office (RPMO) should set up an “Environmental Protection Division” with 4 personnel, responsible for the environmental issues in the Project.

4.2.1.2.2 League World Bank Loan Project Management Office

The League World Bank Loan Project Management Office (LPMO) should set up an “Environmental Protection Division” with 2 personnel responsible for the environmental issues in the League scope.

4.2.1.2.3 County/Banner World Bank Loan Project Management Office

The County/Banner World Bank Loan Project Management Office (C/BPMO) should set up an “Environmental Protection Division” with 2-3 personnel responsible for the environmental issues in the county/banner.

4.2.1.2.4 Townships and villages should assign persons responsible for the environmental issues in their localities.

4.2.1.3 Environment Protection Consultant Group

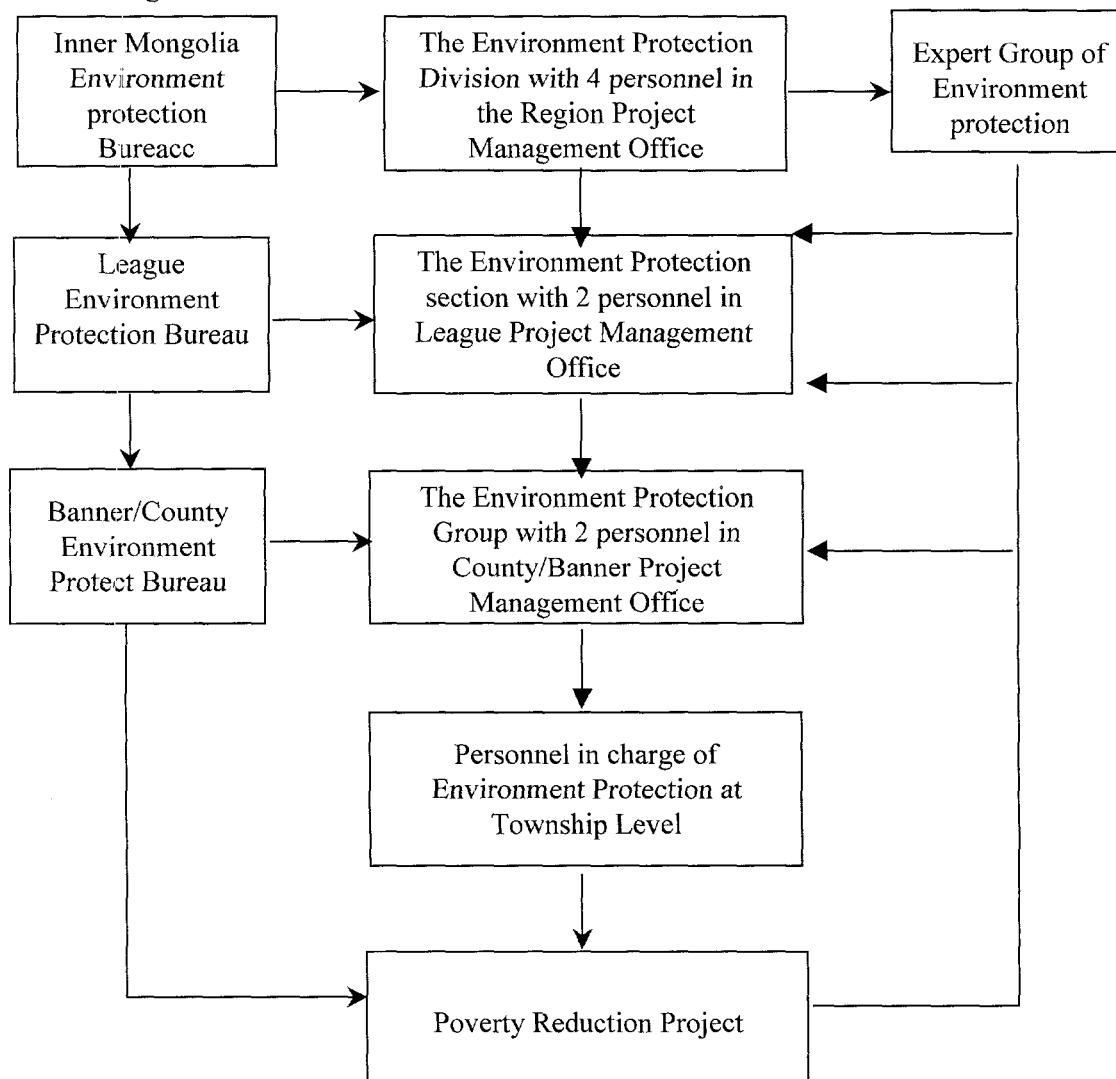
The Region PMO should set up an environment protection consultant group composed of environmental experts, responsible for surveying the environmental issues and providing information and solutions for the environmental problems during the implementation and operation of the Project. The Environmental management network for the Project is shown in Figure 4-1.

Figure 4-1 The Environmental Management Network for the Project

Supervision and
Management

Execution

Consultation



4.2.2 Responsible of the Environmental Agencies

4.2.2.1 Responsibilities of the Governmental Environmental Agencies

The governmental agencies (Environment Protection Bureau, EPB) at all levels are responsible for the policy making, law endorsement, management and monitoring of the environmental issues at their localities. They are the authorities for supervising and monitoring all activities concerned with the environmental issues. They check and accept the implementation of the environmental protection measures in the project.

4.2.2.2 Responsibilities of the Environment Protection Divisions (EPD) in a PMO

1. Executing the concerned policies, laws and regulations. Making up the environmental management plans in the project.
2. Managing and monitoring the environmental activities. Making environmental management plans and procedures for the activities. Taking on the routine management and monitoring of the environmental issues in the Project.
3. Disseminating and popularizing environmental protection awareness. Organizing workshops and training courses for trainees at all levels.
4. Collecting information, organizing researches and popularizing new techniques.
5. Assigning environmental monitoring works during implementation and operation periods of the project.
6. Responsible for investigation and decision making for environmental accidents during the implementation and operation periods of the Project.
7. Coordinating different parts and efforts for environmental protection.
8. Responsible for data collecting, paper filing, and report writing in the environmental issues.

4.3 Environmental Monitoring Plan

4.3.1 Environmental Monitoring System

4.3.1.1 Inner Mongolia Environmental Monitoring Center (IMEMC) and Inner Mongolia Grassland Ecological Environmental Monitoring Center (IMGEEMC) will be responsible for organizing and executing the monitoring works in the regional level. Their main responsibilities include: making monitoring plans, setting up quality standards, coordinating and supervising the works of league and county/banner branches. Collecting and analyzing data. Compiling and working out environmental quality reports.

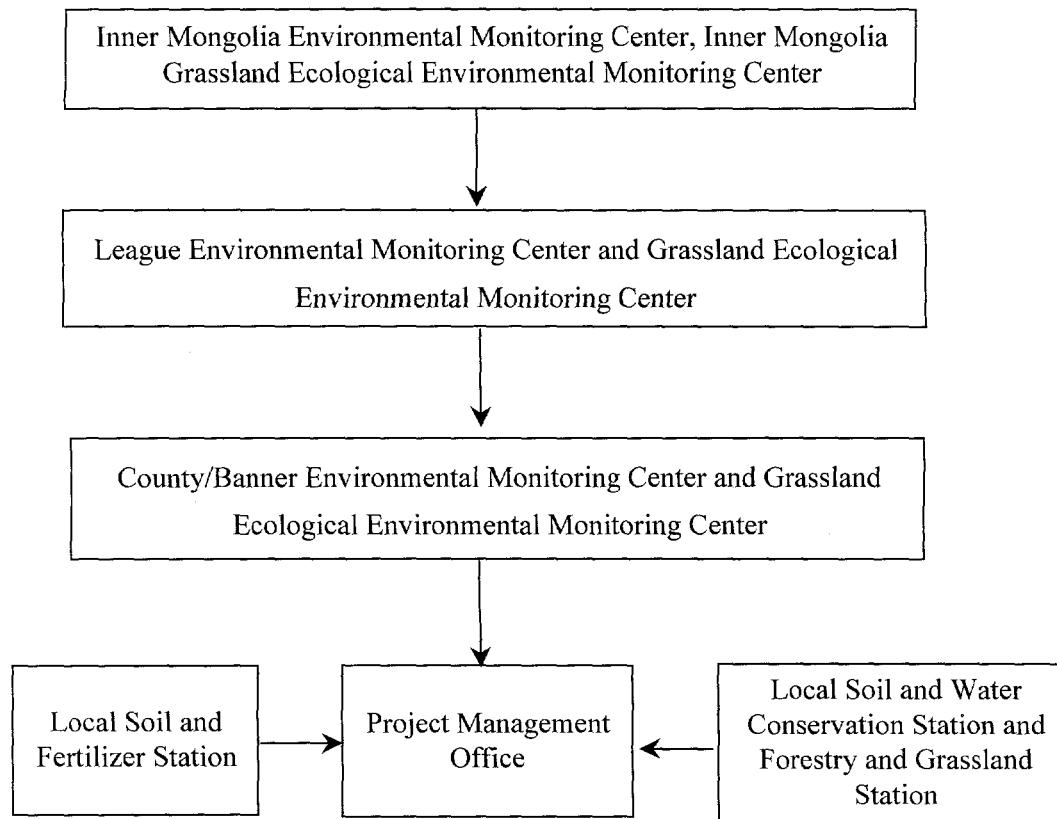
4.3.1.2 Under the leadership of the IMEMC and IMGEEMC, League and county/banner environmental monitoring branches are responsible for their own monitoring works and send reports to the IMEMC and IMGEEMC.

4.3.1.3 To guarantee a smooth operation and a successful accomplishment of the environmental monitoring works agreements between the environmental monitoring agencies at all levels and the PMO should be reached.

4.3.1.4 Soil conservation stations are entrusted by the PMO for monitoring the soil erosion and reporting the data to the IMEMC and IMGEEMC for filing.

The environmental monitoring organization and system are shown in Figure 4-2.

Figure 4-2 Environmental monitoring organization and system for the Project



4.3.2 Environmental Monitoring Procedure and Methods

An environmental monitoring plan mainly contains: monitoring factors, monitoring indicators, monitoring frequency, layout of monitoring sites, analysis of samples, monitoring agencies and supervision organization.

4.3.2.1 Contents of Environmental Monitoring

The contents of environmental monitoring for this Project contains all environmental activities involved in the 7 components, i.e., agricultural infrastructure, irrigation system, soil conservation, rainfed cropping, animal raising, grassland improvement and rural enterprise.

4.3.2.2 Monitoring Methods

Monitoring methods contain: site selection, sampling, analysis, data processing and so on. All of the jobs involved should be carried out strictly in accordance with the State standard procedures.

4.3.2.2.1 Site selection is based on the types of a component and the local ecological features. For items, such as animal and public health, randomized sampling survey will be used.

4.3.2.2.2 Sampling and Analyzing Methods:

For surface water, underground water and air quality, “Standard Handbook for Water Environmental Analysis” and “Standard Handbook for Air Quality Analysis” are followed. Procedures for soil, noise and biological materials are sampled and analyzed in accordance with other concerned standards. Remote sensing technique is used for monitoring the grassland deterioration and land desertification.

4.3.2.2.3 Data Processing:

All data is processed with computers for statistical treatment and analysis. Information is shared publicly through using computer network.

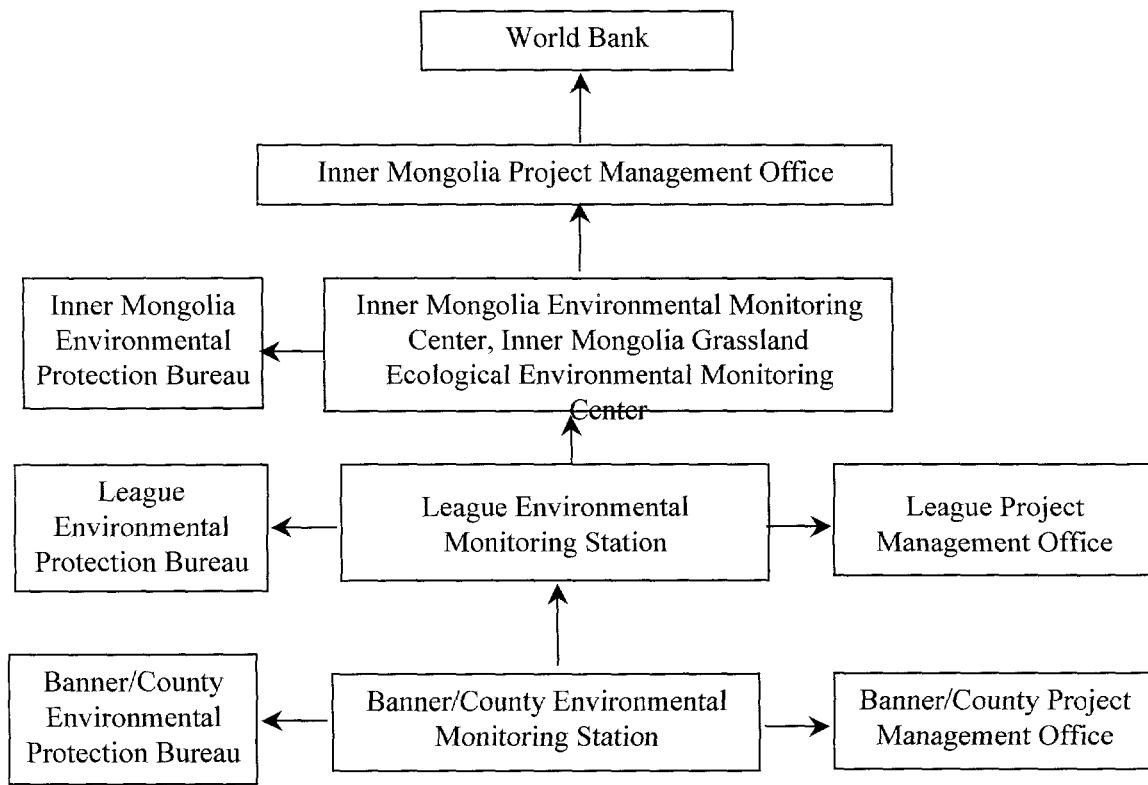
4.3.3 Financial Plan for Environmental Monitoring

Staff in the WBLPMO Environmental Protection Divisions and staff in the EMC (Environmental Monitoring Center) belong to the state public servant series. Their salaries are arranged in the corresponding agencies. The project will not be responsible for their payment and expenses. Based on the poverty reduction nature of the Project, the monitoring charges will only take account of the basic cost for directly performing the monitoring works, it does not include any equipment replacement fees. Only the 6 years of implementation period is considered for the monitoring charge. The monitoring for the operation period will be taken into the routine monitoring plans. The total financial budget is estimated as 1.6684 million Rmb.

4.4 Monitoring Reporting Regulation

Monitoring data collected by the local environmental monitoring branches should be sent to the IMEMC and INGEEMC within one month after every monitoring. Based on the data provided by the local branches, IMEMC and IMGEEMC should make annual summary report to the Inner Mongolia Environment Protection Bureau (IMEPB) and the World Bank Loan Project Management Office. PMO should submit the report to World Bank in a most convenient early date. The reporting procedure is shown in Figure 4-3.

Figure 4-3 Environment monitoring result reporting procedure



4.5 Training programs

4.5.1 Trainees and Training Contents

4.5.1.1 The trainees are mainly the environmental administrative and management persons, environmental monitoring technical staffs, persons involved in local environmental project and farmers/herdsmen. Through the training programs, the trainees should be qualified for carrying out their concerned environment work and gain good awareness of the environmental issues.

4.5.1.2 Contents of the Training Programs

The main courses are as follows:

- Introduction to Environmental Science, Introduction to Ecology
- Rural Ecological Environmental Science and Natural Environment Protection
- Environment Management and Environment Monitoring
- Environment and Social Sustainable Development, Environmental Policies for the World Bank Loan.
- Computer Environmental Information System

4.5.2 Training Approaches and Methods

4.5.2.1 Training Approaches

4.5.2.1.1 Training Abroad

Trainees should be management officials and monitoring and evaluation technical staff. They should be young persons with fairly good educational background and enthusiasm for poverty reduction and environmental work. Overseas workshop, visiting scholar programs, international conferences and on-site visit are the main components of the overseas training program. The ultimate purpose of the training program is to adopt advanced techniques and successful management experiences into the Project.

4.5.2.1.2 Training in China

Short term training courses, seminars, symposiums and on-site visiting will be arranged as part of the training programs in China. It is expected that advanced techniques and good management experiences will be quickly adopted for resolving the environmental problems in the Project.

4.5.2.2 Training Methods

4.5.2.2.1 The regional EPB will organize short-term qualification training courses for the environment management personnel and monitoring staff at different levels.

4.5.2.2.2 League or county/banner EPBs will organize workshops and on-site visits and invite environmental experts to give lectures. They will distribute pamphlets and use public media (TV and Radio) to disseminate environmental knowledge.

4.5.3 Training plan

1 person (times) of abroad training (budget: 50,000Rmb) and 1077 persons (times) of internal training in China (budget :397,040Rmb) are planned for the training program. The total budget will be amounted to 447,040 Rmb. Details are seen in Table 4-5-1.

Table 4-5-1 Abroad and Internal Local Training Program

Agency	Program	Budget (10000Rmb)		Total person (times)	Yearly plan				
		Per person	Total		1	2	3	4	5
Regional PMO	Abroad	5	5	1		1			
	Local	0.3	0.9	3	1	1	1		
League PMO	Abroad								
	Local	0.3	1.8	6	1	2	3		
County PMO	Abroad								
	Local	0.15	2.25	15	5	5	5		
Township	Local	0.04	5.44	136	40	40	40	16	
Village	Local	0.032	29.314	916	500	300	100	16	
Others	Abroad								
Total			44.704	1077	548	349	149	32	

4.6 Investment Budget for Environmental Protection Issues

The environmental protection investments are as follows:

- | | | |
|---|--|-----------------|
| 1 | Tree planting revegetation along roads: | 35,000 Rmb |
| 2 | Dissemination, popularization (all included in the project budget) | 150,000 Rmb |
| 3 | Tree planting around fenced pastures: (includes the fenced pastures) | 425,000 Rmb |
| 4 | Non-tillage research expenses: (all included in the project budget) | 250,000 Rmb |
| 5 | Environmental monitoring expenses: | 1,668,400 Rmb |
| 6 | Training expenses: (all included in the project training plan) | 447,040 Rmb |
| 7 | Total: cost for improvement of ecological environments. | 26,020,000 Rmb |
| 8 | The total cost for environmental protection is | 28,995,440 Rmb. |

5 ANALYSIS OF SOCIAL, ECONOMIC AND ENVIRONMENTAL BENEFITS

5.1 Social benefits

The implementation and operation of the Project will greatly promote the rural development, change the poverty stricken situation, increase material production and improve the living standards in the Project region. The benefits which may be generated by the Project are summarized as follows.

5.1.1 Providing Employment Opportunities, Particularly, Employment Opportunities for Women.

All together, the Project will have 170 thousand ha land for intensive farming, which will provide a large number of employment opportunities for the rural labour force. Particularly, the fast development of animal husbandry will draw great labour force on it. It is estimated that the increased 1.2 million sheep units will provide 400 thousand opportunities for women.

5.1.2 Rural Infrastructure Construction

The construction and improvement of the rural infrastructures (irrigation and drainage, transportation, electric power and water supply, etc) will greatly improve the social welfare and public services. 539 thousand people will be benefited for the Project.

5.1.3 Improving the Scientific Awareness to Guarantee a Sustainable Development

The implementation of the Project will provide educational and training opportunities for a large number of people at different levels. In the Project, 259,000 people will be provided direct training opportunities (environmental protection, cropping, animal raising, farm machinery, feed/food processing, plant protection, disease prevention, etc.), in which, 112,000 persons/times will receive technical training, 4,709 persons/times will receive management and administration training, 7,884 persons/times will receive the training about infrastructure. The improvement of people's scientific awareness and educational level will ensure more sustainable development in the Project region (the details are listed in technique financing and training plan).

5.1.4 The implementation of the Project will promote the developments of related rural industries such as the processing industry, transportation industry, farm machinery industry, and irrigation service. These will in turn greatly promote the industrialization of the agricultural economy.

5.1.5 The Project will greatly increase the income and improve living standards as well as promoting the development of the education and health care.

With the implementation of the Project, per capita income in the Project region is expected reach 1,128 Rmb, the per capita. Availability of crop land is expected to increase to 2mu and that of livestock to 30 sheep units per herdsmen. It is expected that and per capita grain supply will increase to 500 kg. With these developments of animal husbandry and the increase in the grain supply it is expected that the nutritional situation will improve. Life expectancy should be prolonged and living standard will be greatly improved. Children's schooling rate will reach 100% and infant mortality rate will be below 3.8%. Public hygiene and social welfare services will be greatly improved.

5.2 Economic benefits

The Project will have a very good economic benefit. A brief economic analysis can be seen in the Table 5-1 (these data from "Project Feasibility Study Report").

Table 5-1 Economic Benefit Indexes of the Project (Rmb)

Item	Internal Returning Rate	Net Present Value	Annual Increased Production Value	Annual Increased Tax Value	Calculating Period
Index	26%	0.507 billion	0.65 billion	4.41 million	20 years

5.3 Environmental Benefits

With the implementation of the Project, the overall ecological condition will have an obvious improvement. It may mainly be reflected from the following aspects.

5.3.1 Effective Control of Soil Erosion and Land Desertification

After 6 years' implementation period, the total area of soil conservation and grassland improvement will reach 718.1 km². This is a significant increase in the area in which soil erosion and land desertification will be achieved.

5.3.2 The project will increase irrigated land by 35,400 ha through the provision of wells and diversion works. There will also be 246 ha of protected farmland and 9,114 ha of new terraces land built on sloping land. Through construction of farmland shelterbelts, rainfed farmland will be protected. And through other measures such as emphasis on cultivation along contours disease prevention and the recovery of plastic film, the production conditions of the farmland will be greatly improved. The farmland damaged by water erosion and nutrient loss will be reclaimed. The agricultural ecosystem will be gradually improved and sustainable development achieved.

5.3.3 Increasing Forest and Grass Area and Improving Regional Ecological Environments

The construction of soil conservation forest and farmland shelterbelts as well as the cultivation of forage grass will increase the degree of vegetation cover in the project area. At the same time, engineering measures, such as check dams for building farmland, and horizontal ditches will be constructed. The combination of biological measures, such as planting *Caragana* and *Astragalus*, and the engineering measures will control soil and water erosion, reduce runoff and wind erosion, improve water holding, improve micro-climates, and promote soil fertility and land productivity. Thus, the regional ecological environments will be improved gradually.

5.3.4 Crop Straws are Converted into Feed and More Organic Fertilizers Are Provided.

The development of animal raising will consume a large quantity of crop straw which is now being burned as waste.

It was estimated that the implementation of the Project will increase the organic manure production by about 48.8 thousand tons which is equivalent to 123.4 tons of urea, 152.2 tons of phosphate fertilizer and 72.2 tons of Potassium chloride fertilizer. This amount of manure is enough for 1,620 ha of cropping land, at 30 tons per ha. Thus, the conversion of crop straw into animal feed not only reduces a serious source of air pollution but also reduces chemical fertilizer applications and the related production investments. It may also improve product quality, maintain soil fertility and reduces fertilizer pollution of soil and water resources.

5.3.5 Protection of the Loss of Biodiversity

Completion of the Project will increase the vegetation cover and improve the ecological environment conditions in the Project region, which will provide favourable habitats for wild life. Species number and population quantity will increase and some endangered animals can be effectively protected. Ecological balance can be maintained.

6 PUBLIC PARTICIPATION

A survey was undertaken in order to know the public opinions on the Project, to bridge the relations between the policy makers and the public and to integrate good ideas and constructive suggestions into the design of the Project. Through the public participation procedure, the practicality of the feasibility level planning and social design are improved. Economic and ecological benefits can also be realized.

The Project involves a large population in a vast region. In order to achieve reliable public participation results, different forms of public participation were used, which included the use of questionnaire, random surveys, visiting persons/families of different background, consultations with academic associations, and so on. In the 136 townships of the 15 counties/banners, 4,650 questionnaires were distributed (4,515 recovered). 6 meetings were held, 20 experts and 4 academic associations were consulted. The results of the questionnaire are summarized below.

6.1 Composition of the Questionnaire Population

In the questioned population, farmers make up 62.5%, herdsmen 18%, technical personnel and school teachers 8%, administrative personnel 6.5%, members of the People's Congress Committee and People's Consultation Committee 3%, and private commercial 2%. The participants represented different groups of the population in the Project region in terms of their occupation, sex and standard of living. Since the Project is primarily focussed on farmers and herdsmen particular attention was paid to these groups.

6.2 Results of the Questionnaire

The results of the questionnaire are shown in Table 6-1. Farmers/herdsmen questioned provide most of the labour in the families. Most of them have secondary school educational background and some of them have primary or high school educational background. They are keen of the Project, wish an early implementation of the Project and expect a great success of the Project.

Among the 4,515 recovered questionnaires (97% of the total 4,650 questionnaires distributed), 94.6% good knowledge of the Project, 4.7% know a little about it, only 0.5% did not know of the Project at all. Almost all the respondents had positive attitudes to the project, and considered that the Project would promote the economic development and improve their living standards.

Most people in the Project region are used to their current environmental conditions, and had no questions on the environment mitigation measures. However, 11.2 of the questioned people considered that the mitigation measures are not good enough, or effective enough. On the problem of the pollution and ecological destruction caused by the Project, 93.2% of the participants considered that there would be no impact, 4.5% considered that there would be slight impact, 0.5% considered that there would be serious impact, and 1.8% has no idea on the subject.

Most (96.9%) of the respondents consider that the planning and design of Project is feasible. However, they were concerned about the use of the loan. They worried about whether the loan can be distributed to them on time and can be used on the Project activities. They expressed a desire to strengthen the management of the Project. Most of the Participants wish to strengthen the scientific and technical input in the Project and some of them express concern about on the surrounding environmental protection and wish to control soil erosion and land desertification under expert advice.

Most (95.4%) of the respondents consider that the project takes women's interests into account and is helpful for providing employment opportunities for women and improving women's social position.

6.3 Conclusion of the Public Participation

Through different forms of public participation surveys, we conclude that the people in the Project region have fairly good understanding about the Project and consider the Project will be great help for promoting local economic development, relieving poverty, providing environmental protection and improving women's social position. Most people have positive attitudes towards the Project and desire an early implementation of the Project. Although majority of the public (93.2%) considers the project has no impact on the local ecological environment, 5% of the participants considers that the Project may bring some adverse impacts on the local environment. To relieve their concerns about the environment issues, it is suggested that the Project should strengthen the environmental monitoring and the environmental mitigation measures. The public should be made aware of the environment plans and mitigation measures and public opinions and suggestions should be seriously considered.

During the consultation, experts and academic associations paid great attention to the Project. They consider that the Project is very helpful for relieving the poverty problems and that the combination of the Project implementation and the ecological land management will bring good ecological benefits. It will also greatly promote the sustainable development of the local economy.

Table 6-1 Public Survey Summary

Educational level	Illiterate	126	Sex	Age group	<30	578	
	Primary School	1240			31-45	2689	
	Secondary School	2451			46-60	1104	
	> High School	698			>60	144	
Do you know the Project?		Know			4271	94.6%	
		Know a little			212	4.7%	
		Do not know			24	0.5%	
What is your attitude to the Project?		Positive			4466	98.9%	
		Negative			0		
		No idea			30	0.7%	
What about the Project on the local economy?		Positive			4407	97.6%	
		Negative			8	0.2%	
		No influence			35	1.5%	
The project to your living standard?		Lift up			4367	96.7%	
		Low down			7	0.2%	
		No influence			68	1.5%	
What about the mitigation measures?		Good			3943	87.3%	
		Not practical			288	6.4%	
		No measures at all			217	4.8%	
What about the Project on pollution/ecology		Serious			21	0.5%	
		Slight			201	4.5%	
		No influence			4208	93.2%	
Is the Project practical?		Yes			4376	96.9%	
		No			22	0.5%	
		Do not know			85	1.9%	
Do the Project consider the women's benefit?		Yes			4309	95.4%	
		No			69	1.5%	
		Do not know			95	2.1%	
General idea to the Project		Urgent to implement			4422	97.9%	
		Feasible to implement			80	1.9%	
		No idea			13	0.3%	
		Not to implement			0	0	

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

7.1.1 The Project which will use a World Bank loan and domestic counterpart funding for poverty reduction in Inner Mongolia is located in the 15 poorest counties/banners in the region. Its components include: agricultural infrastructure construction; irrigation system development; rainfed cropping; water and soil conservation; animal production; grassland improvement; and rural township enterprises. Its primary aim is to relieve the poverty problems in the region through improving the basic production conditions and the ecological environment.

7.1.2 At present, the natural ecological conditions are marked by frequent drought and high winds associated with soil and water erosion, seriously deteriorated grassland, infertile land

resources and low productivity. Water resources are unevenly distributed in the region. Most of the region is poor water region and only Duolun county and Kerqin Sandy land are have relatively abundant water supplies. Some patches of land in the mountain valleys have rich water resources. The qualities of air and water are fairly good.

7.1.3 None of the components of the Project involves the disturbance of sites of cultural or historical value, or includes areas o f natural reserve.

7.1.4 The construction of electricity power line and drinking water facilities will have little impacts on the environments. Road construction will only affect a very small area of land. Revegetation measures will recover the destruction on ecological environments

7.1.5 Development of irrigated land may have cause some problems of soil salinization related to poor irrigation management. Pollution may also be caused by use of chemical fertilizers and plastic films. Soil salinization problems can be overcome by adopting rational irrigation management and installing drainage systems where needed. Pollution problems can be resolved by means of reducing the chemical fertilizer application through balanced fertilization, combined with the use of organic fertilizers, and achieving effective recovery of used plastic films. Negative impacts on the environment can be minimized through effective management and dissemination of advanced techniques.

7.1.6 In general, the soil conservation component in the Project may have positive effects on the control of soil erosion and land desertification. However, minor negative impacts may occur during the construction period. These negative impacts mainly include: new soil erosion during the land construction work; destruction of original vegetation; disturbance to the wild animal habitat; and loss of land resources. With good planning and management, these impacts may also be minimized.

7.1.7 Rainfed cropping may have some negative impact on the environments, through increased wind and water erosion and chemical pollution. It is recommended that measures such as cultivation along contour lines, shelter forest establishment, terrace land construction and no-tillage and minimum tillage practices should be considered for reducing the risk of soil erosion and land desertification. As for the pollution of agrochemical materials, measures for reducing fertilizer applications should be adopted. These should include the use of balanced fertilization and the use of smaller but more frequent applications. The increased application of manure will also increase the efficiency of fertilizer use. The application of regulations for safe use of farm chemicals needs to be improved by teaching farmers how to them more safely. Farmers should also be encouraged to use low toxic chemicals and apply integrated pest management procedures to control disease and pests of crops.

7.1.8 The animal production component of the Project mainly takes the form of farm household livestock. Its main negative impacts on the environment could be to increase the grazing pressure on the grassland, resulting in the accelerated deterioration of pastures and land desertification. It is recommended that the feed for the increased number of animals must come be provided from the increased areas of forage crops or from crop residues. The balance between animal demand and feed availability must be maintained. Popularization of techniques of silage making, ammoniation and micro-fermentation should be used to increase the feed digestibility and relieve the grazing pressure on the natural grassland. Animal dung is good organic fertilizer and can be used as substitutes for some chemical fertilizer, but more importantly to increase soil organic matter and improve the soil structure, moisture holding capacity and fertility retention. In doing this, it reduces cropping costs and in reduces chemical pollution to the environment.

7.1.9 The grassland improvement component will have positive impacts through protecting grasslands from deterioration and improving the local environmental conditions. It is also good for the animal husbandry development. During the grassland improvement, soil erosion and reduction of biodiversity may occur. Measures such as establishing shelter forest, increasing the species number in artificial pasture establishment, and inter-sowing of herbage with shrubs may relieve the problems.

7.1.10 minimum tillage farm machinery is recommended for use in the Project. Avoiding operation during windy days to reduce the soil erosion risk. For feed/food processing, safe operation instructions must be followed.

7.1.11 The implementation and operation of this Project have good social, economic and ecological benefits. It would greatly promote the rural economic and social development and improve agricultural production conditions. This would lead to an increase in material wealth of farmers and herdsmen with related improvements of women's social position, improved scientific and technical awareness, and development of the rural educational and public health sectors. There would also be an improvement of ecological environmental conditions in the Project region.

7.1.12 Public opinion surveys have shown that most people in the Project region support the Project and desire early implementation of the Project. They consider the Project will be a great help for promoting local economic development, relieving poverty, strengthening environmental protection and improving women's social position. They also consider the project has no serious negative impact on the local ecological environments.

7.1.13 The mitigation measures proposed in the EIA report should be taken into serious consideration and be realized in the design, implementation and operation periods. Environmental management plan, monitoring check-up are to be carried out strictly. Training programs should be carefully organized.

7.1.14. The total budget for environmental protection is 28.9954 million Rmb (3.5% of the total investment of the Project).

7.1.15 The project shows good economic and ecological benefits and has a high IRR figure.

7.1.16 All initiatives proposed for the components can be realized during the design and implementation period of the Project.

In summary, the implementation and operation of the Project can assist the people in the region escape from poverty. The Project shows good social, economic and ecological benefits. It is welcomed by the local people. The negative impacts on the environments can be minimized so long as the environmental management plan is followed and environmental management works are carefully performed. The Project will have a number of well defined ecological benefits.

7.2 Recommendations

7.2.1 Because the project lies mostly in the arid grassland it is difficult to reestablish the original vegetation along the roads particularly where soil is excavated for road base construction. The use of specially designated locations for road base excavation is recommended.

7.2.2 Special attention should be paid to chemical fertilizer leaching problems while developing paddy fields, irrigated crops and dryland crops. Frequent but low applications of chemical fertilizer are recommended using balanced fertilization approaches. Maximum use of organic fertilizers is also recommended to improve soil tilth and product quality. Soil secondary salinization problems should be monitored carefully.

7.2.3 Efforts should be focussed on the research of zero-tillage and reduced tillage cultivation. It is suggested that a special institute for the rainfed cropping and cultivation techniques be established. Visits should be made within China and overseas to select the most suitable rainfed cultivation and reduced tillage equipment.

7.2.4 For animal production, no more grazing pressure should be placed on the natural grasslands and the number of animals must be controlled in accordance with the forage supply capacity. Market prices, climate fluctuations, and social demands for the animal products should all be taken into account as key factors while working out this development plan.

7.2.5 It is essential that there be close coordination between the Project execution organization and the environmental project organization for successful implementation of the Project.

Environmental protection management and monitoring should extend throughout the implementation and operation periods of the Project.

7.2.6 Dissemination, popularization and technical training concerning environmental issues is necessary for increasing the public's environmental awareness and the promoting public action for environmental protection.

Appendix Table 1-1 Agricultural Chemicals and Herbicides Used for Irrigated Cropping Land Unit: kg/mu

Crop	Chemicals					Herbicides			
	Methamidophos	Deltamethrin	Phoxim	fenvalerate	20% Tricyclazole	60% Butachlor	96% molinate	28% Diclofopmethyl	25% fomesafen
Irrig. Maize	0.05								
E.Irrig. filmed maize	0.05								
W.Irrig. filmed maize		15 ml	1.5%						
Irrig. wheat				15 ml					
Irrig. soybean								0.133	0.07
Rice					0.025	0.1	0.2	0.133	0.07

Appendix Table 1-2 Possible Diseases and Control Measures

Crop	Disease	Pest	Control measure	Harms to people, animal and environ.	Mitigation measure	Remarks
Rice	Blast, Downy mildew, Rot	Paddy borer, striped borer, locust, thrips	1. use disease resistant varieties. 2. agricultural control: adjust sowing date, good management in fertilizer application, irrigation, rotational cultivation, seed treatment. 3. Chemical control: cartap, isoprothiolane, carbendazim and trichlorphon, 4. Biological control: protecting natural enemies. 5, trap killing	Low toxicity to animals and people. No/little residue in the environment. Over use may cause pollution.	1. safe application methods. 2. proper time of application. 3. use low toxicity and high effective chemicals. 4. proper concentration/density. 5. combine biological control measures	1, No forbidden chemicals are used. 2, use toxicity chemicals at low concentration/density whenever possible, to protect the natural enemies of the harmful insects. 3, take care of honeybee and other pollinating insects.
Maize	Big patch, small patch, black knot, drarf mosaic	Borer, aphid	As above 1,2,4,5. Chemical control: dimethoate, dichlorvos and metalaxyl			
Sunflower	Sclerotium, rust, broom rape	Borer	As above 1,2,4,5. Chemical control: carbendazim, trichlorphon, cartap			
Potato	Heliosis, virus disease, rot	Tuber moth, ladybird	As above 1,2,4,5. Chemical control: dimethoate, dichlorvos and metalaxyl	Dimethoate is high toxicity to animals and people. Keep away for one month after application.		
Wheat	Rust, scab, smut, powdery mildew	Red spide, milk suckling insect, aphid, army worm	As above 1,2,4,5. Chemical control: dimethoate, carbendazim and others	Apart from dimethoate, others no harm. Do not over use.		
Beans	Sclerotium, downy mildew	awk moth, pod borer	As above 1,2,4,5. Chemical control: dichlorvos and others	Similar to the above.		
Milkvetch	Powdery mildew, yellow drarf	Locust, army worm, crop pests	1, As above. 2, early cutting. 3, chemical control: similar to the above.	Similar to the above.		

Crop	Disease	Pest	Control measure	Harms to people, animal and environ.	Mitigation measure	Remarks
Alfalfa	Leaf spot, Rust, downy mildew	Locust, army worm, crop pest				Consider the economic benefits.
Natural grassland	Sclerotiam Powdery mildew Smut	Locust, army worm, borer	Chemical control by air drilling	May cause air and water pollution and harm to human beings		Use low/no toxic chemicals
Comment	Take consideration of the principle of "prevention the first and control measure the second". Adopting comprehensive measures combining cultivation, chemical and biological methods.					

Appendix Table 1-3 Safe Use Guide for Agricultural Chemicals

Crop	Chemical	Type	Application rate	Mxm. Rate	Apply method	Appl. allowed	Safe period	Remark
Wheat	Dimethoate	40%EC 3.5%D	100-125ml 1500g	125ml/mu 1500	Low Spray Dust	3 times 1	10day 9d	Minimum use of powder 60g once
	Carbendazim	50%WP 25%WP	70-100g 35g	150 60	Spray Spray	2 2	20d 20d	
Rice	Cartap	50%WP	75g	100	Spray	3	14d	Every 7 day
	Isoprothiolane	40%EC	70g	100	Spray	3	28d	
	Carbendazim	50% WP	50g	50	Spray	3	30d	
	Dipterex	90% solid	100g	100	Spray	3	7d	
Maize	Parathin chlorothalonil	1% 75%WP	750-1000 500-800X	4g/p. 800X	Plant Spray	1 2	10d	Later season use
Sunflower	Carbendazim	50%WP	75-100g	150	Spray	2	20d	
	Dipterex	90% solid	100g	100	Spray	2	10d	
	Cartap	50%WP	75-100g	100	Spray	3	20d	
Potato	Dimethoate	40%	125g	125	Spray	3	10d	Not more than 3 time per season
	DDVP	80%	150-250g	250	Spray	5	6d	
	Metalaxy1	25%	150-250g	250	Spray	3	14d	
	Seed dressing frost	40%	2g/kg sd	2	Sd trt.	1		
Beans	chlorothalonil	75%WP	100g/mu	100	Spray	3	10d	
	DDVP	80%	1000-2000X	500X	Spray	5	5d	
	Parathin	50%	1000-5000X	1000	spray	5	10d	

NB: 1, application rate is used as ml/mu or g/mu. 2, g/kg sd = g/kg of seed.

3, g/p = g per plant. 4, 800X = 800 times of diluting